博士論文

A Study of Designing E-vocational Construction Drawing Learning Model in Civil Engineering Education Study Program

Abdul Haris Setiawan

Student Number: 18-8601-501-2

Asian Educational System Development Course

The Graduate School of East Asian Studies

Yamaguchi University

山口大学 大学院 東アジア研究科

September, 2021

DECLARATION

A Study of Designing E-vocational Construction Drawing Learning Model in Civil Engineering Education Study Program

This dissertation or any part of it is my original work and has not been submitted for any other university degree except publications.

Yamaguchi, July 13, 2021

Abdul Haris Setiawan

Student Number: 18-8601-501-2

SUMMARY

This study aims to correspond students' learning experiences with the industry demands by designing the e-vocational construction drawing (ECD) learning model. The second objective is to enhance students' skills by implementing the ECD in a civil engineering education study program. The ECD is an industrial adaptation learning model in construction drawing using a project-based flipped classroom strategy with the e-vocational learning platform support. Furthermore, it challenges students to do the best for their projects and promotes teamwork working experiences to enhance the collaborative skill needed by industry in facing the actual workplace. The e-vocational learning platform is developed to assists the students in learning effectively inside (regular-class) and outside (pre-class and after-class) the class. Students learn the lesson material in pre-class (asynchronous) before entering the regular class, apply it to work on projects in the regular class, and advance it in the after-class (synchronous).

It is developmental research that adopts the Borg and Gall 1983, begins with survey and identification, planning, designing, and developing phases. Besides, several methods are employed in a series of supporting research, such as surveys with descriptive statistics analysis, *ex-post-facto* with regression, experiment with t-test, and evaluation using discrepancy evaluation model. The survey and identification determine the course subject to be developed regarding the urgency level, check the course's availability with minimum facilities, observe the student readiness, and conduct teachers group discussions to design the main learning steps. The result determines the CAD construction drawing as the course to be developed. Besides, students are ready to use their computers and agree with an e-learning platform to support the learning process. Moreover, the study determines the seven main learning steps: (1) project auction (challenging stage), (2) proposing project, (3) proposing work schedule, (4) proposing progress report and monitoring, (5) reviewing and preparing for project presentation, (6) presenting the project, and (7) reflecting and evaluating.

Investigation research was conducted to reveal the student skill condition to support the development of the ECD learning model. The investigation results show the construction drawing skills are in a Good category of 68.26 with a Low discrepancy of 31.74% and the collaborative skills are in a Fair category of 61.69 with a Low discrepancy of 38.31%. Furthermore, there is a significant and positive influence of collaborative skill (X) toward construction drawing skill (Y). Besides, the analysis has presented a linear regression model $\hat{Y} = 31.443 + 1.952X$. It also exhibited a correlation coefficient of 0.644, a coefficient of determination (R-squared) of 0.415, and an Adjusted R-squared of 0.410. It means the collaborative skill (X) as a predictor in the regression model gives a 41% contribution to explain the variants of the construction drawing skill (Y) as the dependent variable in a moderate category. Moreover, the research found a unique phenomenon of high social heterogeneity in Indonesia. Students' various customs and cultures offer different characteristics, which lead to different motivations, habits, and behaviors, thus making different collaborative mindsets that build different collaborative skills and construction drawing skills. From the result of the investigation research, the students can be classified into two groups: (1) linear score group (the collaborative group) 25.38% and

36.92% = 62.31%; (2) non-linear score group (the non-collaborative group) 31.54% and 6.15% = 37.69%. It is indicated that most of the student accepts the collaborative approach. Furthermore, regarding the research finding of students' skill achievement characteristics, the designing lesson and learning model consider observing the students' perception and satisfaction of the proposed collaborative lesson and learning model to accommodate the non-collaborative students and prioritizing collaboration between peers and learning interdependence. These results support developing the ECD learning model draft in the planning stage as actual references of ideal learning experiences and strategies. The ECD draft implements Regulation Number 44, 2015, Article 17 of The Minister of Research, Technology and Higher Education of the Republic of Indonesia. The regular class meeting time is 16 times in one semester. This design using the flipped classroom strategy with 16 meetings (face to face or synchronous), 16 pre-class meetings (independent assignment), and 16 after-class meetings (structured assignment).

The developing phase involves raters, revising, examining the design by preliminary field testing and second field testing. The first is the alpha test to get expert's validation, and the second is the beta test by the individual, small group, and field testing. The e-vocational used blended online platforms including WordPress, SNS Whatsapp, the eFront LMS, YouTube, Zoom, Imgbb, and Google for Education integrated into a learning package for better advantages. The platform provides a project showroom with comment tools for discussion, collaborative learning material, and sustainably developed tutorial videos. The evaluation result by raters and field testings states that the e-vocational online learning platform is feasible for use and can be continued for further development.

The first ECD learning model implementation was held in the Civil Engineering Education Study Program for one month. It concludes that there is a significant improvement of collaborative mindset between the pre-test and post-test (experiment class B), increasing the mean value of 9.653 from 70.28 to 79.93 and a highly significant correlation, r=0.935 with Sig. 0.000<0.05. It got a g-score of 0.3225 (medium category), which means that the collaborative mindset in the experiment class increased by 32.25%. Moreover, the independent samples *t*-test revealed that the two classes' initial behaviors are equal with a *t*-count of 0.278< *t*-table of 1.665 and the value of Sig. (2-tailed) 0.782>0.05 probability. In opposition, the post-test result asserts a significant difference of collaborative mindset between the two classes (experiment class B and the control class A) with a *t*-count of 3.707>*t*-table 1.665 and the value of Sig. (2-tailed) 0.000<0.05. The first ECD learning model implementation concludes that the ECD Learning Model significantly enhances students' collaborative mindset.

The second ECD learning model implementation was conducted for one semester concludes that there is a significant improvement of construction drawing skills with a highly significant correlation of 0.927 and Sig. 0.000 between pre-test and post-test by a paired samples *t*-test. There is an increase in construction drawing skill mean score of 41.51 from 43.96 to 85.47. Simultaneously, it discovers a significant improvement of collaborative skill with a highly significant correlation of r=0.942 and Sig. 0.000. While there is an increase in collaborative skill mean score of 19.583 from 70.28 to 89.86. Moreover, the independent samples *t*-test revealed that the two classes' initial construction drawing skills are equal with a *t*-count of 0.569<*t*-table of 1.996 with Sig. (2-tailed) 0.571>0.05 probability. on the other hand, the collaborative skills t-count of 0.278< *t*-table of 1.665 and the value of Sig. (2-tailed) 0.782>0.05 probability. In opposition, the post-test

result asserts a significant difference of construction drawing skill between the experiment class and the control class with a *t*-count of 8.69 and the value of Sig. (2-tailed) 0.000. The post-test result asserts a significant difference of collaborative skill between the experiment class and the control class with a *t*-count of 10.351 and the value of Sig. (2-tailed) 0.000. Moreover, the N-gain score of construction drawing skill is 0.742 and 0.673 for collaborative skill, which means the construction drawing skill increased by 74.2%. At the same time, the collaborative skill increased by 67.3% after implementing the ECD learning model for one semester. Therefore, based on all the analysis tests, it can be concluded that the ECD learning model is significantly enhancing students' skills. Furthermore, the future-works are implementing the ECD in other classes with different characteristics and developing it based on the new findings and research recommendations.

Keywords: project-based learning, flipped classrooom, e-learning, e-vocational, collaborative mindset, student skill, construction drawing skill, civil engineering drawing skill, collaborative skill, vocational education

ACKNOWLEDGMENTS

In the name of Allah, the most gracious and merciful.

I would like to express my sincere gratitude and deep respect to my major supervisor Professor Ryo Takaoka, for the best guidance, encouragement, and extraordinary support throughout my doctoral research. I also appreciate the insights and experiences he shared with me during my years as a doctoral student also teaching/research assistant. I truly cherish him as a trusted supervisor and friend. I also acknowledge and express my sincere gratitude to my co-supervisors, Professor Qi-Wei Ge and Professor Mitsuru Nakata, for the guidance, encouragement, motivation, and support during my doctoral study.

I would like to appreciate and thank Professor Hiroyuki Mitsuhara and the rest of my dissertation examination committee for their encouragement and insightful comments to improve my dissertation manuscript.

I am deeply thankful to all professors in Asian Educational System Development Course, the Graduate School of East Asian Study for the courses, comments, discussions, and invaluable inputs in developing my research. I also want to express my sincere gratitude and deep respect to Professor Fukuda Takamasa for his endless encouragement and continuous support.

I am grateful to all my friends for their kind support throughout my doctoral program. I also want to express my thanks to Kaze-no-Kai family for their kindness voluntary support. Sincere appreciation also addressed the Ministry of Foreign Affairs of the Republic of Indonesia, the Indonesian Embassy in Tokyo, and the Indonesian Consulate General at Osaka for the great support. Gratitude is given to my colleagues and all my students in Universitas Sebelas Maret for their great encouragement and support during my study.

I gratefully acknowledge the Ministry of Education and Culture Republic of Indonesia through Universitas Sebelas Maret for the scholarships. I also acknowledge the MEXT and the Government of Japan for the scholarship and financial support for my children. Without which my doctoral study could not have been completed.

In retrospect to the years of my life and education, I am deeply indebted to my parents, my great father (Suradi, S.Ag.), my beloved mother (Hj. Endang Nur Mujiastuti, S.Pd.I), and our big family for the endless prayer, patience, and great support. I heartily dedicate my degree to them. I am also grateful to my parents-in-law, especially my great mother (Suyatmi), for sincere prayer, patience, and unconditional trust and love from Sigro Prayitno's big family.

Finally, I appreciate and heartily dedicate this dissertation to my family, my dearest beloved wife (Puji Rahayu) and my lovely children (Excel, Excelsa, and Exceline) for the sincere prayer, patience, and great understanding. I am grateful to be surrounded by their endless love, spirit, smile, and happiness.

Yamaguchi, July 13, 2021
Abdul Haris Setiawan

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1 INTRODUCTION

1.1. Background

Over the past decade, significant progress was made towards increasing access to education at all levels. In 2020, as the COVID-19 pandemic spread globally, countries majority announced the temporary closure of schools, impacting more than 91% of students worldwide. By April 2020, near to 1.6 billion children and youth were out of school. The first time happened, so many students were out of school simultaneously, disrupting learning and upending lives, especially the most vulnerable and marginalized. The global pandemic has far-reaching consequences that may endanger hard-won earnings made in improving global education as the aim of The United Nations Sustainable Development Goal 4 (UN SDG4) education agenda [1]. In contrast, the UN SDG4 is indispensable for national development, generating a skilful and qualified workforce in their fields to get a proper job to assure society's well-being [2][3]. The UN SDG4 17 agenda of United Nations presented at Figure 1.1.

Source: United Nation 2019 [4]

Figure 1. 1 The 17 Agenda of United Nations Sustainable Development Goals

In line with Presidential Regulation Number 18 of 2020, the Indonesian national mid-term development plan 2020-2024 increases human resources' quality to be skilled, competitive, intelligent, adaptive, and innovative through quality education services improvement [5][6]. Nowadays, Indonesia is in a transformation step towards a knowledge economy. Skill gaps between the workforce and the industry demand are seen as vital obstacles in the country's development [7][8][9]. The skilled workforce for increasing better industrial production is a vital factor that needs more attention and priority. Having ready-to-work skilled labor is a very desirable thing for all industries, while vocational

education is the primary provider of the potential skilled workforce in increasing economic development to obtain a prosperous community [10][11][6]. The UN SDG4 target 4.3 and target 4.4 is presented at Figure 1.2.

Source: United Nation 2019 [4]

Figure 1. 2 The UN SDG4 Target 4.3 and Target 4.4

Technical and Vocational Education and Training (TVET) has a crucial role in developing the workforce's skills, improving community welfare and economic growth. TVET alumni should be available to accommodate business venture needs, ready to work and increasing economic value, providing better products and services to satisfy society [12][13]. The crucial role of vocational education for developing a stable economy by creating the right environment for job creation with a balance of supply and demand. Besides, the stability builds trust and confidence to promotes more investment both in technology and human capital. The rapid growth of the industrial sector will develop labor absorption and an increase in investment. This augmented demand for labor requires educational institutions, especially vocational education, to make improvements to create prospective workers who are ready to enter the world of work without requiring significant adjustments. It is in line with the fourth target of UN SDG4.4, by 2030, extensively increasing youth and adults with relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship [14].

Recommendation concerning TVET was clearly stated in the General Conference of the United Nations Educational, Scientific and Cultural Organization (UNESCO), Paris meeting, November 3 to 18, 2015, at its 38th session, vocational education understood as being part of both the universal right to education and the right to work. It contributes to sustainable development by empowering individuals, organizations, enterprises, communities and fostering employment, decent work, and lifelong learning to promote inclusive and sustainable economic growth and competitiveness, social equity, and

environmental sustainability [15][16]. The absorption of vocational education graduates is still below the standard and the performance of graduates has not been considered satisfactory by the industry. An initial study summarised that Indonesia's unemployment rate is relatively high at 5.3%, the majority of whom are vocational school and senior high school graduates [17]. Moreover, a study stated that the vocational school graduates' employment rate was 70% in Daerah Istimewa Yogyakarta (DIY), Indonesia. Nonetheless, this rate is not sufficient. It should be at the smallest 80% [18]. Even in 2019, unemployment has declined by fifty thousand persons, as the Open Unemployment Rate or in Indonesia *Tingkat Pengangguran Terbuka (TPT)*, which fell to 5%, but *TPT* for Vocational Schools is yet the most preeminent among other education levels 8.63% [19][20]. This unsatisfied condition is a big problem to solve both by the government, vocational education as well as by industry as the main stakeholder [21].

Vocational education aims to develop individuals' potential to have better work insight, better technical skills, and self-transformation to the industry's changing demands and the job market. It has a decisive role in developing the employer's quality and promoting welfare to respond to social and economic interests. With an ideal learning strategy and matching supporting tools for adapting the condition of industry and world of work, every vocational student should be ready to be professional in providing such services or business ventures, having economic value, producing better commodities and services to meet society's needs [13][22]. Vocational education needs to increase its relevance to industrial needs by implementing various strategies, including improving the quality of learning in synergy with industrial conditions. Carrying out proper apprenticeship accompanied by learning in the classroom with adopting work conditions is needed to train students to be technically skilled and adapting quickly in the workplace. Besides the technical skill enhancement and technological development, a crucial part of the strategy also concerns the work application and the adoption by real workplace practices [23]. Understanding the high expectation of vocational education, where students who graduate from vocational schools are required to be ready to work and adapt to their work and all the challenges faced in the workplace, the main objective is to provide the logical solution.

Vocational education requires higher costs than the general one. While providing the needs of decent facilities and learning equipment to present actual learning experiences for the student to become professional, vocational education also faces enormous

challenges with the various conditions of expertise needed by the industry. This diversity of areas of expertise adds to the burden on the government in providing vocational education services. The specific and various learning facilities and equipment for each expertise make the condition more difficult for vocational education providers to realize an excellent vocational school. Instead of creating a perfect vocational school that can produce graduates ready to work, many schools have difficulty keeping minimum operation sustainably. Many vocational schools closed because they could not finance educational operation, which is relatively expensive, and many requirements must be fitted as the right workforce providers [24][25].

This research was initiated from the concern over the harsh conditions in which vocational education must educate students to become trained graduates who can adapt well in the workplace with limited expenses. The possible solution is by designing lesson and learning model which provide relevant learning experiences adapting the workplace condition. Simultaneously, the defining learning approach and strategy are based on the characteristic of the job characteristics in the workplace, national regulation, and pedagogical references. The collaborative mindset improvement then became the main idea to decompose the Project-Based Learning approach and adapt them into the contextual vocational condition using the flipped learning strategy supported by a blended online learning platform in a Computer-Aided Design (CAD) Construction Drawing Course.

The development of blended online learning platforms is in line with the principles of learning technology present to solve the problems that arise in the learning process. It is strengthened by the ontology foundation of the emergence of the concept of learning technology to design the blended online platform: (1) there are a large number of people whose learning opportunities have not been fulfilled; (2) there are resources that cannot be utilized for learning purposes; (3) there needs to be an effort to work on these resources so that everyone's learning desires can be fulfilled; and (4) the need for management of learning resources so that they can be used optimally for learning [26]. Learning by utilizing digital technology is one of the essential keys for improving the quality of education. It becomes relevant where the acceleration of technological development can go hand in hand with improving the quality of education, including content knowledge and pedagogy. There are three core components at the heart of good teaching with technology, i.e., content, pedagogy, technology, and both. The synergies between them are the basis of effective

teaching and learning, pedagogical techniques that use technologies in constructive ways to teach what makes the knowledge concepts easy to learn. Technology can help redress some of the students' learning problems. These three knowledge bases form the core of the technology, pedagogy, and content knowledge (TPACK) framework [27].

Project-based learning can provide learning experiences that are the same or almost the same as working conditions. In line with Friesen [28], project-based learning has come to represent a relevant perspective for a range of different orientations to the use of technologies in education and learning. Project-based learning represents the tasks that professional workers in the industrial world must achieve. Students are invited to perform activities that they will do when they are already working in the industry. According to Querol et al., the results of the final marks of the respective groups of civil engineering students illustrate the better performance of the students who previously took courses with project-based learning methodologies compared with students who did not take a project-based learning course [29]. While collaborative learning can provide opportunities for successful learning practices, as instructional technology for learning, collaborative learning involves the active participation of students and minimizes differences between individuals. Collaborative learning has added momentum to formal and informal education from two powers that meet a realization of practice. Life outside the classroom requires collaborative activities in life in the real world and fosters awareness of social interaction to realize meaningful learning. According to Smith and Macgregor, collaborative learning is an umbrella term for various educational approaches involving a joint intellectual effort by students or students and teachers together [30]. Therefore, collaborative learning will be a cover term for the project-based learning lesson and learning model using flipped classroom strategy with an e-vocational education blended online platform involving joint intellectual work by student teamwork with teachers' support. The flipped classroom is chosen as the instructional strategy to streamline the ideal implementation of the course credit system, refer to Regulation Number 44, 2015, Article 17 of The Minister of Research, Technology and Higher Education of the Republic of Indonesia [31]. It moves the learning activities outside the class that may have been considered as homework into the classroom. Students learn by following the online lectures, collaborate in works and discussion groups, or carry out the project assignment at home while engaging in concepts in the classroom with teachers' guidance.

1.2. Research Problems

Based on the preliminary study, there are several basic problems found as follow:

1) There are gaps between students' skills and the needs of industries, students' skills is lower than the industries need [7][8][32][33].
2) Lack of sufficient correspondence between the practical training and skills taught in TVET institutions and the labor market demands. [7][8].
3) The uneven balance between teachers with academic and practitioner background in TVET institutions [7][8][9][34].

1.3. Research Focus

For focusing the research scope, this study limited the objectives to focus only on the main problems as follow:

1) Lack of sufficient correspondence between the lesson and learning taught in vocational education institutions and the industry demands. The objective is to correspond the vocational lesson with the industry demands by designing the ECD learning model with e-vocational education in CAD construction drawing course.
2) There are gaps between students' skills and the needs of industries, the students' skills are lower than the industries need. The objective is to enhance the students' skills (construction drawing and collaborative skills) by implementing the e-vocational construction drawing (ECD) learning model (project-based collaborative flipped classroom) with e-vocational education (blended online learning platform) in a civil engineering education study program.

1.4. Research Objectives

The objectives of this study are as follow:

1) To correspond to the lesson and learning taught in vocational education institutions and the industry demands by designing the ECD learning model.
2) To enhance the students' skills by implementing the ECD learning model.

1.5. Research Questions

For accomplishing the research objective, the following research questions are identified:

1) What is the course subject to be developed?
2) How are the facility and the student readiness?
3) What is the learning approach and strategy?

4) How are the learning steps?
5) How are the students' skills characteristics?
6) How is the contribution of collaborative skills toward students' skills?
7) How to design the ECD learning model with the e-vocational learning platform?
8) How to evaluate the ECD learning model with the e-vocational learning platform?
9) How to enhance the students' skills?
10) How is the enhancement of the students' skills?

1.6. Research Structure

Based on the research objectives, the research structure is presented in Figure 1.3. The works are built according to four stages as follow:

1) 1st stage: Survey and Identification
    a) Determine the vocational course subjects
    b) Discover the facility requirement and students' readiness
    c) Defining the learning approach and strategy
    d) Defining the learning steps
2) 2nd stage: Investigation and Planning
    a) Investigating the students' skills characteristics
    b) Investigating the contribution of collaborative skill
    c) Presenting the descriptive statistics of student skills
3) 3nd stage: Designing and Development
    a) Designing the ECD learning model with the e-vocational learning platform
    b) Presenting the designing result
4) 4th stage: Evaluation
    a) Evaluating the ECD learning model with the e-vocational education online learning platform
    b) Presenting the evaluation result
5) 5th stage: Implementation
    a) Enhancing the student's skills by implementing the ECD learning model with e-vocational learning platform.
    b) Evaluating the enhancement of the students' skills
6) 6th stage: Conclusions and Future development
    a) Presenting the conclusion
    b) Planning the future development

The research structure of this dissertation is presented as follow:

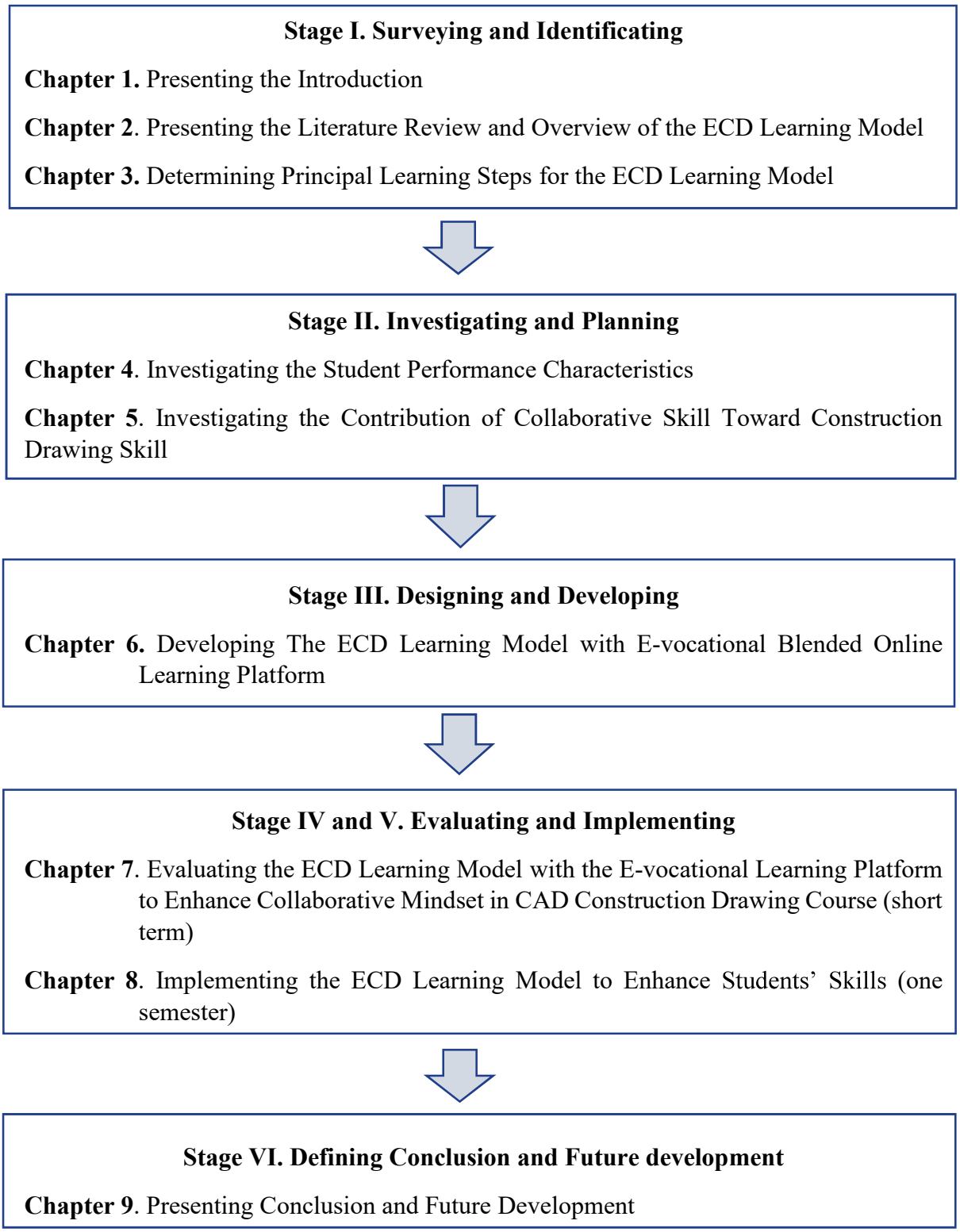


Figure 1. 3 The Research Structure

CHAPTER 2 LITERATURE REVIEW AND OVERVIEW OF THE E-VOCATIONAL CONSTRUCTION DRAWING (ECD) LEARNING MODEL

2.1. Vocational Education Approach in the Learning Model

2.1.1. Philosophy, Theory, and Practice

1) Philosophy

Vocational education as an education-for-work is based on the philosophy of essentialism, existentialism, and pragmatism. According to Strom [35], pragmatism is the most suitable philosophy for this education-for-work. Because the pragmatism philosophy balances the essentialism and existentialism philosophy, besides other philosophies that underlie vocational education are the humanism philosophy concerning personal growth and the progressive philosophy concerning social reform. Essentialism philosophy is the root of idealism and realism. Essentialism aims at educating humans to be useful, meaningful for life, and competent. Essentialism emphasizes the role and function of the educator or trainer in the learning process, expert, and mastering the subject matter, developing skills by practising, repetition, conditioning, and developing good habits in influencing student behavior [36]. Student learning is carried out progressively from less complex skills to more complex skills. Essentialists usually teach subjects such as reading, writing, studying literature, foreign languages, history, mathematics, science, art, and music.

Existentialism philosophy states that each human being forms the meaning of his own life. They are choosing their way of life. The reality of life is subjective. Humans will always find themselves in the world, and the main context is self-awareness of who they are. Jean-Paul Sartre believes that individuals create their own essence through free choice and action. So that vocational education forms students to become experts in their respective professions with all their actions and the consequences are choices [36][37][38]. Soren Kierkegaard argues that human nature and human identity differ depending on the values and beliefs they hold. The most challenging task for everyone is to make themself exist as a unique and meaningful individual [36][39]. However, this freedom is often disturbed by the structure of human creation. The creation of such institutions can seriously limit and undermine human freedom as a clear example of the existence of women on an equality with men. Simone de Beauvoir synthesizes the adverse effects of the way women are educated, resulting in the systematic exclusion of women from their role as different from men [36][40].

Meanwhile, pragmatism is a philosophy of action, questioning how the practical consequences are in human life. Concerning vocational education, pragmatists want to divide it into theoretical and practical problems. Theory development provides ethical and normative provisions, while practice prepares professionals according to the needs of society with a balanced proportion. Pragmatism is a philosophical movement that wants concrete results. Something important must be seen in its usefulness. As a pragmatic and progressive figure, John Dewey stated that life is not static but dynamic. All is in the making, and everything is in progress. Dewey's view reflects the theory of evolution and his belief in the human capacity for moral advancement and the social environment through education [36][41]. In this light, he places the philosophy of pragmatism at the service of democratic beliefs. At the heart of the beliefs is the placement of individual thinking at the service of social-individual action. However, he does not accept a transcendent reality but connects reality with experiences [42]. So, pragmatism advocates the unity of knowledge and action, values, and experiences. Education is essential to reconstruct these experiences to supervise transformation from uncertainty to precise goal.

John Dewey also believes that the fundamental purpose of education is to meet individual needs for personal fulfillment and preparation for life [43]. Vocational education teaches how to solve problems differently according to their conditions. Dewey rejects the perception of students as passive objects, controlled by the pressures of the market economy, and their existence is limited in developing their intellectual capacity. Students are individuals who are active in constructing knowledge [44]. Dewey's thinking is philosophically known as pragmatism, which has been identified as the foremost philosophy of vocational education in recent years [45]. Pragmatic education tries to prepare students to solve real problems logically and rationally, is open to looking for and finding alternative solutions, and ready to carry out experiments. The expected outcome of pragmatic education is a knowledgeable society that is vocational capable of adapting, being self-sufficient, participating in a democratic society, and believe that learning and experiencing is a long process as the principle of lifelong learning [44]. Vocational education for pragmatists aligns job needs and what skills or competencies are needed to meet these job needs. Vocational education is always dynamic and even has to be adaptive to the changing needs of the job itself. This philosophy then gave rise to the demand-driven theory as a substitute for supply-driven [44][46]. In the philosophy of pragmatism, the

purpose of vocational education is to meet persons' individual needs in preparing their life career, emphasizing problem-solving, high-order thinking, and learning is constructed from previous knowledge.

2) Theory

Vocational education develops not only in conjunction with educational policy instruments but also in relation to social, economic, political and labor policy instruments. Vocational education is sensitive to social problems and changes in society. Economically and politically, the development of vocational education requires an integral policy with the support and full participation of government and non-government organizations to form a consensus among stakeholders, proactive and responsive to the changes, and adopting a long-term strategy, responsive in changing the global economic environment, and grounding the culture of the local community and politics [47]. From a socio-economic perspective, vocational education is a kind of economic education because it is derived from the needs of the labor market, which contributes to economic strength [48][49]. As an education derived from economic needs, vocational education is clearly more directed at education for earning a living. Vocational education aims to prepare students to enter the workforce [50][51]. Thus, vocational education must always be close to the world of work. It is developed by considering the community's need for work. Students need better programs to provide skills, knowledge, work attitudes, experience, insights, and networks to help get match jobs with their career choices.

Vocational education serves the purpose of an economic system, sensitive to the contemporary dynamics of society. Besides, vocational education must also be adaptive to technological changes and diffusion, having broad social benefits [49]. The function of vocational education is to acculturate and enculturate the global change. It encourages change for improvement to proactively adapt the change and adopt long-term strategies relevant to the needs and demands of change [52]. Vocational education is based on the needs of the world of work/demand-driven. Therefore, the emphasis lies on mastering the competencies needed by the world of work in the community environment [50][51]. Historically, vocational education was not originally a part of public education. In the early 1800s, public schools were for the elite. Advocates for vocational education considered that introducing vocational education into public schools would: (1) Make education more meaningful; (2) Encourage youngsters to spend more time in school; (3) Create better

educated and more skilled workers with the ability to earn more; (4) Have an indirect and positive effect on the aims and methods of general education; and (5) This results in better teaching and learning by employing “learning by doing” and not mere book learning [53]. Some scholars believe there were two distinct models of vocational education in the early twentieth century: education for social efficiency and education for democracy. David Snedden is identified with the former, John Dewey with the latter [53][54].

Vocational education can prosper the community's economy, stabilize the economy, build income distribution, and welfare living in harmony. Vocational education must pay attention to market demand (demand-driven/market-driven). The level of relevance of vocational education can be measured from the level of conformity of educational programs with the needs of the labor market. The higher the suitability of vocational and vocational education programs to market demand, the higher the relevance of vocational education. For this reason, education and training programs in vocational education need to pay attention to market demand and even have to reach the ability to create markets [36]. Vocational education will be efficient if the environment in which a person is trained is a replica of the environment in which he will work later. Perfect practice is training in the actual workplace, interacting with real and contextual situations. Practicing in the workplace and judged by the community is better than by a teacher or instructor at school.

3) Practice

The development of vocational learning science will never stop. The ontology of the world of work grows, and its characteristics develop continuously. New types of work and ways of working continue to grow and develop rapidly. Changes in the world of work require changes in educating and training students as prospective workers according to new demands. The vocational learning methodologies must also change in order to have high axiological benefits. Without the innovation of vocational learning methodology in more creative ways, the benefits will not be meaningful and positively impact the community.

The new world requires new ways and new conditions of working. 21st Century vocational learning also requires new ways and new conditions in learning. The shift of work artifacts from material tangibles in the form of hardware to non-material forms in digital-based software and innovative ideas are increasingly coloring the work of the 21st Century. These products are known as weightless products. The new color is learning to develop digital-based knowledge workers. The need for approaches, methods, techniques,

strategies, patterns, learning technologies has changed significantly [36]. How do new ways of working grow and develop in society? What changes have occurred in the manufacturing sector? Moreover, what changes have occurred in the information industry sector? How is the development of learning technology used in vocational education and training? The changes in the industry build new demands for vocational learning today.

Generally, learning in vocational schools has a fundamental problem. It contextualizes the materials taught in real work life, where the contextual of subject matter with work tasks that will be undertaken and faced. Students have difficulty connecting the materials learned at school with their application in everyday life at work or in the community. Students are not used to learning to solve real problems they face. Students lack actual work experience. It is due to the fact that the learning material is still abstract, the knowledge component is not structured, tends to be partial, drifts apart from one material to another, and the concept of competence is not fully and correctly understood.

Vocational learning must be work-related learning and problem-related learning. Any learning that students undergo must be related to the world of work, associated with work tasks, associated with actual and contextual work problems. Students from an early age in vocational or vocational schools are accustomed to learning to work. It is essential to develop work habits from an early age. Learners experience the process of habituation to work in the learning process. After having work habits, they are then trained to work productively, work with high-quality work standards, and then increase efficiency. At an advanced level, students are trained to be creative in applying innovation in solving work problems. Work discipline, work collaboratively, work perseverance, work honesty, fulfillment of work standards, and soft skills are taught in an integrated manner and the skill practice process. In this way, soft skill learning is not trapped in theory without application.

2.1.2. Relevant Learning Model in Vocational Education

The diverse needs of vocational learning praxis encourage research and development of learning models. Moreover, research and development of learning models have produced many learning model products [55]. The product has also been widely applied and researched its effectiveness. Learning models then develop based on philosophical concepts and learning theories. The learning model is a conceptual, theoretical, and philosophical framework that guides the implementation of learning. The learning model contains model components that are arranged systematically in realizing the learning objectives. The

learning model systematically contains the syntax or learning steps, the requirements of the social learning system, the environmental requirements and conditions of the learning place, and the needs of other support systems.

Learning models have generally been tested for their effectiveness through development research and experimentation in the educational environment. In addition, the terms of ease of use are also an important variable. The learning model describes a systematic and organized procedure regarding the implementation of learning with the aim of providing a very meaningful learning experience to the students. Learning models are usually guided by learning designers and educators in carrying out learning activities. Based on the essential characteristics of vocational education, it is apparent that the use of learning models in 21st Century vocational learning is always based on contextual learning.

Learning models applied in vocational learning must meet the needs of their suitability with the work context. Learning models that are suitable for vocational education include problem-based learning models, project-based learning models, competency-based learning models, work-based learning models, workplace learning models, cooperative learning models, discovery learning models, and inquiry learning models [55]. A good 21st Century vocational learning model has four special characteristics as follow: (1) it is philosophical rational, theoretical, conceptually logical, effective, and efficient applied in contexts and learning processes for work; (2) have a clear learning theory framework and conceptually the structure is intact and reasonable, easy-convenient-safe to implement, and measurable level of success in the implementation of workplace learning; (3) have a clear and strong TVET pedagogy-andragogy-heutagogy foundation; (4) provide real solutions to problems and gaps in vocational learning outcomes; and (5) provide real solutions to problems and gaps in vocational learning outcomes, such as (a) oral and written communication skills; (b) critical thinking; (c) creatively solving work problems; (d) professionalism and work ethic; (e) work as a team; (f) build work collaboration; (g) apply technology; (h) leadership; (i) discipline, honest, responsible, tenacious, dynamic, likes challenges, marketing, and entrepreneurial spirit; and (j) project management.

The linkage and integration of vocational learning materials with the workplace context will stimulate students' motivation to learn to apply the lesson materials to solve everyday problems at home, in the community, and the workplace [55]. Vocational learning should be under the framework of a contextual learning approach.

1) Workplace Contextual Learning

The main objective of vocational learning is that every vocational student masters the work competencies required by the industry, ready to enter the workplace, skilled in completing jobs, collaborating with colleagues, socializing with consumers, and solving various dynamic workplace problems [55]. From the beginning, vocational learning materials must be oriented to the workplace, linked, and even integrated. Vocational learning will not be effective if it is not related to the context of the workplace.

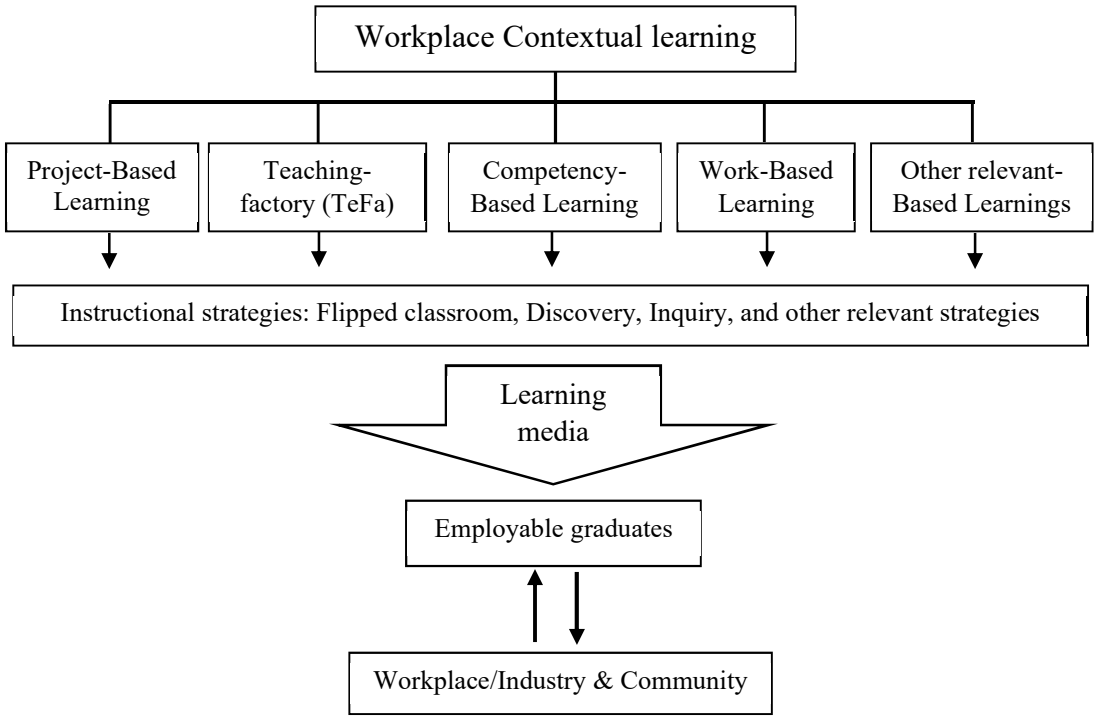


Figure 2. 1 Contextual Learning Concept of Vocational Education

In the view of social efficiency, the development of the workplace has always been the main context of vocational learning. The underlying philosophy is what jobs are needed and what competencies are needed to carry out those work tasks. The development of competence in learning is based on the need for work competence. Developments in the context of the workplace, new demands, and new contexts for the workplace are then used as a reference for the need for developing competency materials, methods, learning media, and vocational learning strategies [55]. Vocational learning materials are adapted to the real context of the workplace. The workplace's authentic contexts can be in technological contexts, scientific contexts, policy contexts, location contexts, natural conditions, contexts of situations and community expectations, time contexts, cultural contexts, social contexts,

political, economic, and trade contexts. Figure 2.1 shows the contextual learning concept of vocational education.

It means that there has been an extraordinary shift in the employment system in the industry. Contextual vocational learning is a conception of learning that helps teachers or instructors relate the subject matter content to the real-world situation, carry out work tasks, and prepare standardized worker competency qualifications. Both for the contextual workplace related to the learning today and in the future should motivate students to learn and acquire competencies for their later work. To maintain the linkage of the competencies trained with the needs of the workplace, it is necessary to changes the context of the workplace to be appropriately adapted. Vocational learning also needs to be anticipated to change so as not to lose future job orientation. Applying a contextual learning approach to vocational learning will make the learning outcomes more meaningful and impactful for students in carrying out work tasks in their future workplace.

2) Project-Based Learning

Project-based learning is suitable for a vocational environment because it provides a learning experience to create projects. The projects produced can be drawings, tool designs, learning media designs, learning kit designs, home designs, business place designs, clothing models, toy models, games, and other related projects in the vocational education environment [55]. The project-based model is a learning model where real problems in the workplace are raised as the basis for problems that are solved using projects. It can encourage students to carry out learning activities with high motivation because there are challenges, tasks, or problems that they have to solve. Through Project-Based Learning, students can improve their mastery of work competencies to solve work problems, organize work, apply technology, and manage the work time.

The purpose of project-based is to improve students' learning experience in terms of strengthening collaboration skills, learning motivation, work motivation, work habits, teamwork, communication skills, creativity development, critical thinking, leadership, and self-discipline. Besides, project-based learning also makes the students learn decision making, accessing, and analyzing information from various sources, the use of new technology, and others required in 21st Century skills. project-based learning can develop work skills, work knowledge, attitudes, and work morals comprehensively.

In project-based learning, it is essential to note that students work on a project with the teacher's supervision, starting from the first planning phase, preparing the schedule, doing the project, and testing. The students carry out a problem orientation process, with the teacher as a supervisor, explaining the learning objectives, identifying the necessary materials, and building the essential questions (start with the essential question). The next step, in the second stage, is to organize students into groups according to their respective duties. In the third stage, the teacher guides students in gathering information, analyzing information, using relevant information for project completion. At stage 4, students are asked to present the results of project work in the form of reports, documents, models, and works. The final stage is the joint evaluation stage between teachers and students. The teacher helps students carry out self-assessment and reflection on the projects that have been done, what successes are, the shortcomings, and reach a conclusion that can strengthen students' knowledge in carrying out a project. This model is very well applied in vocational learning because it provides direct experiences that the student will face at the workplace.

3) Teaching Factory (TeFa) Learning

Learning in the workplace in the form of an internship program has become a necessity. The limited industries and time available for internship programs can be overcome by establishing TeFa in schools. This challenge then explains how the factory concept can be presented in schools as part of the teaching process [55][56]. Then the concept of TeFa emerged. TeFa presents the factory concept for teaching. Not a factory for business purposes or profit at school. Factory designed for the vocational learning process.

TeFa is a product/service-based and works competency-based vocational learning model. The fundamental challenge of vocational learning is providing real experience for students to practice according to tasks and work settings in the workplace, such as factories and construction companies [55][57][58]. TeFa accommodates the learning concepts of:

a) Enterprise Based Training/Experience-Based Training
b) Competency-Based Training (CBT)
c) Production Based Education and Training (PBET).

TeFa refers to standards and work procedures applied in the industry and implemented in the same industry condition. TeFa is a gradual process of learning process skills to learn the development of work habits, work accuracy, work standards, and procedures towards work creativity. The implementation of TeFa applies the principles of

competency block and time block, application of tasks and work tools according to industry standards, using standard job sheets, process, and product-based assessments. The learning design in TeFa is designed for one student per job or one student group for one job with a specific division of tasks. Besides developing process skills, TeFa also produces goods/services that are ready to be marketed.

4) Competency Based Learning (CBL)

CBL model is prevalent to be referred to and used in education and training systems, both formal and non-formal. The CBL model is based on developing students' abilities to perform work tasks that include work knowledge, work skills, work attitudes, and work morale. CBL focuses on mastering work competencies. Learning management leads to the development of a graduate competency profile [55][59][60]. CBL contains specific training programs based on competency needs to carry out work assignments for one type of occupation. Learning activities are centered on individual students as subjects who actively practice developing their competencies. CBL is important to train the skills needs of the 21st Century as future work needs.

CBL applies the principles of problem-solving learning with a contextual approach through real experience. Learning takes place actively interacting with the environment as a collective process. Teachers must apply work-related learning. Competency materials are work-oriented, work-related, and work-integrated. Students are facilitated and given broad opportunities to connect work knowledge and work skills with real applications in the workplace. Assessment of competency achievement using performance reference assessment [55][61]. The minor performance of competency is defined as the minimum completeness criteria. Students who have not reached the minimum completeness criteria must repeat until they reach the minimum completeness criteria. Students are declared passed if they have reached the minimum completeness criteria. Graduation gradations can be made with excellent, very good, and good levels.

5) Work-Based Learning (WBL)

Work competencies will not be fulfilled if learning is only carried out at schools. For vocational students, the learning at school only will not meet the needs of developing work competencies because the situation, conditions, and culture of the school are different from the workplace culture. It is the basic foundation for vocational learning and applying work-based learning and workplace learning (WBL/WPL). The utilization of WBL in

vocational learning is based on the philosophy of improving the quality, relevance, and efficiency of vocational learning for the workplace [55]. The setting of vocational schools is very good if it is close to the settings and conditions of the workplace. WBL develops students' work skills for future jobs that are increasingly qualified. WBL provides a good space for student's future career development because the learning materials are relevant to the needs of students and the world of work. WBL is important in developing cooperation between education and training institutions and the workplace.

The strategies used in WBL [55] include (1) action learning, (2) apprenticeship, (3) career advice, (4) continuing professional development, (5) internships, (6) mentoring, (7) networks and communities, and (8) team development. Learning with direct action (action learning) is the basic strategy of WBL. The act of learning is carried out in a work internship at the company (apprenticeship). In the apprenticeship process, students have begun to have a salary. Many companies recruit workers through apprentices. This method is beneficial because the performance of prospective workers is assessed over a long period. WBL provides opportunities for students to develop their careers and receive supervision to develop them.

6) Flipped Classroom

A flipped classroom is an instructional strategy that reverses the traditional learning environment by delivering instructional content outside the classroom. It moves activities, including those that may have been considered homework, into the classroom. What is normally done in class and what is normally done as homework is switched or flipped [62][63][64]. Students watch online lectures, collaborate in online discussions, or carry out research at home while engaging in concepts in the class with the guidance of a mentor.

The flipped classroom intentionally shifts instruction to a learner-centered model in which class time explores topics in greater depth and creates meaningful learning opportunities, while educational technologies such as online videos are used to deliver content outside of the classroom. In a flipped classroom, content delivery may take a variety of forms. Often, video lessons prepared by the teacher or third parties are used to deliver content, although online collaborative discussions, digital research, and text readings may be used. Flipped classroom approaches remove the traditional transmissive lecture and replace it with active in-class tasks and pre-/post-class work [65][66][67][68][69]. Figure 2. 2 presents a flipped classroom basic activity.

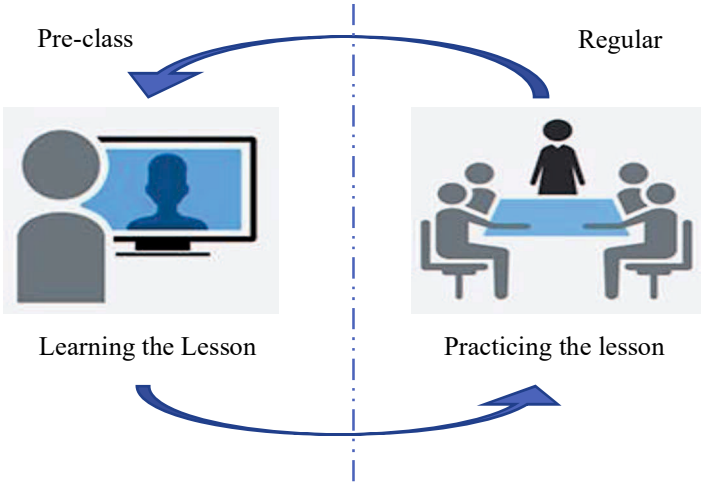


Figure 2. 2 Flipped Classroom Basic Activity

By providing students with the material to gain a basic level of knowledge and understanding before class, the classroom time is used to deepen learning and develop higher-level cognitive skills. One of the core objectives of the flipped classroom strategy is to move students away from passive learning and towards active learning, where students engage in collaborative activity, peer learning, and doing a project together in a project-based learning model. Within this context, the role of the teacher shifts towards that of facilitator and coach by empowering students to take control of their own learning [70][71][72]. The use of technology further enriches the flipped learning process and promotes skills that are essential for 21st-century learning. Class becomes the place to work through problems, advance concepts, and engage in collaborative learning. Most importantly, all aspects of instruction can be rethought to best maximize the scarcest learning resource time [73]. By implementing this strategy, there will be increased interaction between students and teachers, with a shift in the teaching strategy towards student-centered learning where learning lies in the students' hands. The students can prepare at a suitable time and place which suits them, and as many times as required to meet their needs. The approach also facilitates collaborative working between students, increasing student engagement and shift the learning from passive learning to active one.

2.2. The ECD Learning Model

The e-vocational construction drawing is an industrial adaptation learning model in construction drawing using a project-based flipped classroom strategy with the e-vocational learning platform support. Furthermore, it challenges students to do the best for their projects and promotes teamwork working experiences to enhance the collaborative skill

needed by industry in facing the actual workplace condition with multifaceted problems. The learning model is a conceptual framework that describes a systematic procedure in organizing learning experiences to achieve specific learning objectives and serves as a guide for learning and the crier proclaimed and teachers in implementing the learning activities [74]. It is a description of the mental and physical mechanisms involved in acquiring new skills and knowledge and how to engage those mechanisms to encourage and facilitate learning [75]. Figure 2. 3 presents the ideal thinking framework of the ECD learning model.

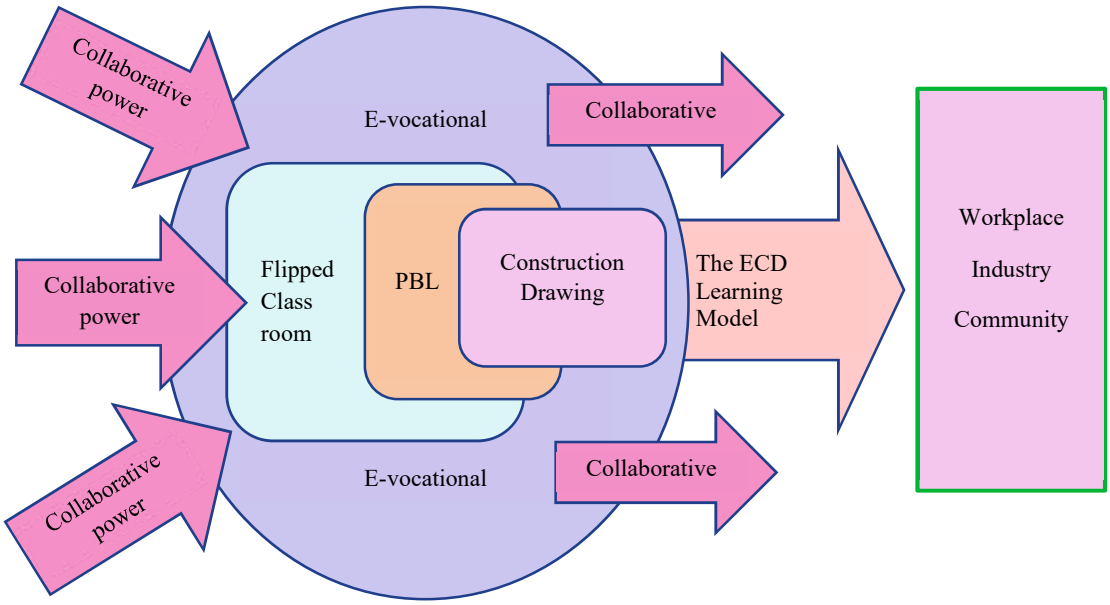


Figure 2. 3 The Ideal Thinking Framework of the ECD Learning Model

Collaborative power gives great meaning to the students' experiences. Therefore, the lesson plan contains seven main steps of the ECD learning model with enriched learning experiences that motivate the student to do the best and grow the collaborative spirit. The steps are as follows:

1) Project auction, construction drawing challenging stage
2) Proposing construction drawing project and negotiation
3) Proposing construction drawing work schedule
4) Proposing progress report and monitoring
5) Review and prepare for project presentation
6) Present the construction drawing project (collect critique and revision)
7) Reflecting and evaluating (based on evaluation criteria number 2).

2.2.1. E-vocational Platform Learning Multimedia

The e-vocational platform is an online learning website that used blended online platforms, including WordPress, SNS WhatsApp, eFront, YouTube, Imgbb image hosting, and Google apps for education. This platform aims to facilitate the ECD learning model in implementing the project-based flipped classroom learning process.

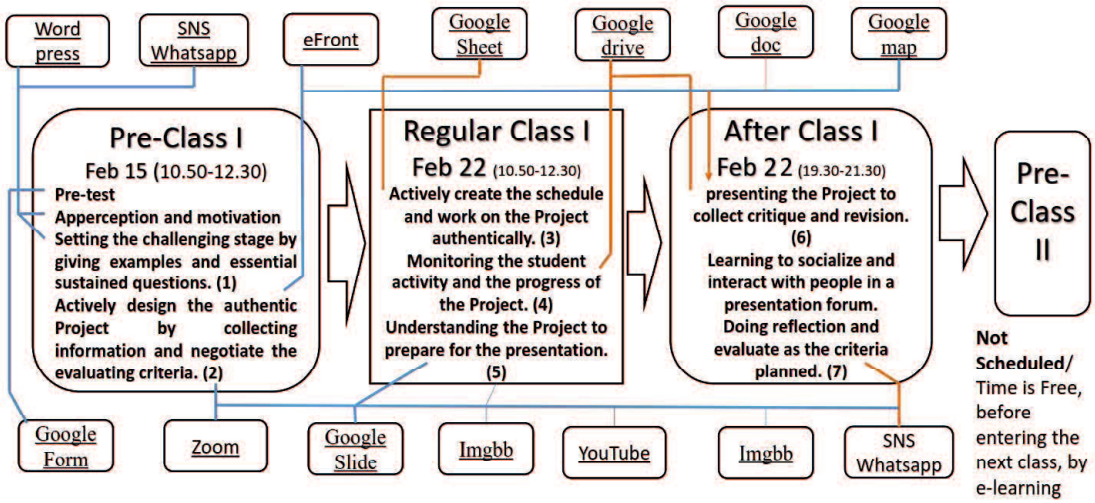


Figure 2. 4 Summary of Lesson Plan 1

The ECD learning model help student to learn effectively by having intensive learning program. The students not only enter the class to have a regular lecture, but they have a better program. They start to learn and mastery the theory before entering the regular class because of the availability of the pre-class. Moreover, they enter the regular class in a better condition. They have earned the lesson materials at the pre-class. Besides, the e-vocational platform facility is always available to support them anytime. Figure 2. 4 shows that the blended online platforms are available to support the students anytime. The e-vocational provides collaborative learning materials and projects showroom to publish the student assignments for the advanced discussion to collect authentic revisions. Figure 2. 5 shows the e-vocational in show room web page.

It uses WordPress for the web content management system (CMS) as the website front page and plugs SNS WhatsApp for the instant message and eFront for the learning management system (LMS) and google apps for education on the online instruction that integrated into a learning package give better advantages to the student. Figure 2. 6 presents the ECD learning platform (e-vocational) in e-learning module.

As e-learning encourages the growth of a sense of togetherness among team members, e-vocational seeks to provide a comfortable, collaborative atmosphere to advance

student performance. Quotes that promote collaboration are echoed through the web, e-learning, and SNS WhatsApp. In addition, the e-vocational brings up wise quotes from famous figures, for example: “when you need to innovate, you need collaboration”, an excerpt from Marissa Mayer; Simon Sinek with “a team is not a group of people who work together, a team is a group of people who trust each other,” Moira Alexander with “you will never meet the great success if you are alone on the journey of the victory,” Russel Honore with “when you form a team, why do you try to form a team? because teamwork builds trust and trust builds speed,” and “if everyone is moving forward together, then success takes care of itself”, a quote by Henry Ford.

Figure 2. 5 The E-vocational in Showroom Webpage (the purple team’s project)

In the 21st Century, vocational students without exception need knowledge and skills to apply multimedia in learning and practicing carrying out work tasks. The utilization of digital multimedia, including audio, video, e-learning, and websites, has become a basic need in the learning process. Using multimedia is an essential part of the development of knowledge and communication skills. The skill of using multimedia is then determined to be the primary skill in 21st Century learning. As a medium for delivering messages (print, graphics, animation, audio, video, websites, and more), the type of multimedia is chosen according to the characteristics of the message to be conveyed. Multimedia then becomes an important learning component in the implementation of 21st Century vocational learning. Multimedia learning is one of the learning components that must exist and effectively realize the good learning objectives achievement.

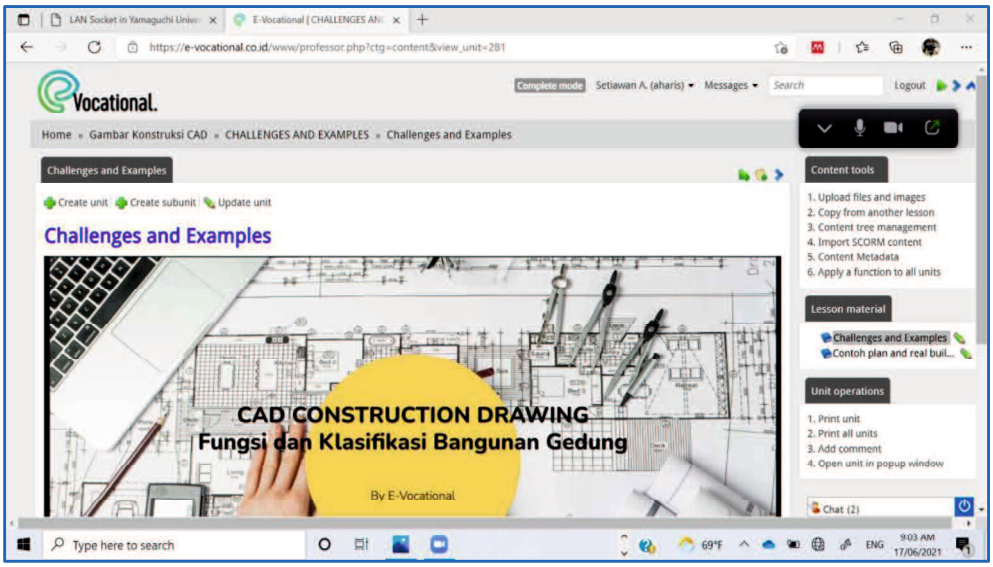
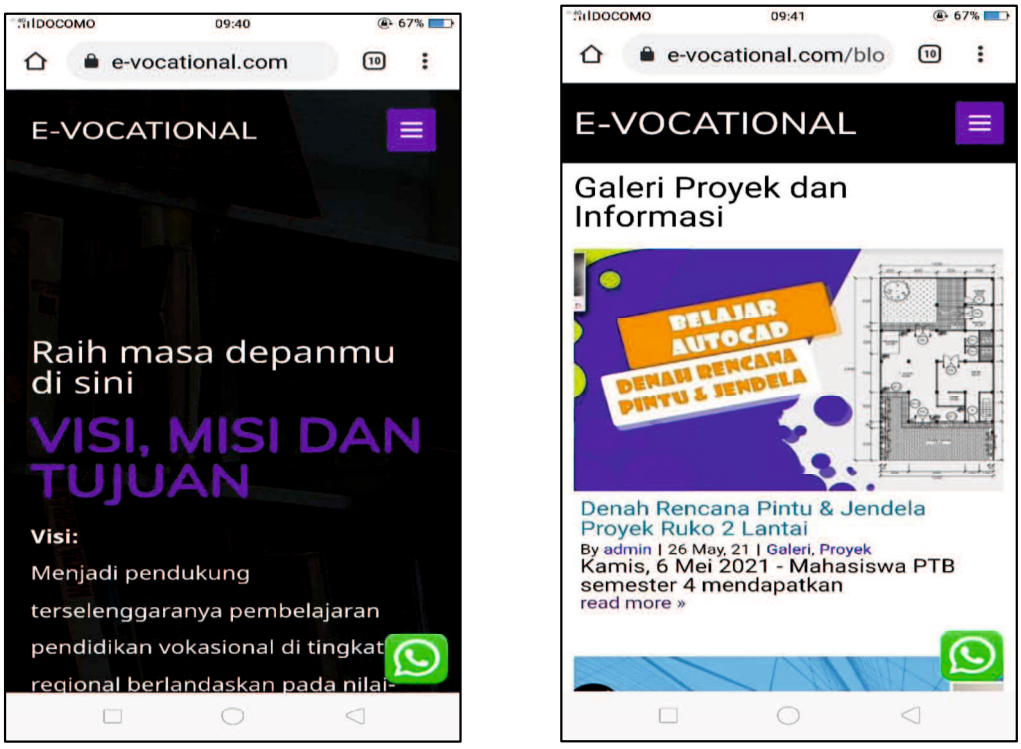


Figure 2. 6 The ECD Learning Platform (e-vocational) in E-learning Module

As the aim of the development research, the supporting media should be easy to use in every standard ordinary device for efficiently facilitating student learning inside or outside the class. It is imperative not only for promoting the learning process but enhancing student confidence. The platform will assist the students in changing their negative feelings with positive ones, such as having unconvinced attitudes for the course, and they do not know how to ask when they do not understand the course [76].



e-vocational front page e-vocational projects show room page

Figure 2. 7 The E-vocational in a Mobile Phone Screen

As a learning component to effectively achieve learning objectives, the e-vocational learning platform makes vocational learning efficient in time, energy, practice materials, and tools. Besides, the platform's simple and easy use can help the students who are undergoing the learning process only by using a standard personal computer without worrying about the lack of computational laboratory facilities.

2.2.2. Theoretical Framework for Evaluating the ECD

The ECD learning model integrated with e-vocational learning platform as e-learning is defined as a formal approach to learning strategy where the instructor and students interact remotely with one another using Internet technology (e-infrastructure) [77]. There are different concepts and interpretations of learning technology, including learning models and e-learning. Each interpretation concept is historically rooted and finds its expression in modern educational institutions open to global culture, society, and personals [78]. According to Pham et al. [79], There are four main characteristics in assessing the online platform-based learning model. These characteristics are:

1) Students who study and teachers who work together in different locations
2) Schools that support the learning and teaching process using e-learning together with adapted student evaluation strategies
3) Platform used for interactions between the instructor and the students
4) Effective communication with industry.

Table 2. 1 Theories Adapted to the Assessment Indicators of the ECD

Theories	TPACK	UTAUT	TAM
Key feature	1. Technological 2. Pedagogical 3. Content knowledge	1. Performance expectancy 2. Effort expectancy 3. Social influence 4. Facilitating conditions	1. Perceived usefulness (PU) 2. Perceived ease of use (PEOU)
Indicators adapted	3. Professional structured materials 4. Relevant educational content 5. Collaborative support 6. Visual design quality 7. Innovative feature 8. Usability	1. Professional structured materials 2. Collaborative support 3. Visual design quality 4. Innovative feature 5. Usability	1. Professional structured materials Visual design quality 2. Innovative feature 3. Usability
Implementation to the learning model	The ECD needs technology, pedagogy, content knowledge, and the ability of the educator to conduct the platform to implement the learning model [27][80][81]	The implementation of the platform requires the performance expectancy, effort expectancy, social influence, and facilitating conditions [82][83][84]	The learning model requires the e-learning platform which perceived usefulness (PU) and perceived ease of use (PEOU) [85][86][87]

The global development of information and communication technologies also multimedia tools is very fast, the use of strategic and innovative learning models by utilizing online platforms is important from the perspective of mass communication which sooner or later must be implemented and developed [88]. Education experts are currently analyzing how new technologies contribute to the improvement of digitally mediated learning models. The evaluating indicator for the ECD assessment instrument refers to the Technological Pedagogical Content Knowledge (TPACK), the Unified Theory of Acceptance and Use of Technology (UTAUT), and the Technology Acceptance Model (TAM). Table 2.1 shows theories adapted to the assessment indicators of the ECD.

Technology helps us in many conditions. It brings us to the simple and easy work than before. However, teaching with technology is complicated further when the challenges of newer technologies present to teachers are considered. As teachers know, teaching is a complex practice that requires specialized knowledge to apply complex knowledge structures in different cases and contexts. In applying new learning models such as the ECD, teachers should understand the learning steps used and be able to use the e-learning platform to facilitate the implementation of learning models according to their functions and objectives. Assessment that accommodates new technology aspects as a learning support facility and implementing the new e-learning platform is reflected in TPACK. The framework builds on Shulman's (1986,1987) [27][89][90] provide descriptions of Pedagogical Content Knowledge (PCK) to explain how teachers' understanding of educational technologies and PCK interact with one another to produce effective teaching with technology.

2.2.3. Construction Drawing

Construction drawing is the general term in engineering used for drawings that form part of the production information incorporated into tender documents and the contract documents for the construction works, especially in civil engineering. The drawings are needed to determine the product description standard. Besides, they have legal significance and form part of the agreement between the employer and the contractor [91]. The primary purpose of construction drawings is to provide a graphic representation of what is to be built. Construction drawings should be concise and coordinated to avoid, wherever possible, ambiguity and confusion. Delays and misunderstandings can be minimized by adequately coordinating the drawings between the engineering team, the contractor, and the employer.

Specifications will describe the materials, techniques, and standards required to implement the works. Construction drawings provide a graphical representation, indicating the arrangement of components, detailing, dimensions, and other relevant specifications. They may sometimes contain some of the information set out in specifications, but this should be avoided if possible by referring to specifications rather than duplicating information [91]. A complete set of construction drawings comprises floor plans, elevations, sections, and detail drawings, that together provide a complete representation of the building. Figure 2. 8 shows an example of a floor plan drawing, a part of the construction drawing project, drawn by the pink team, a team in the CAD construction drawing course.

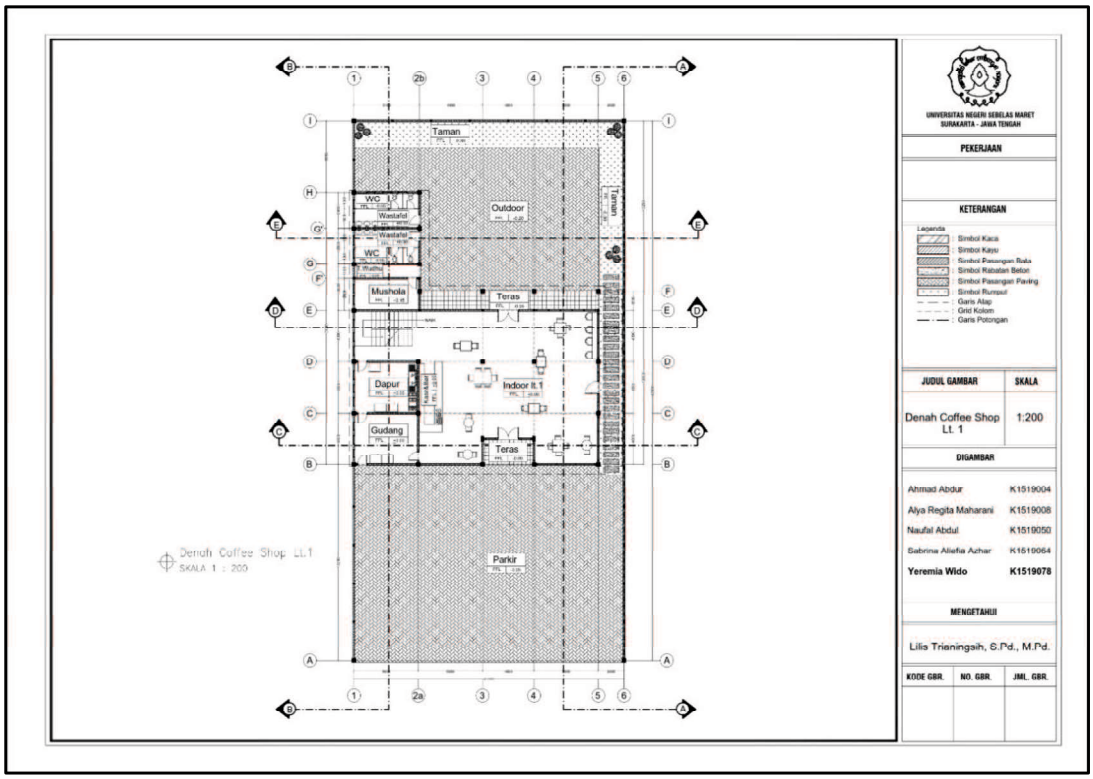


Figure 2. 8 Students' Construction Drawing (floor plan drawing by pink team)

Construction drawings may be drawn by hand, but in the present day, it is more common to be drawn using computer-aided design or drafting (CAD) software. While the construction drawing in this research is prepared using CAD, the learning model is determined and developed to be implemented in the Civil Engineering Education Study Program on CAD construction drawing course. An observation conducted in the Civil Engineering Education Study Program determined the selected course, which is urgent to develop based on the priority scale.

This developmental study is expected to achieve the learning objective of the CAD construction drawing course. Start from the observation of determining the research focus to propose solutions for the existing research problems, i.e., the gaps between students' skills and the needs of industries. A series of research is conducted to uncover the gap and propose solutions. The curriculum of the CAD construction drawing course is calibrated into the industry. A curriculum review is conducted with vocational teachers and lecturers in related fields involving the industry. The student competency expected after completing this course is as follow:

1) Mastering general principles of building design, including (a) mastering building security requirements, (b) mastering building comfort standards, (c) mastering building regulations, (d) mastering administrative requirements, and (e) designing buildings with certain functions
2) Planning the concept design, including (a) collecting data and information from customers about development needs and requirements so that development goals and objectives can be fulfilled perfectly, and (b) design and discuss design concepts with customers
3) Preparing to draw, including (a) determining the materials and tools needed, and (b) making a work time schedule
4) Sharing the drawing tasks to the team member, including (a) sharing the drawing tasks to the team member in a correct proportion, and (b) carry out the drawing tasks according to the plan and the specified time
5) Implementing the drawing process, including (a) drawing software settings (layers, folders, plot style settings), (b) analyzing drawing plans (drafts/sketches), and (c) doing the drawing process
6) Communicate with the team regarding the drawing process, including (a) working on drawing tasks based on the portion of the given task by always coordinating with the team, and (b) checking the progress of teamwork drawing result continuously.
7) Complying with the rules of technical drawing, including (a) applying drawing layout correctly, (b) drawing construction line, (c) applying the use of letters, numbers, and symbols correctly, (d) applying drawing title block properly, (e) applying the correct construction shape in the drawing, (f) applying the drawing scale correctly and meet the applicable rules, (g) drawing the building materials

with the correct symbols, according to the applicable rules in building planning, (h) drawing construction details, and (i) determining the completeness of the drawing as requested in the building plan

8) Drawing plans and construction detail drawing, including (a) drawing floor plans accurately, detailed and informative, (b) drawing the building view, front, right side, left side, back, and top, (c) section drawing A-A, B-B, C-C, D-D, (d) drawing the detailed foundation plan, (e) drawing the detailed roof construction, (f) drawing the plumbing and mechanical and electrical plans, (g) drawing the title block, and (h) setting and implementing plotter printing
9) Presenting the drawing, including (a) presenting the drawing information both verbally and in writing, and (b) explaining the arguments of the drawing concept.

Those competencies are expected to be achieved by all students in the civil engineering study program. The preliminary developmental study investigated the student performance and evaluated the data to determine the student characteristics for defining the best learning experiences. The study proposes a collaborative approach to enhance the student construction drawing skill. The investigation result on the regression examination stated a significant and positive contribution of collaborative skill toward construction drawing skill. Therefore, this study includes a developed collaborative assessment indicator to be implemented in the class.

2.2.4. Collaborative Approach and Vocational Learning Principles in the ECD

The idea of proposing collaborative learning starts from a philosophical perspective on the concept of learning. To be able to learn, one must have a partner. In 1916, John Dewey wrote a book "Democracy and Education" which stated that the classroom is a mirror of society and serves as a laboratory for learning about real life [92][93]. Dewey's main thoughts on education are as follow:

1) Students should be active, learning by doing
2) Learning should be based on intrinsic motivation
3) Knowledge is evolving, not permanent
4) Learning activities should be following the needs and interests of students.
5) Education must include learning activities with mutual understanding and respect for each other, meaning that democratic procedures are very important
6) Learning activities should relate to the real world and aim to develop that world.

With his concept of "active learning," Piaget argues that students learn better if they think in groups, according to their thoughts, therefore explaining a job is better showing in front of it. Piaget also argues that if an active group, the group will involve others to think together to learn is more interesting [94][95][96][97]. Collaborative skills in this study refer to 10 indicators developed as follows: (1) being an active problem solver, giving ideas, and likes discussion; (2) preparing to work with high expectations; (3) willing to work in a team with risks and problems; (4) prioritizing the team choices and expectations; (5) prioritizing collaboration over individual competition; (6) prioritizing team responsibilities and learning interdependence; (7) believing that peer discussion is also a source of learning; (8) giving the colleagues chance and opportunity; (9) building the spirit of lifelong learning; and (10) fostering relationships and respect each other.

Collaborative learning can provide opportunities to lead to successful learning practices. As technology for learning (technology for instruction), collaborative learning involves the active participation of students and minimizes differences between individuals. Collaborative learning has added to the momentum of formal and informal education from two converging powers [98], as follow: (1) realization of practice, that life outside the classroom requires collaborative activities in life in the real world; (2) grow awareness of social interaction to realize meaningful learning. Therefore, to realize a good collaborative mindset to all the students, besides embedding it to the learning experiences, the teacher motivates the students in every class meeting about the importance of collaborative skills to enhance their professional skills, especially in construction drawing.

Vocational learning that mismatches with industry should be avoided and needs to be corrected immediately. Meaningful learning with the realization of practice and the right collaborative mindset is the energy of vocational education. Need serious effort for actualizing it, there are vocational learning principles that are important to emphasize the ECD are as follows:

1) The learning model provides contextual experiences and increases the ability of students' work competencies (competency-based)
2) The learning model improves the students' work capability, it is necessary to use a work-based and workplace learning approach
3) The learning model increases students' capability in solving work problems, so it is carried out on a problem-based approach

4) The learning models improve the students' capabilities in producing goods and services (project-based)
5) The learning model increases students' capabilities in designing goods, systems, and services (based on technology and engineering)
6) The learning model increases students' creativity in solving problems in the workplace (creative problems solving)
7) The learning model constructs new design, work procedures, and working principles through the stages of observing, questioning/formulating problems, collecting information/experiment, associating/analyzing, concluding, communicating ideas and findings (scientific based)
8) The learning model increases the students' capability to work together (collaborative learning)
9) The learning model is contextual and authentic based by adapting the teaching factory and internship programs
10) The learning model is carried out related to work (work-related learning)
11) The learning model is oriented to work as well as work in industry (work-oriented learning)
12) The learning model is connected/integrated to work (work-connected/integrated learning).

CHAPTER 3 SURVEY, IDENTIFICATION, AND DETERMINATION OF THE PRINCIPAL LEARNING STEPS

3.1. Summary

As the first stage research of survey and identification, this chapter is intended to: (1) determine the vocational course subjects, (2) discover the facility requirement and students' readiness to access personal computer for the e-learning, (3) define the learning approach and strategy, and (4) defining the learning steps. It is a survey and identification stages of the main research of a study of designing the e-vocational construction drawing (ECD) learning model. Observation, courses review, and group discussion were conducted for determining the course subject. Surveys were held to know: the facility condition, the availability of the course to be conducted with minimum facilities, the student readiness to access a personal computer, and determined the learning steps. Group discussions had been done to get the views of the vocational teachers and lecturers. The result showed: (1) CAD construction drawing is selected to be the course developed; (2) the facility requirement and the students' readiness and positive opinion to use e-learning is in the very high category; (3) the project-based collaborative flipped classroom is determined to be the learning approach and strategy; and (4) the teachers and lecturers approved the CAD construction drawing course to be the developed lesson using e-learning to be conducted and give the recommendation to do the seven Project-Based Learning (PBL) steps to be the principal syntax of the ECD learning model.

Keywords: e-learning, project-based, collaborative learning, flipped classroom, construction drawing, vocational course

3.2. Introduction

The vocational course has a different characteristic than the general ones. Students should have the same learning experience as in the world of work so that they are ready to work to provide such services or business ventures, have economic value, and produce goods and services to meet the needs of the community [99][100][101][102]. However, making the learning process the same as the workplace is not easy and cheap. The effectiveness of all education systems depends critically on the quality of teaching and learning in the classrooms, workshops, laboratories, and other spaces in which the education takes place. While teachers engage students, well-designed courses, facilities fit for purpose, and a good level of resources are necessary if any educational provision is to

be excellent. [103]. Besides, the increasing complexity in all facets of work and community life coupled with persistent calls for educational reform over the past several decades present numerous challenges to professionals in career and vocational education [104].

The study is conducted at the Civil Engineering Education Study Program at Sebelas Maret University. Observations were conducted to see the learning problem which happens in the vocational course. The study started by reviewed the courses and determined the CAD construction drawing course is the focused course to be developed. Nowadays the drawing skills are so important for supporting many courses in vocational education, especially in civil engineering. For this reason, drawing skills should be learned effectively in every stage of vocational education. In fact, there are unsolved problems in teaching CAD construction drawing to students. From the observation of the previous course, the major problem can be classified as (1) The needs of facilities; (2) The duration of the course (3) Understanding the lesson (3) Doing project activity in a team; and (4) Supervising the project. The designing CAD construction drawing course using e-learning with a project-based learning approach and flipped classroom strategy is expected to answer the problems.

Students access the e-learning by their own computer could minimize the school computer facilities, even the school has minimum facilities of computer laboratory, the course still can be conducted. The availability of the course that does not depend on the school computer facilities makes the arrangements of the course schedule become easy, the duration of the course needed will be easy to be fulfilled without getting a problem with the laboratory using schedule. Moreover, the students could have more time in studying individually. Understanding the lesson is a big problem when some of the students fail in studying in the class, it will make them feel anxious, lost the motivation and difficult to finish the course, as they have to do assignments without understanding and guidance. The e-learning will give guidance to be followed and learned by self-doing experiences or groups. In this case, the e-learning will give much support to the students by giving guidance, demonstration video, and job assignments. The student who fails to understand the lesson in the class could use the tutorial video as they can come back to learn the in class for the demonstration session, and this will give an opportunity to increase the student competence with a minimum cost. The abilities to share information with team members, making decisions together with the team and the abilities to communicate in the project supervising will be gained by the PBL approach.

3.3. Designing Project-Based Vocational Course Using E-learning

Although the e-learning is believed could help the students in learning, it must be understood that e-learning is only a media that cannot change the condition of the student instantly. However, e-learning will not replace other training instruments, but will rather qualitatively complement them [105]. We need a good instructional design to be implemented using the e-learning. The strategy of conducting a vocational course with a practical lesson oriented. The instructional design to run the course will be prepared by using an ideal approaching in line with the vocational education characteristics. The project method stems from John Dewey's idea of the concept of learning by doing. Student knowledge will develop as students face new experiences that compel to build and modify initial knowledge. Student intellectual development is reached by many new experiences when they are learning and then attempts to solve the problems raised by the experiences they had.

Almost all vocational education courses are practical knowledge that needs to be done as a real project for the students. The concept of learning by doing is the process of acquiring learning outcomes by working on certain actions in accordance with the objectives [106]. Piaget also argues that student competence will increase as long as the students face new experiences that push the student to build and modify their initial knowledge. On the other hand, Vygotsky states that individual intellectual development is faced with new and challenging experiences and then attempts to solve the problems raised by that experience. These statements are in line with constructivism theory which emphasizes knowledge built by students by using the experiences and cognitive structures that they already have [107]. PBL is an innovative approach to learning that teaches a multitude of strategies critical for success in the twenty-first century. Students drive their own learning through inquiry, as well as work collaboratively to research and create projects that reflect their knowledge. From gleaning new, viable technology skills, to becoming proficient communicators and advanced problem solvers, students benefit from this approach to instruction [103]. This approach integrates knowing and doing. Students learn knowledge and elements of the core curriculum, apply what they know to solve authentic problems, and produce results that matter, take advantage of digital tools to produce high quality, collaborative products. It refocuses education on the student, a shift mandated by the global world, which rewards intangible assets such as drive, passion,

creativity, empathy, and resiliency. These cannot be taught out of a textbook but must be activated through experience [104]. Projects make the world go around. For almost any endeavor, whether it's launching a space shuttle, designing a marketing campaign, conducting a trial, or staging an art exhibit, you can find an interdisciplinary team working together to make it happen [105].

Taking the advantages of digital tools to enhance the learning environment is a good strategy while the student is ready to have it. The camera phone is familiar for pupils and a meaningful tool for communicating and working. The benefit of a mobile data terminal, such as a smartphone connected to other networked technologies is that it goes where the learners go [106]. The personal computer owned by almost every student let the idea of designing vocational course by using e-learning has the same condition as a student-centered instructional strategy be a reasonable solution for the problem. From the e-learning, the learner gets the knowledge and apply it to solve problems given by the designer to reach the learning goal.

The principles of PBL refer to the Gold Standard PBL, articulated by Larmer, Mergendoller, and Boss requires student learning goals in two domains, deep subject-matter knowledge and the ability to transfer learning to new problems and contexts [6]. These learning goals are reached via 7 project design principles: (1) a challenging problem or question, (2) sustained inquiry, (3) authenticity, (4) student voice and choice, (5) reflection, (6) critique and revision, and (7) a public product. The principle will be implemented by learning steps which is designed based on the contextual vocational environment. Survey and discussion were done with a group of vocational teachers and lecturers to determine the learning activities. The George Lucas Educational Foundation developed PBL steps as follow: (1) start with the essential question; (2) design a plan for the project; (3) create a schedule; (4) monitor the students and the progress of the project; (5) assess the outcome; and (6) evaluate the Experience [108]. The syntax is a subject to be brought down to the specific class and get reconciliation with the condition of the specific vocational condition. The learners have their freedom in getting the knowledge, they could get by self-learning or by a group of learners. In the implementation, the student will have the lesson individually and also in a group. The project-based learning approach can be implemented whether students work individually, in pairs, or in groups, having them design something from scratch taps their creative abilities [8].

The learning activity suggested by Hrbek & Stix is divided into nine steps: (1) the teacher sets the stage for students with real-life; (2) students take on the role of project designers, (3) students discuss and accumulate the background information needed for their designs; (4) the teacher coach and students negotiate the criteria for evaluating the projects; (5) students accumulate the materials necessary for the project; (6) students create their projects; (7) students prepare to present their projects; (8) students present their projects; (9) students reflect on the process and evaluate the projects based on the criteria established in step 4. These steps are considered to be ideal for the contextual conditions, the steps are consulted with the result of group discussion and expected to be a new ideal PBL syntax for a vocational course.

3.4. Flipped Classroom

The flipped classroom strategy has been recently introduced as an alternative teaching paradigm and has been expressed to promote the students' competency, skills, and self-efficacy [62][109]. The research determined the flipped classroom as the instructional strategy expected to be the best way to solve the problems, a type of blended learning that reverses the common learning system by giving the lesson outside the class. It shifts the learning activity outside the class and implements the learning result into the class.

Learners study by observing the e-learning lectures, collaborate in discussion groups, or carry out the project assignment at home while engaging in concepts in the classroom with the guidance of a teacher. Among the various possibilities, the flipped classroom stands out for its time optimization, technological resources, and the personalization of the processes [110][111]. The flipped classroom is an innovative pedagogical approach that focuses on learner-centered instruction [112]. This strategy will be implemented and collaborated with PBL which is inline as a student-centered learning model.

3.5. Method

The method used is developmental research with a descriptive procedural model by adapting the Borg and Gall model. Educational research and development (R&D) is a process used to develop and validate educational products [70]. In this research, the Borg and Gall model is modified with the process begins by doing research and information collecting by survey and identification. After the information collecting, the next stage is planning, it begins by references study. After mastering the theory then began to enter the

designing phase, then it will be developed in the developing phase, it will be reviewed by relevant experts as expert judgment, revise and the next step is to test the design into a preliminary field testing. Then from the test, it will get corrections and revisions as it will be conducted the main product revision. After revision, it will be tested into the main field testing. Then it will get any revisions as the operational product revisions. The latest product revision as the research and development product will be tested. The test aims to find out whether the product made is feasible to be used or need revision. Model or product trials also look at the extent to which a product is created to achieve goals and objectives [113]. And the result will be disseminated and implemented. The procedure is illustrated in the development cycle in Figure 3.1.

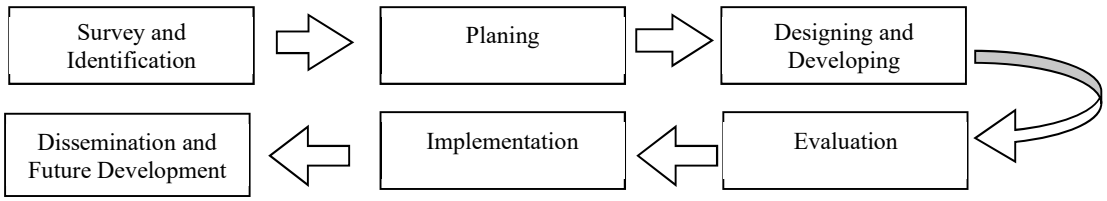


Figure 3. 1 The Development Cycle of the Main Research.

The first activity in this study is collecting the information. The survey conducted to 272 students from 1st to 4th grades, and 242 students answered the survey. There are 15 lecturers, and 5 teachers participate in the group discussion. From figure 3. 1, it is written as survey and identification, this phase is conducted to give a proper foundation and justification for this study are as follow: (1) reviewed the courses that require a development based on priority scale, it's determined the CAD construction drawing course as the focused course to be developed; (2) survey the availability of the computer facilities from the students and their opinion of the e-learning development as the students' readiness; and (3) review and decomposing the instructional strategy with a practical lesson oriented using an ideal approaching, decomposing PBL to be familiar with vocational education characteristics with the flipped classroom strategy. While the result of this phase is stated and give a positive recommendation, the planning phase could begin to be conducted.

3.6. Result and Discussion

As the vocational education has many major fields of study, depend on the certain skill to be expert, for the beginning of the study, it was determined that the study will begin from the civil engineering education major. An observation was conducted in the Civil

Engineering Education Study Program by choosing which course is considered urgent to be developed based on the priority scale. There are 68 total courses need to be passed (for structure major 68 courses and for drawing major 67 courses) by the students to finish the Civil Engineering Education Study Program as follow: 10 general courses, 5 basics of education courses, 41 major skills courses as we know it by the vocational courses, major skills by interest (5 courses structure major/4 courses drawing major), and 12 optional courses (not mandatory). Learning process skill including 6 courses, and 1 educational development course. The 41 major skills courses were observed, the observation was based on (1) the level of linkages with learning outcomes, (2) facility problem, and (3) implementation difficulties.

Table 3. 1 Urgency Level Summary of 41 Major Skills Courses

Num.	Course Name	Level of Urgency	Rank	Num.	Course Name	Level of Urgency	Rank
1	Applied mathematics	4	25	22	Steel Structure	4	25
2	Carpentry equipment	9	8	23	Hydraulics and Water Building	4	25
3	Applied physics	4	25	24	Foundation Engineering	4	25
4	Engineering mechanics 1	4	25	25	Drawing Techniques	8	15
5	Engineering mechanics II	4	25	26	Construction Management	8	15
6	Engineering mechanics III	4	25	27	Cost Estimation	9	8
7	Engineering mechanics IV	4	25	28	Wood Structure	10	2
8	CAD Construction Drawing	12	1	29	Plumbing and ME	4	25
9	Building Construction I	6	20	30	Masonry	9	8
10	Building Construction II	6	20	31	Practice of Plumbing and ME	9	8
11	Building Construction III	6	20	32	Carpentry I	10	2
12	Surveying I	10	2	33	Carpentry II	10	2
13	Surveying II	10	2	34	Furniture Design & Practice	10	2
14	Environmental Engineering	4	25	35	Concrete Practice	9	8
15	Construction checks and repairs	4	25	36	Practice of Steel & Aluminium	9	8
16	Building Materials Science	4	25	37	Field Observation	6	20
17	Soil Mechanics	9	8	38	Industrial Apprenticeship	8	15
18	Concrete Technology	4	25	39	Educational Apprenticeship	7	18
19	Concrete Structures I	4	25	40	Educational Seminar	5	24
20	Concrete Structures II	4	25	41	Thesis	7	18
21	Basic construction of roads and bridges	4	25				

The observation was conducted by reviewing the courses' curriculum and interviewing the courses' lecturer. The result was discussed with a group of lecturers to get corrections. The CAD construction drawing is written in Table 3.1 with urgency level 12, number 8, the first rank.

From the result of the course's review, it is determined that the CAD construction drawing is the most urgent vocational course to be developed. The next step was observing the existing CAD construction drawing learning condition. Curriculum design is a critical point for course development. To give course unites in an efficient way, some units must be divided into the submodules. By this way, cognitive loads of each module may be balanced for the students [114]. Here are the lesson materials of CAD construction drawing course: (1) building regulations; (2) designing building construction; (3) building construction drawing procedures; (4) coordinate system and CAD tools; (5) simple construction objects; (6) construction objects with modifications; (7) applied objects in buildings construction; (8) applied objects with modifications along with dimensions with the specified layer; (9) complete building construction; and (10) project presentation.

The observation was conducted based on the vocational course review focused on the CAD construction drawing course. The observation including the major problem classified as (1) the needs of facilities, (2) the duration of the course, (3) understanding the lesson, (4) doing project activity in a team, and (5) supervising the project. The common difficulty of implementing a vocational course usually needs many facilities to support the students' learning experiences which are considered a high cost. At the same time, this study expected to get a solution that avoids the high cost. It expects to solve the problem by supporting the students to study on their personal computers without depending on the laboratory facility. However, this condition lay several consequences. The availability of students' personal computers will be the main problem. The common condition is that the learners have their personal computers, while the survey confirms the alternative condition too. The alternative conditions will support the implementation of the learning model if the first item fails to be fulfilled. These items will keep ensuring the learning model can be implemented in a minimum facility. Besides owning a personal computer, they could borrow a computer from their family or friends or rent it from computer rentals.

Table 3. 2 Percentage Value Category

Number	Percentage Interval (%)	Assessment Category
1	81–100	Very High
2	61-80	High
3	41-60	Medium
4	21-40	Low
5	0-20	Very Low

Arikunto, 2014 [115]

To confirm prerequisite conditions as the consequences of using the personal computer instead of the laboratory facilities. The research surveys the availability of the

students' personal computers, family computers, friend's computers, and rented computers. The survey also answers that the student agrees with the e-learning development. The questionnaires include six questions with two closed-ended optional answers. The results were analyzed using descriptive statistics with the frequencies categories adapted from Arikunto [115] as we can see in Table 3.2.

Table 3. 3 Summary of the Available Frequencies for All the Students

Item of Survey	Students' Grade (%)					Assessment Category
	4th	3rd	2nd	1st	Average	
Personal computer	94.7	94	80	87.1	89.0	Very high
Family computer	47.4	78	53.8	62.9	60.5	Medium
Friends' computer	61.4	88	86.2	80	78.9	High
Buy new	49.1	22	43.1	55.7	42.5	Medium
Rent	38.6	18	18.5	55.7	32.7	Low
Agree with e-learning	80.7	96	92.3	95.7	91.2	Very high

The respondents are students who had passed the course and those who plan to take the course. The survey result shows that the students who have their personal computers are in the very high category, 89%. The availability of family computers is in the medium category, 60.5%. The availability of friend's computer is in the high category, 78.9%. The student who plans to buy a new computer is in the medium category, 42.5%. The availability of computer rental is in a low category, 32.7%. The students who agree to have e-learning for supporting the course is in the very high category, 91.2%.

Table 3. 4 Comparing the PBL Steps by the Discussion

The 6 PBL Steps (The George Lucas Educational Foundation)	The 9 PBL Steps (Hrbek & Stix)	The 7 PBL Steps (Vocational teacher and lecturers review)
1. Start with the essential question;	1. The teacher sets the stage for students with real-life	1. Teacher setting the stage, give example and essential question
2. Design a plan for the project;	2. Students take on the role of project designers,	2. Student design the project by colecting information and negotiate the evaluating criteria
3. Create a schedule;	3. Students discuss and accumulate the background information needed for their designs;	3. Create the schedule and work on the project
4. Monitor the students and the progress of the project;	4. The teacher-coach and students negotiate the criteria for evaluating the projects;	4. Monitor the progress
5. Assess the outcome;	5. Students accumulate the materials necessary for the project;	5. Prepare for the presentation
6. Evaluate the experience	6. Students create their projects;	6. Present the project
	7. Students prepare to present their projects;	7. Reflection and evaluate as the criteria planned
	8. Students present their projects;	
	9. Students reflect on the process and evaluate the projects based on the criteria established in step 4	

The survey result recommends continuing the study to the next phase. The review of instructional design was done by observing the project-based theories and adapted to the contextual vocational condition. The view of PBL from the George Lucas Educational Foundation [116], the learning steps suggested by Hrbek & Stix [117], and the Gold Standard Project-Based by Mergendoller and Boss [107] were compared, reviewed, and discussed by a group of vocational teachers and lecturers.

Table 3. 5 The PBL Steps Revised by the Vocational Teachers and Lecturers

7 Principles of The Gold Standard PBL	7 PBL Steps (Vocational Teacher and Lecturers Review)	7 PBL Steps Revised by the Vocational Teachers and Lecturers
1. A challenging problem or question	1. Teacher setting the stage, give example and essential question	1. Teacher setting the challenging stage by giving example and essential sustained questions.
2. Sustained inquiry	2. Student design the project by colecting information and negotiate the evaluating criteria	2. Student actively design the authentic project by collecting information and negotiate the evaluating criteria sustainably
3. Authenticity	3. Create the schedule and work on the project	3. Student actively create the schedule and work on the project authentically
4. Student voice and choice	4. Monitor the progress	4. Monitor the student activity and the progress of the project
5. Reflection	5. Prepare for the presentation	5. Understanding the project to prepare for the presentation,
6. Critique and revision	6. Present the project	6. Present the project to collect critique and revision
7. A public product	7. Reflection and evaluate as the criteria planned	7. Reflection and evaluate as the criteria planned

The seven PBL steps revised by the vocational teachers and lecturers become the main steps for the ECD learning model development.

3.7. Conclusion

The result emphasizes the CAD construction drawing as the course to be developed and recommends continuing the course development to the next steps. The survey shows the students' readiness to learn with their personal computers is very high. Furthermore, the students' agreement of using e-learning is in the very high category. Besides, the teachers' discussion results recommend developing the ECD learning model. Furthermore, the discussion recommends the seven PBL steps as follow: (1) teacher setting the challenging stage; (2) students design the authentic project by collecting information and negotiate the evaluating criteria sustainably; (3) students actively create the schedule and work authentically; (4) monitor the student activity and progress; (5) understanding the project to prepare for the presentation; (6) present the project to collect critique and revision; and (7) doing reflection and evaluation as the criteria planned.

CHAPTER 4 INVESTIGATION OF VOCATIONAL STUDENTS' SKILLS FOR DETERMINING THE LEARNING EXPERIENCES ON CAD CONSTRUCTION DRAWING COURSE

4.1. Summary

As a part of developing research to design a vocational course, this chapter aims to examine students' skills in the industries and discover the gap between industry need and vocational students' skills. It is a gap evaluation study using 130 samples selected from four vocational high schools by proportional random sampling with descriptive analysis and matched-pairs Wilcoxon test. The results showed the construction drawing skills are in a Good category of 68.26 with a Low discrepancy of 31.74% and the collaborative skills are in a Fair category of 61.69 with a Low discrepancy of 38.31%. Furthermore, the lowest students' skills with the highest gap are the collaborative skills, prioritizing collaboration between peers of 57.50 with 42.50% discrepancy, prioritizing the team's expectations of 58.08 with 41.92% discrepancy, and prioritizing group responsibilities and learning interdependence of 58.65 with 41.35% discrepancy.

Keywords: vocational student skill, drawing skill, collaborative skill, collaborative mindset, collaborative learning, learning experience, teamwork, learning interdependence.

4.2. Introduction

Indonesia is currently enduring a transition period towards a knowledge economy, heightened competitiveness, and growth of employment performance, skill gaps are seen as significant obstacles in this respect [7][8][9]. Prioritizing vocational student to be the potential human resources to increase the development of economic for realizing a prosperous and stable country is a significant task to be implemented [10][11]. It is in line with the UN SDG 4, improving the quality education by ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all, as target number three to six. By 2030, ensuring equal access for everyone to have affordable and quality technical, vocational and tertiary education, increasing the relevant skills, eliminate gender disparities including persons with disabilities, achieving literacy and numeracy [3][2]. Vocational education aims to develop the full potential of individuals to have work insight, technical skills, and carry out self-transformation to the changing demands of the world of work. In this case, vocational education has a strategic role in developing the quality of the workforce

and improving welfare to respond to the social and economic interests of a country. With the same learning experience as in the condition of industry and world of work, students should be ready to work to provide such services or business ventures, have economic value, create better products and services to meet the needs of the community [12][13].

An introductory study revealed that the employment rate of vocational school graduates was 70% in Yogyakarta, Indonesia. This rate is still not satisfying, considering the employment percentage should be at least 80% [18]. The main challenges currently facing by vocational education in Indonesia is requiring adequate conformity between the learning experiences taught in vocational institutions and the demands of the industry and labor market [7]. Through vocational education, the Indonesian government strives to create better educational programs to answer and anticipate the demands of the labor market [36]. The government vocational educational learning program related to students' competences is the Dual System Education (DSE) through work experience in real workplaces as apprentices [118][119]. To identify the gap between students' skills and industry needs, we conduct student skills investigations when they carry out DSE programs as apprentices. Conducting research when students perform internships in the industry is expected to provide authentic skill information, where students are genuinely carrying out tasks given by the main stakeholders of vocational schools.

With not neglecting research in the classroom that conducted as mandatory evaluation of teaching carried out in a scheduled and structured manner, this research expected to become an essential reference for improving classroom learning quality as primary data obtained directly from the industry as the vocational school major stakeholder. Furthermore, learning characteristic in the vocational institution is different from learning in a general academic setting, the learning approaches concrete industrial tasks, and both the educational class setting and workplaces contribute to the students' gradual development of technical and vocational education [120][121].

Students would master their skills as they learn from experience [122][123][41]. To get knowledge may be untroubled by received it passively but understanding and mastering the competence of it are different cases. Learners have to make meaningful connections between prior knowledge, new knowledge, then getting involved, and experienced in the learning processes. In the view of constructivism, learning is not merely memorizing, but the process of constructing knowledge through experience [124][125].

As a series of processes and events experienced by each individual, especially students in a specific scope following the learning methods or strategies provided by the teacher adapted with learning objectives, the learning experience will make students learn effectively and contextually. Experiences let reinforcement for students to remember and reuse lessons from the past [126][127]. Precise learning activities would effectively enhance student knowledge, understanding, behaviors, skills, and competencies. On the other hand, specific vocational student skills which are demanded by the labor market still not particularly identified. We need to understand the gaps between industry needs and student performance as an essential reference for determining the most wanted strategy. From the result of this study, we could design precise learning activities by analyzing the gaps between students' skills and industrial needs in every indicator and sub-indicator of the learning outcome from the industrial perspective.

4.3. Methods

4.3.1. Research Methods

This research chapter was a quantitative study using the discrepancy evaluation model [18][128]. It aims to measure the level of discrepancy between the students' skills performed in the field of carrying out work assignments given by the industries in the internship program with the ideal performance following the industrial needs. The formulation concepts of performance standards determined based on the study of relevant theories and industrial requirements. The study's locations were in the civil construction engineering industries when the students were doing the internship program in the academic year of 2019/2020.

4.3.2. Population, Sample and Data Collection Technique

The population of this research in this chapter were 201 students of vocational schools in Yogyakarta City, Surakarta City, Sragen Regency and Cilacap Regency, Indonesia. The samples were 130 students taken from the total population by proportional random sampling. Assessment sheets with rubrics used to collect the data as the collection instruments.

The testing of the research instrument using the content validity test. The instrument content validity was employing the raters agreement index regarding the validity of the items proposed by Aiken V with seven experts as raters from the university and industries. The assumption of validity is when the index value of $V \geq 0.40$, it will consider being valid [129].

The content validity test results of the student skill assessment sheet using the raters agreement index regarding the item validity proposed by Aiken V showed that the average content validity of the 39 statement items was 0.88, higher than the index V value of 0.40, so the instrument items in this research are declared valid.

The reliability of this study used the formula of Interclass Correlation Coefficient (ICC). Reliable assumes we used in the instrument was the ICC value more than 0.75 (ICC value $\geq$ 0.75) [130]. The instrument reliability test results for student skills assessment sheet between raters using the IBM SPSS showed that the ICC reliability coefficient value was 0.858 which means it had met the minimum requirement of the ICC reliability coefficient value $\geq$ 0.75. Hence, the interpretation of the assessment instrument sheet is reliable.

Table 4. 1 Proposed Skills Indicator for Vocational High School Construction Drawing

Aspect	Indicator/Sub-indicator
Construction drawing skills	1. Preparing to draw; determining the materials and tools; making a work time schedule 2. Drawing process: software settings; analyzing drawing plans; drawing 3. Complying with the rules of technical drawing: applying drawing layout; drawing construction line; applying the use of letters, numbers, and symbols; applying drawing title block; applying the correct construction shape; applying the drawing scale; drawing the building materials with the correct symbols; drawing construction details; determining the completeness of the drawing 4. Drawing plans and construction detail drawing: drawing floor plans; drawing the building view, front, right side, left side, back, and top; drawing section; drawing the detailed foundation plan; drawing the detailed roof plan; drawing the plumbing and ME plans; drawing the title block; Setting and operating the plotter 5. Presenting the drawing: presenting the drawing information both verbally and in writing; explaining the arguments of the drawing concept
Collaborative skills	1. Being an active problem solver, giving idea and likes discussion 2. Working preparation with high expectations 3. Working with the team with risks and problems 4. Prioritizing choices matching the team expectations 5. Prioritizing collaboration between peers rather than individual competition 6. Prioritizing group responsibilities and learning interdependence 7. Believing team discussion as a source of learning 8. Giving the opportunity to colleagues 9. Building the spirit of lifelong learning 10. Fostering relationships and respect each other

This study's data analysis techniques are descriptive analysis and Wilcoxon matched-pairs test analysis to test the discrepancy between the ideal standard of student skills grades expected by the industry with the original student skills scores achieved at the time of the internship. Assessment criteria of vocational students' skills are divided into four groups: very good, good, fair, poor [131]. And the criteria for determining the discrepancy are: no gap, very low, low, quite high, high, and very high [132]. Table 4.1 shows the proposed student skills indicator for vocational high school on construction drawing course.

4.4. Results

This study reviews the vocational students' skills into two aspects, i.e., student construction drawing skills and student collaborative skills. The descriptive analysis results of student construction drawing skills shows a mean value of 68.26 on a scale of 100 with a Good category. In comparison, the student collaborative skill shows a mean value of 61.69 on a scale of 100 with a Fair category.

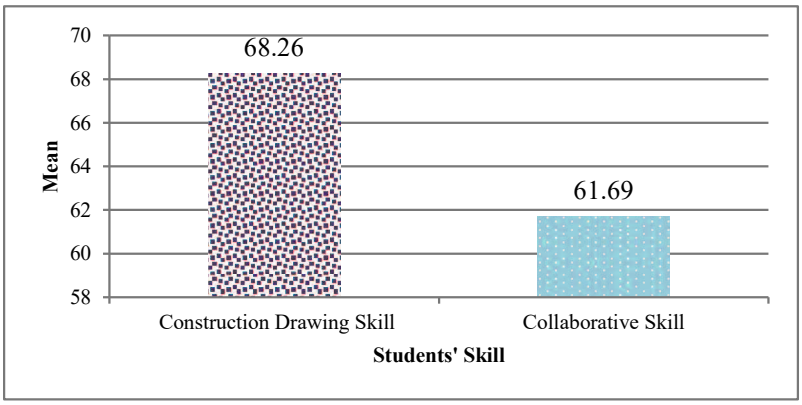


Figure 4. 1 Mean of Students' Skills Score

The mean scores of students' skills and vocational students' skills frequency distribution from 130 students as research samples visually are shown in Figure 4.1 and 4.2.

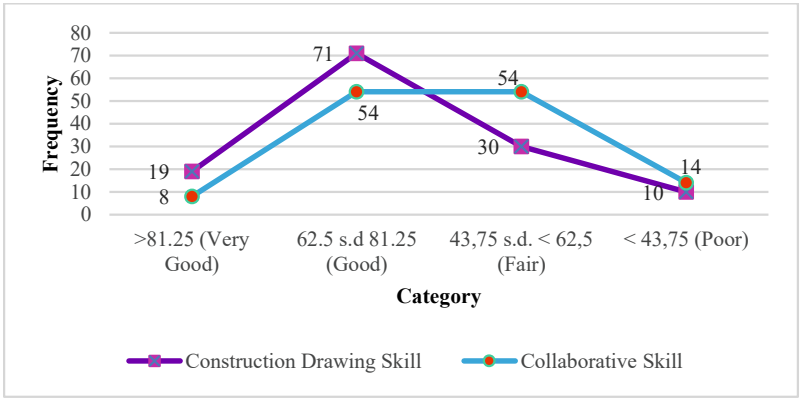


Figure 4. 2 Frequency Distribution of Students' Skills

The using of the Wilcoxon matched-pairs test is to find out the gap between students' skills and the specified standards expected by the industry. The assumption used is the calculated Zo value = $Z_{0.05}$ of 1.64 in the statistics table, it means there is no gap, but if Zo ≠ $Z_{0.05}$, then it is concluded that there is a gap. Table 4.2 is presenting the summary of the Wilcoxon matched-pairs students skills test results on the aspects of construction drawing skills.

Table 4. 2 The Wilcoxon Matched Pairs Test for Construction Drawing Skills

Aspect	Zo ≠ Z0.05		Result	Discrepancy (%)	Category
	Zo	*Z0.05*			
Construction drawing skills	-9.900	1.64	There is a gap	31.74	Low

According to Table 4.2, the Zo is -9.900, where -9.900 ≠ $Z_{0.05}$ of 1.64, it means there is a gap between the students' construction drawing skills with the standards demanded by the industry. The students' construction drawing skills gap according to industry assessment of 130 students as research samples is 31.74%, including in the Low gap category. Frequency distribution of construction drawing skills gaps of 130 students as research samples visually is shown in Figure 4.3.

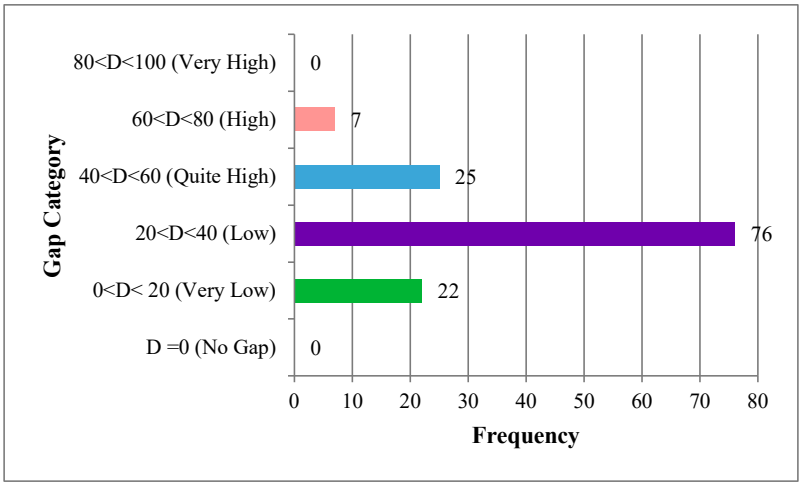


Figure 4. 3 Frequency Distribution of Construction Drawing Skills Gaps

According to the results of the gap values contained in Table 4.3, the highest value of the gap is in the "presenting the drawing" indicator on item 29, "explaining the arguments of the drawing concept". Then “drawing plan and construction” indicators on items 19 and 25, "drawing the detailed roof construction plan" and "drawing the plumbing and mechanical and electrical (ME) plan". Table 4. 3 presents the lowest mean score and highest discrepancy on construction drawing skills.

Table 4. 3 Lowest Mean Score and Highest Discrepancy on Construction Drawing Skills

Indicators of Construction Drawing Skills Aspect	Sub-Indicator	Mean	Category	Discrepancy (%)	Category
Presenting the drawing	29. Giving the arguments of the drawing concept	59.62	Fair	40.38	Quite high
Drawing plan and construction detail drawing	19. Drawing the detailed roof plan	61.73	Fair	38.27	Low
	25. Drawing the plumbing and ME plan	61.73	Fair	38.27	Low

After the Wilcoxon matched-pairs test revealed the discrepancy between students' construction drawing skills with the standards demanded by the industry, the subsequent analysis is testing the students' collaborative skills with the specified standards expected by the industry. The assumption used is the same, by calculated Zo value = $Z_{0.05}$ of 1.64 in the statistics table as the conclusion of no gap. Table 4.4 is presenting the summary of the Wilcoxon matched-pairs test of the collaborative skills aspects.

Table 4. 4 Summary of the Wilcoxon Matched Pairs Test for Collaborative Skills

Aspect	Zo ≠ Z0.05		Result	Discrepancy (%)	Category
	Zo	*Z0.05*			
Collaborative skills	-9.904	1.64	There is a gap	38.31	Low

Table 4.4 describes the Zo is -9.904, where -9.904 ≠ $Z_{0.05}$ is 1.64, it implies that there is a gap in students' skills in aspects of collaborative skills to the standards demanded by the industry. The students' collaborative skills gap of 130 students as research samples is 38.31%, including the Low gap category. The summary of the lowest mean score and highest discrepancy representing student collaborative skills are in Table 4.5.

Table 4. 5 Lowest Mean Score and Highest Discrepancy on Collaborative Skills

Aspect	Indicator/Sub-indicator	Mean	Category	Discrepancy (%)	Category
Collaborative skills	33. Prioritizing choices that match the expectations of the team	58.08	Fair	41.92	Quite high
	34. Prioritizing collaboration between peers rather than competition	57.50	Fair	42.50	Quite high
	35. Prioritizing group responsibilities and learning interdependence	58.65	Fair	41.35	Quite high

According to the results of the discrepancy values listed in Table 4.5, three indicators that have the highest gap values in the performance aspects of collaborative skills are indicators 33, 34 and 35 with the highest discrepancy is number 34, "prioritizing collaboration between peers rather than competition". It is followed by indicator number 33, "prioritizing choices that match the expectations of the team" and indicator number 35, "prioritizing group responsibilities and learning interdependence".

Table 4. 6 Summary of Descriptive Analysis and Wilcoxon Matched Pairs Test

Vocational Students' Skills	Mean	Category	Discrepancy (%)	Gap category
Construction drawing skills	68.26	Good	31.74	Low
Collaborative skills	61.69	Fair	38.31	Low

Descriptive analysis results and Wilcoxon matched-pairs test of vocational students' skills which assessed from two aspects, including construction drawing skills and collaborative skills are in Table 4.6.

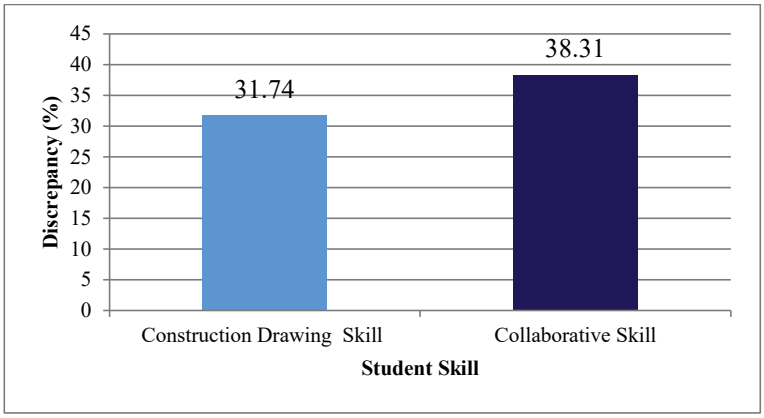


Figure 4. 4 Vocational Students' Skills Discrepancy

Table 4.6 shows that the value of the collaborative skill gap is higher than the construction drawing skill. In this case, the industry assesses students tend not to be accustomed to collaborating in the context of completing tasks or work in the work environment. The discrepancy value of vocational students' skills can be seen visually in Figure 4.4.

4.5. Discussion

4.5.1. Construction Drawing Skills

The descriptive analysis result of students' construction drawing skills presented above was in a Good category, 68.26 on a scale of 100. The discrepancy values of students' construction drawing skills result from Wilcoxon matched-pairs test shows that there is a Low discrepancy of 31.74%. The highest gap is in presenting the drawing with 40.38%, which is in a Quite High category.

The results of construction drawing skills are generally included in the Good category, even though they are at the lower limit. We optimistically expect to optimally enhance these skills by implementing appropriate learning strategies and focusing on the exact parts of the problem. Whereas "presenting the drawing" has a Low mean value and a Quite High gap in the sub-indicator "explaining the arguments of the drawing concept" with a mean value of 59.62 included in the Fair category and 40.38% discrepancy, which included in the Quite High category. It means that the construction drawing skills were not entirely in good condition. There are still several problems to be solved, and some skills need to be

enhanced. Beside "presenting the drawing," there are two more sub-indicators which have a lower score and higher discrepancy, "drawing the detailed roof plan" and "drawing the plumbing and ME plan" with a mean score of 61.73 on a scale of 100 with a Fair category and the discrepancy of 38.27% included in the Low category.

In line with Kilbrink, which states that when students enter a complex workplace set, they experience problems in their efforts to transfer learning, reflect the knowledge, and skills developed in schools [121]. In this study, the aspects of construction drawing skills show that the high discrepancy is at the presenting of the drawing, students tend to have difficulty specifically in terms of presenting arguments to underlie the concept of building drawings to co-workers, and the customer. Moreover, developing the concept of the principal drawing, utility, until the building facade that meets customer needs. On the other hand, the second-highest gap is students having difficulty in drawing plumbing installations and ME plan. It is because students do not fully understand the system installation and operational work. Therefore, vocational education's most crucial thing is to provide students with the same competence with the industrial needs as well as the underlying theory related so that students at the workplace can develop themselves and form a whole learning experience through the transfer of knowledge and competence for bridging the gap that occurs between the students' skills and industrial needs.

4.5.2. Collaborative Skills

The students' collaborative skills investigation result from the descriptive analysis presented above was 61.69 on a scale of 100, including in a Fair category. The discrepancy of students' collaborative skills result from the Wilcoxon matched-pairs test shows that there is a Low discrepancy of 38.31%. The highest discrepancy was in "prioritizing collaboration between peers rather than competition" with 42.50%, including in a Quite High category.

The students' collaborative skills generally included in the Fair category. It is lower than the lowest level of construction drawing skills mean score. This condition emphasizes that the gap between the skills needed by industry and the skills mastered by students is still quite high. However, we expect to have the fittest learning strategy by analyzing the result of this study. Ongoing development research has been conducting to develop the ideal course design for enhancing these low skills by implementing appropriate learning strategies. Besides the general collaborative skills, there were some detailed indicators of collaborative skills discovered in a low skill level, i.e., "prioritizing collaboration between

peers rather than competition" has the lowest mean value of 57.50 on a 100 scale included in the Fair category and the highest gap of 42.50% discrepancy included in the Quite High category. This result implies that most of the students did not like to collaborate with peers. We need to have more investigations on the daily behavior and culture to know why it could happen to the vocational students in these schools. The second-lowest mean score and the second-highest gap was "prioritizing choices that match the expectations of the team" with a mean value of 58.08 included in the Fair category and 41.92% discrepancy, which included in the Quite High category. Moreover, the third-lowest mean and the third-highest gap was "prioritizing group responsibilities and learn interdependence" with a mean value of 58.65 included in the Fair category and 41.35% discrepancy, which included in the Quite High category.

The finding gives the implication that the collaborative skills were not in good condition. We need to solve the problems by planing the learning strategy by analyzing this result. Students do not seem to be accustomed to learning and working collaboratively. They prefer to do individual competition rather than work in teams to achieve mutual goals and succeed together. In line with Le H. et al., there are four common barriers to collaboration, students' lack of collaborative skills, free-riding, competence status, and friendship, and the results showed three interrelated antecedents that contribute to these obstacles [133]. It probably will raise a negative impact on student learning success, because, in the vocational education environments, most subjects are project-based, which ideally require collaborative work. Besides, in the industry, most of the job is a complex project consisting of various kinds of derivative jobs that are interrelated, which inevitably requires teamwork in the implementation. Whereas in fact, vocational school students prefer to work and learn individually. It might because of the learning system applied to them, where the tasks that they get in the class are individual tasks without any obligation to discuss and cooperate with the team. Usually, the assignments given at school are pieces of a large part of the work that separated into individual tasks.

Moreover, at the end of the course, students never know how the assignment pieces collected into a single project result, which usually bigger and complicated. It is unfavorable where the pieces should be done in a coordinated manner in a team so that the work becomes more manageable and connected during the learning and working process to the collection of tasks into a single and compact job. With the ignorance of students

learning and working collaboratively, we should have an effort to solve the problem. It is needed to socialize with students about the collaborative mindset. So far, not every student has embedded themself with a collaborative mindset. To overcome this problem, in daily learning, it should be instilled in working among each student. Habituating collaborative learning and working to the student can be implemented by designing collaborative approaches learning models, collaborative learning methods, and facilitating the students with collaborative learning media, online learning platforms, also collaborative blended learning. In addition to designing learning strategies and collaborative learning models, incorporating collaborative content in the curriculum can also be done by including the content of collaborative knowledge and the raising of a collaborative mindset, expressly students are expected to be able to master collaborative skills as stated in the learning objectives.

4.5.3. Determining Learning Experiences

By considering the results of this study, we will determine the learning experience that students will take so that they can learn effectively with excellent learning outcomes according to the learning objectives, which can ultimately minimize the gap between the students' skills with industrial needs. As stated in the previous study, students reached their intellectual development by many new experiences when they are learning, practicing, and then attempting to solve the problems by the experiences they had [12].

The condition of student skills as a result of this study, i.e., students seem to be accustomed not to learn and work collaboratively. They prefer to do individual work and have individual competitions rather than work in teams to achieve mutual goals and succeed. The investigation revealed that vocational students' collaborative skills were still low so that it required efforts to improve with the following priority order:

1) Prioritizing team collaboration
2) Prioritizing team choices and expectations
3) Learning interdependence and team responsibilities
4) Support colleagues to be active in the learning process
5) Willing to work with a team with risks and problems
6) Believing team discussion as a source of learning
7) Fostering relationships and support each other
8) Being an active problem solver and like discussions

9) Building the spirit of lifelong learning and
10) Preparing work with high expectations.

The next study will determine better learning experiences contextually by giving more attention to the provision of collaborative skills. Beside vocational education gives students the necessary knowledge and skills to be ready to work in their occupation, project-based learning with an emphasis on the collaborative mindset development is considered to be a better instructional approach for the course and applied into the vocational school curriculum [134][135][136]. The developing of instructional design will be implemented using e-learning with a collaborative PBL strategy focused on the priority order as stated the finding of this research. The delivery models will be designed as possible teaching scenarios, online or blended.

The findings and the recommendations of this study represent a contribution to the SDG4 targets. The objective can help in developing solutions to most of the problems formulated as the basis for the creation of sustainable development of the future by designing an instructional strategy with the help of technological tools [137][138][139]. It will reduce the education cost for affordable and quality technical and vocational education as the target number three, deals with the acquisition of skills relevant to the job market for youth and adults as the target number four, eliminates gender disparities and ensure a chance for persons with disabilities and vulnerable situations as the fifth target. For the target number six, due to the ease of access to online learning, it represents a chance for the youth and adults of both genders across the world to achieve appropriate proficiency levels of literacy and numeracy skills.

4.6. Conclusion

The investigation result of vocational students' skills for the four vocational high schools is categorized as Good with a Low gap value of 31.74% in the construction drawing skills and categorized as Fair with a Low gap value of 38.31% in the collaborative skills. The highest three gap value is in the collaborative skills categorized as Quite High, and these are (1) prioritizing collaboration between peers rather than individual competition, (2) prioritizing choices matching the team expectations, and (3) prioritizing group responsibilities and learn interdependence. Besides the highest three gap value of collaborative skills, there is also a Quite High gap categorized at construction drawing skills, i.e., presenting the drawing in the sub-indicator of explaining the drawing concept's

arguments. It will raise a negative impact on student learning success as in the vocational education environments, most subjects are project-based, which ideally require collaborative work. While in the industry, the project consists of many interrelated derivative jobs, which inevitably requires teamwork in the implementation.

Furthermore, next activity is to determine better learning experiences contextually by giving more attention to the provision of collaborative skills. Therefore, the students can learn effectively with excellent learning outcomes according to the learning objectives, which can ultimately minimize the gap between the students' skills with industrial needs. Habituating collaborative learning and working to the student is very important for instilling a collaborative mindset. The implementation involves designing and developing collaborative learning models using various collaborative learning methods. Moreover, facilitating students with collaborative learning media, online learning platforms, and collaborative blended learnings.

CHAPTER 5 CONTRIBUTION OF COLLABORATIVE SKILL TOWARD CONSTRUCTION DRAWING SKILL FOR DEVELOPING THE ECD

5.1. Summary

This study aims to support developing research in designing the ECD learning model for civil engineering education study program by examining students' collaborative skills toward construction drawing skills as a substantial skill in civil engineering. This research investigated student performance for proposing collaborative learning approaches to improve student skills as needed by industry. It is e*x-post-facto* research using 130 samples from several vocational high schools in Indonesia with descriptive statistics and regression for the data analysis. The results show the collaborative skill is in a Fair category of 60.00 and the construction drawing skill is in a Good category of 67.49 on a 100 scale. There is a significant and positive influence of collaborative skill (X) toward construction drawing skill (Y) with a linear regression model $\hat{Y} = 31.443 + 1.952X$. It exhibited a correlation coefficient of 0.644, a determination coefficient (R-squared) of 0.415, and an Adjusted R-squared of 0.410 where it can be concluded that the collaborative skill variable (X) as a predictor in the regression model includes the moderate category, which gives a 41% contribution in explaining the variants of the construction drawing skill (Y) as the dependent variable. It needs special attention to the specific behavioral details of the collaborative skill. The next activity is improving collaborative skills that emphasize prioritizing collaboration between peers and learning interdependence.

Keywords: collaborative skill, collaborative mindset, collaborative learning, drawing skill, vocational course, civil engineering, learning experience, learning interdependence

5.2. Introduction

After entering the post-cold war era, Indonesia lacks a significant external threat, having free access to the global markets, and good internal stability to support its continuing national development programs [140]. Besides facing a transition period to be a knowledge economy, growth of competitiveness, and employee performance improvement, there are significant barriers in the preparation of the prospective workforce by vocational education [7]. Significant obstacles in vocational education development are skills gaps between student and the industrial demand [7][12][13]. In the past year, unemployment has decreased by 50 thousand people, in line with the Open Unemployment Rate or in Indonesia *Tingkat Pengangguran Terbuka (TPT)*, which fell to 5.01% in February 2019. Judging from

the education level, *TPT* for Vocational High Schools or in Indonesia *Sekolah Menengah Kejuruan (SMK)* is still the highest among other education levels, amounting to 8.63% [20][141]. The low absorption of vocational school graduates to find jobs in industries indicates vocational school graduates have not met industry demands [12][22]. An initial study exposed that *SMK* graduates' employment rate was 70% in DIY, Indonesia. This rate is still not enough, considering the employment percentage should be at least 80% [18][22]. The industry still holds that vocational graduates are not ready to work. They still have to do initial training for new employees. The government's expectation for *SMK* to overcome unemployment is tremendous as the *SMK*'s vital role to be the leading supplier of labor to drive the nation's economic growth. More attention to vocational education in producing the potential human resources is an essential key point for stabilizing and developing the country [10][11].

The 2030 agenda of United Nations Sustainable Development Goals (UN SDGs) is an urgent call for action by all countries, especially on goal number four in improving the education quality by ensuring inclusive, equitable quality education and promoting lifelong learning for everyone [2][142]. An urgent target of the UN SDGs on goal number four (UN SDG4) regarding quality education is the target number three, ensuring equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university [143]. Moreover, UN SDG4 needs to realize the target number four, substantially increasing youth and adults with relevant skills, including technical and vocational skills, employment, decent jobs, and entrepreneurship. Every country obliges to implement these targets to ensure stable economic development, foster tolerance between people, and contribute to more peaceful societies [144]. Therefore, the Indonesian government is addressing these challenges through empowering vocational education and striving to create relevant educational programs to answer and anticipate the demands of industrial needs [18]. In recent years, efforts to improve vocational education quality have been carried out in line with the presidential instructions to revitalize vocational education [145]. It is stated in presidential instruction number 9 the year 2016 with four focus on revitalization, including revitalizing curriculum, educators and education personnel, cooperation, and graduates [146][147][148].

This study aims to contribute to the vocational education revitalization in the curriculum side by developing a vocational course with a series of initial studies as a

foundation for the formation of learning according to stakeholder needs by considering the characteristics of current student skills. To obtain data on student characteristics, we investigated student skills. Investigations are carried out directly on students who are doing internships in the industry. One of the government learning programs for vocational education is the internship program known as Dual System Education or in Indonesia *Pendidikan Sistem Ganda (PSG)* through work experiences in the industry. Student gets their actual practices in the workplaces by this program [118][119][149]. This program allows the student to get practical knowledge directly in the industrial workplace. Besides, this study investigated the students' skills while they are working.

As a part of development research to improve the student skills in construction drawing by designing a vocational learning model in a civil engineering education study program, this study proposed discovering the contribution of collaborative skills toward construction drawing skills for developing the ECD learning model. The study proposes a collaborative approach for designing vocational courses as an alternative solution to minimize the gap between industrial needs and current vocational student skills. A study revealed that students' collaborative skills in several vocational schools were not in good condition. Learners do not show accustomed to learning and working collaboratively and prefer to have individual competition rather than work with friends in a team to achieve mutual aims [22][134][150]. Also, it is necessary to reinforce collaboration as one of the 21st-century skills besides communication, critical thinking with a spirit of lifelong learning [151][127]. On the other hand, working together in a team to finish jobs, advanced assignments, and complicated projects is an indispensable working method in the actual workplace. Many of the jobs are a series of interrelated projects that must be completed collaboratively. This research is essential for proposing collaborative learning approaches to improve student skills needed by the industry. In collaborative learning situations, learners work actively in purposeful ways. They are not simply taking new information or ideas but designing new projects with updated information and ideas.

In the perspective of Islam as the majority religion in Indonesia, collaboration is encouraged in all aspects of human life. This Islamic obligation includes teaching and learning taxonomy, where collaborative skill is one of the fundamental skills that should be developed throughout the students' learning experiences to gain the student skills in all aspects of learning outcomes [152][153][154]. Islam professes that everybody requires a

good social relationship to live [155][156][157][158]. Muslims believe God has established mutual rights for everyone, and to meet this requirement, collaboration and respecting mutual rights is the ideal architectural concept. They are taught to keep united and collaborate to strengthen each other like a strong building structure. Collaborative activities immerse students in challenging duties or problems. Instead of being separate observers of problems and solutions, students become immediate practitioners [30]. Performing situations challenge students to practice and increase higher-order rationalizing and problem-solving abilities.

5.3. Research Methods

5.3.1. Method

As a part of the investigation research chapter for identifying student characteristics in the specific indicator, this study concentrates on the statistical analysis, which aims to reveal the students' detailed condition on the construction drawing and collaborative skills. The construction drawing skill is needed as a professional field of expertise in civil engineering education and the collaborative skill is needed as workplace competency to face the actual workplace condition with many dynamic problems. To support the ongoing development study on designing a better learning model in a vocational education environment, it used a quantitative statistical approach with an *ex-post-facto* method, which is expected to cover the study's aim in collecting authentic vocational students' performance data from four different schools in Indonesia without giving treatment to the research subjects. The assessors assessed the actual student skill, while the research subjects keep in their original condition because of no treatments. The assessment was conducted directly while the students had an internship program in the industry to ensure the research subject's authentic performance. It acts as a scientific study on how a phenomenon influences a variable that requires theoretically grounded methods by examining social reality, which confirmed the theory and observation are two inseparable things. While theories are needed to explain the natural and social phenomenon, observation is necessary for finding a theory [159][160][161]. We try to uncover the facts that already exist in each of the variables studied and observe the phenomena to find problems and offer possible solutions.

The results of the study were analyzed using descriptive statistics and continued with regression as the inferential statistics. Descriptive analysis is essential to illustrate the collaborative and construction drawing skills by presenting the mean, frequency

distribution, and histograms. It also categorizes the data for further discussion and designs better learning experiences to support the development of the vocational learning model. Meanwhile, regression analysis is needed to prove that collaborative skills contribute significantly to professional competence, especially construction drawing skills, where the improvement of collaborative skills is a solution offered by the ongoing development study as the primary related research

5.3.2. Population, Sample, and Instrument

This research was conducted at several vocational high schools in three different Provinces, including Central Java, DIY, and Papua. The population is 204 apprenticeship students taken from four state vocational high schools in separate cities, including Surakarta, Yogyakarta, Cilacap, and Sorong. From the total population, the study used 130 samples for this research by proportional random sampling. It randomly used samples from each vocational school class that conducted an industrial internship program in the same proportion. For analyzing the data and examining the hypothesis, it employed descriptive analysis and linear regression. This study's dependent variable is construction drawing skill (Y), a substantial civil engineering student skill. In contrast, the independent variable is collaborative skill (X), an essential workplace competency for adapting to actual working problems and developing careers. At the same time, we propose the collaborative enhancement to be an alternative solution to improve student skills needed by industry in related ongoing development research on designing the ECD learning model for civil engineering education study program.

For discovering the student characteristics authentically, the assessment was carried out when the students were having industrial apprenticeships where student performance can be seen in real-time while working in the workplace and finishing assignments given by the industry. Besides, in industrial working practices, collaborative performance could be revealed when the learners worked in teamwork and socialized with colleagues. Moreover, to get the student skills specifically, this research develops the assessment instrument by extracting the existing curriculum with references and discussing with teachers, lecturers, and involving practicians from the industry. The industries' involvement is necessary. As the vocational school stakeholder, they use vocational school graduates and systematically identify the skills needed to carry out assignments in their specific field of expertise, solve problems, and face the industry's dynamic challenges as an actual

workplace for the students after graduation. The developed instrument for assessing student performance is described through indicators as presented in Table 5.1.

Table 5. 1 Student Skills Indicators for Vocational High School in Construction Drawing

Construction Drawing Skill Indicators	
1	Preparing to draw and making work-time-schedule
2	Implementing the drawing process in the correct procedure
3	Complying with the rules of technical drawing
4	Mastering the drawing plan and construction detail drawing
5	Presenting the drawing project
Collaborative Skill Indicators	
1	Being an active problem solver, giving ideas, and likes discussion
2	Preparing to work with high expectations
3	Willing to work with the team with risks and problems
4	Prioritizing the team choices and expectations
5	Prioritizing collaboration over individual competition
6	Prioritizing team responsibilities and learning interdependence
7	Believing that peer discussion is also a source of learning
8	Giving the colleagues chance and opportunity
9	Building the spirit of lifelong learning
10	Fostering relationships and respect each other

The construction drawing and collaborative skills indicators in Table 5. 1 are used as a reference in formulating the assessment sheet used to assess the performance of apprentice students, which refer to the existing curriculum of 2013 [162][163][164] as the primary reference for the vocational curriculum of civil engineering construction drawing course with building construction competency skill. Simultaneously, the student competency is regarding The Minister of Education and Culture Regulation Number 22 of 2016 concerning the education process standard [165], which changed Regulation Number 65 of 2013. Another reference is The Indonesian National Work Competency Standards, wherein Indonesia known as *Standar Kompetensi Kerja Nasional Indonesia (SKKNI)* for architecture draughtsman [166] as the national standard of an architectural drawing for civil engineering in Indonesia. Simultaneously the study proposes collaborative skill enhancement ever since we believe it helps students learn better and more manageable than beyond mere content and ideas. The collaborative mindset promotes a larger educational agenda, one that encompasses several intertwined rationales [30]. The adult learning principles help facilitate the positive transfer of training and include learning designed in realistic settings as the concept of Brown, Collins, & Duguid, 1989 [167]. Moreover, the teacher realizes that vocational students are self-directed learners, have experiences to share, need motivation as an adult learner, and require project assignment as problem-

centered learning for the learning process related to Knowles, Holton III & Swanson, 2005 proposal [168][169].

The assessment sheet contains 39 statement items, including 29 construction drawing skill items and ten collaborative skill items. The 29 items of drawing skill were sub-indicator translated from five primary drawing skill indicators, presented in Table 5. 1. The indicator of preparing to draw contained: determining the materials and tools needed and define work-time-schedule. The indicator of Implementing the drawing process in the correct procedure contained: setting the drawing software (layers, folders, plot style settings), analyzing the drawing plan (drafts/sketches), and implementing the drawing process. Complying with the rules of the technical drawing includes: applying drawing layout, drawing the construction line, applying the letters writing and symbols, applying drawing title block, drawing the construction shape, applying the drawing scale with the applicable rules, drawing symbols of the building materials according to the applicable rules, drawing construction details, and complete the drawing. The indicator of mastering the drawing plan and construction detail drawing contained: drawing a floor plan, drawing the building view by front-right-left-back-top, drawing section, drawing detailed foundation plan, drawing detailed roof structure, drawing plumbing and mechanical and electrical plan, drawing title block, and setting and implementing plotter printing. Simultaneously, the indicator of presenting the drawing project included: presenting the drawing information verbally also in writing and explaining the arguments of the drawing concept. Furthermore, the collaborative skill indicators were expected to describe student performance when they worked and socialized with the industry's working partners. The indicators were including: being an active problem solver, preparing to work with high expectations, working with the team with risks and problems, prioritizing the team choices, prioritizing collaboration over individual competition, prioritizing group responsibilities and learning interdependence, believing peer discussion is a source of learning, giving the team member opportunity to participate in the project, building the lifelong learning spirit, and fostering relationships and respect each other.

The instrument for collecting variables data in this study was designed into an assessment sheet with rubrics that its validity and reliability examined before the implementation. It was tested by the Aiken V content validity test with the raters' agreement index. The raters consisted of lecturers and industrial practitioners. The validity assumption

of V ≥ 0.40 is considered valid [129][170]. The formula of V is presented in equation 5.(1) below.

$$V = \frac{\sum s}{n(c-1)}$$

$$V_{for\ 39\ items} = \frac{\overline{\sum s}_{for\ 39\ items}}{n(c-1)} = \frac{18.44}{7(4-1)} = 0.88$$

5.(1)

Where, raters agreement index = V, and s = the score assigned by each rater minus the lowest score in the category used (s = r-lo, with r = score assigned by each rater, and lo = the lowest score in the scoring category), n = the number of raters, c = the number of scores which the rater can choose. The Aiken V examination result explicated that the content validity is 0.88. This value is higher than the V index of 0.40. Therefore, it can be defined that the evaluation instruments remain valid.

The assessment instrument's reliability test was performed by the Interclass Correlation Coefficient (ICC) formula with a reliable assumption of more than 0.75 (ICC value ≥ 0.75) [130], where the formula is given as the equation 5.(2).

$$r = \frac{MS_{people} - MS_{residual}}{MS_{people} + \left(df_{people}\ x\ MS_{residual}\right)}$$

$$= \frac{0.26-0.006}{0.26+(6x0.006)} = 0.858$$

5. (2)

Where ICC coefficients = r, MS_{people} refer to the mean square between people, $MS_{residual}$ is the mean square within people residual, and df_{people} refer to the degree of freedom within people. The instrument reliability test results by the IBM SPSS showed that the ICC reliability coefficient value of 0.858 meets the ICC reliability coefficient value ≥ of 0.75. It had met the ICC reliability coefficient value requirement above 0.75, so the assessment instrument sheet's interpretation is confirmed reliable.

5.3.3. Data Analysis

The data analysis technique is descriptive statistics and linear regression analysis. The descriptive analysis is to disclose the vocational student skills scores according to predetermined criteria. Moreover, the linear regression analysis examines the contribution of collaborative skill (X) as independent variables toward construction drawing skill (Y) as the dependent variable. The descriptive statistics explain the construction drawing and

collaborative skills in every aspect of indicators. The study used assessment criteria divided into four categories to interpret the results [131]. presented in Table 5.2 as follows.

Table 5. 2 The Assessment Criteria

Grade Value	Criteria
More than (Mi + 1.5 SDi) (>81.25)	Very Good
Mi – (Mi + 1.5 SDi) (62.5 – 81.25)	Good
(Mi - 1.5 SDi) – < Mi (43.75 – < 62.5)	Fair
Less than (Mi - 1.5 SDi) (<43.75)	Poor

Mi is the ideal Mean, and SDi is the ideal Deviation Standard, where Mi = 1/2 (highest score + lowest score), with the highest score of 100 and the low score of 25. While the SDi = 1/6 (highest score + lowest score). The linear regression as the statistical analysis determines the equation model for predicting the dependent variable's values based on the independent variables' level. The linear relationship model between the X and Y variables in the sample can be described as equation 5.(3) [171][172][173].

$$\hat{Y} = a + bX$$

$\hat{Y}$ = the predictive value of variable Y

X = variable X

a = constant value

b = the regression coefficient of Y on X

5. (3)

Equation (3) pointed $\hat{Y}$ as the predictive value of Y if it is known that a specific value of X, a is a constant value, while b is the regression coefficient of Y toward X. Furthermore, the level of accuracy of a regression line can be seen from the size of the Adjusted R squared (Adjusted R^2). The higher the Adjusted R^2 value, the stronger the regression model's ability to explain the actual conditions. In contrast, the smaller the Adjusted R^2, the more incorrect the regression line represents the observed data [174][175].

Before examining the data by the regression test, the linear regression test requirements were carried out to ensure the data analysis results' accuracy. This study examines the analysis requirements, including normality, linearity, autocorrelation, and homoscedasticity. The first analysis requirement was the normality test. It ensures the data to be normally distributed or not by the Kolmogorov-Smirnov normality test. The normally distributed data assumption is when the Asymp. Sig. (2-tailed) more than 0.05 probability,

the research data will be declared normally distributed. In contrast, if the value of Asymp. Sig. (2-tailed) Less than 0.05 probability means the research data distribution is not normal [176][171][175][172].

The second analysis requirement is to test whether the two variables have a significant linear relationship by looking at the Anova Output Table with two ways assumption. The first is comparing the value of Sig. on Deviation from linearity with 0.05 probability. Suppose the value of Sig. on Deviation from linearity is More than 0.05 probability. In that case, it means there is a significant linear relationship between X and Y. In contrast, if Sig. on Deviation from linearity is Less than 0.05 probability, it means there is no significant linear relationship between X variable and Y variable. The second is by comparing the F-count with F-table, assuming F-count is Less than the F-table with 0.05 probability. It is written in the critical value table of F distribution, which means there is a significant linear relationship between the X and Y variables [171][172][175][176].

The research performed an autocorrelation test as the third analysis requirement to confirm the data is independent, and there is no autocorrelation in the residue by using the Durbin-Watson test. The assumption is by comparing d (or 4 - d, whichever is closer to zero) with d_L and d_U in Table of Significance Points of d_L, and d_U: 5% [176]. If $d < d_L$, it concludes that positive serial correlation is possible; if $d > d_U$, there is no serial correlation. (If $4 - d < d_L$, it concluded that negative serial correlation is possible; if $4 - d > d_U$, there is no serial correlation). If the d (or 4 d) value lies between d_L and d_U, it means the test is inconclusive [171][172][175][176].

The fourth analysis requirement is the heteroscedasticity test, which is carried out to determine whether the absolute residual variation is the same or not. If only the heteroscedasticity test is not fulfilled, the assessment will no longer be efficient in small and large samples, and the coefficient estimation can be assumed less accurate [172]. The analysis used to detect the presence or absence of heteroscedasticity was the Spearman rank test. The assumption, if the value of Sig. (2-tailed) More than 0.05 probability, it means there is no heteroscedasticity. On the other hand, if the value of Sig. (2-tailed) Less than 0.05 probability, it means there is heteroscedasticity. Secondly, the assumption of Spearman correlation coefficient arithmetic ($r_{s\ count}$) Less than $r_{s\ table}$ with 0.05 probability is written in the Critical Value Table of Spearman correlation distribution, which means heteroscedasticity does not occur [172][176].

The linear regression analysis was implemented in two ways. The first is by comparing the value of Sig. with 0.05 probability (alpha=0.05). The assumption, if the value of Sig. Less than 0.05 probability means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. With an interpretation, there is a significant and positive effect of collaborative skills toward construction drawing skills, at the contrary, if the value of Sig. More than 0.05 probability means the Null Hypothesis is accepted, and the Alternative Hypothesis is rejected. With an interpretation of there is no significant positive effect of collaborative skills toward construction drawing skills. The second is by comparing the t-count with the t-table of 0.05 probability (2-tailed) written in the critical value table of the t distribution. The assumption, if t-count More than the t-table of 0.05 probability (2-tailed), which means the Null Hypothesis is rejected and the Alternative Hypothesis is accepted, the interpretation, there is a significant and positive effect of collaborative skills toward construction drawing skills. In contrast, if the t-count Less than the t-table of 0.05 probability (2-tailed) means the Null Hypothesis is accepted, and the Alternative Hypothesis is rejected, the interpretation, there is no significant positive effect of collaborative skills toward construction drawing skills [171][172][175][176].

5.4. Result

5.4.1. Descriptive Statistics and Test of Analysis Requirement

The assessment sheet consists of 39 statements, including 29 items for construction drawing skills indicators and ten items for collaborative skills indicators. Construction drawing skill 100% criterion was 29 x 4 = 116, and collaborative skills 100% criterion was 10 x 4 = 40. The analysis examines these two aspects by descriptive statistics and regression.

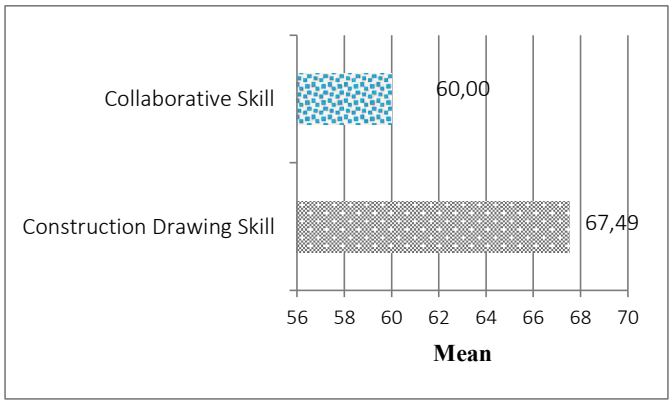


Figure 5. 1 Students' Construction Drawing Skill and Collaborative Skill Score

The analysis result of student construction drawing skills was in a Good category of 67.49 for the mean value; it is on a scale of 100.On the other hand, the student collaborative skill was 60.00 for the mean value on a scale of 100. The collaborative skill results are in a Fair category.We can see the result of students' skills assessment scores in Figure 5.1 and the frequency distribution in Figure 5.2.

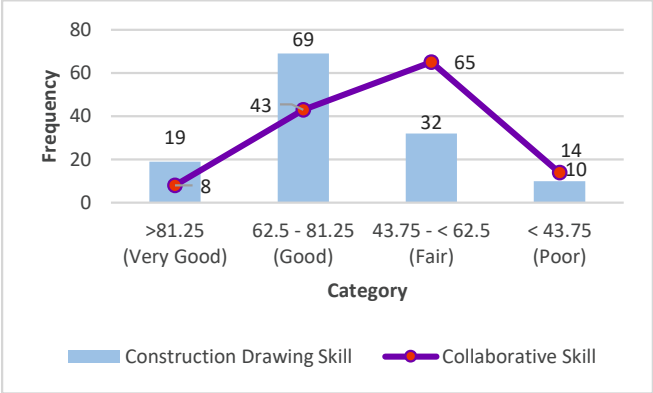


Figure 5. 2 Frequency Distribution of Construction Drawing and Collaborative Skill

Before the linear regression examination, in the beginning, the study conducted the four-analysis requirement test. Firstly, a normality test was conducted to discover the data normality condition by the Kolmogorov-Smirnov normality test. The normality assumption is when the Asymp. Sig. (2-tailed) More than 0.05 probability, then it declared the data distribution is normal. On the contrary, if the value of Asymp. Sig. (2-tailed) Less than 0.05 probability means that the data is not normally distributed [171][175][174][176]. According to Table 5. 3, the result of the Kolmogorov-Smirnov test, the value of Asymp. Sig. (2-tailed) is 0.093, More than 0.05, so it can be concluded that the data distribution is Normal. Thus, the requirements and assumptions for normality in using the linear regression test have been fulfilled. A summary of normality tests presented in Table 5.3.

Table 5. 3 The Summary of Normality Test Result

Variable	Asymp. Sig. (2-tailed)	Conclusion
X-Y	0.093	Normal

After the normality test as the first analysis requirement examination was successfully conducted with an expected result, the study then conducted the second analysis requirement examination, the linearity test. The result was analyzed using two ways. The first is by comparing the significance value with 0.05 probability. If the Sig. Value on Deviation from linearity More than 0.05, there is a significant linear relationship

between the independent (X) and dependent (Y) variables. In contrast, if Sig. Value on Deviation from linearity is Less than 0.05 probability, which means there is no significant linear relationship between X and Y [171][172][175].

The second way is by comparing the F-count with F-table, with an assumption of F-count Less than the F-table with 0.05 probability, which the F-table was written in the critical value table of F distribution, which means there is a significant linear relationship between X variable and Y variable. The summary of linearity test data is presented in Table 5.4 as follows.

Table 5. 4 The Summary of Linearity Test

		df	**F**	**Sig.**	**Conclusion**
X-Y	Deviation from Linearity	23	1.193	0.268	Linear
	Within Group	105			

According to Table 5.4, the linearity test, Sig's value on Deviation from linearity is 0.268 More than 0.05 probability, which means there is a significant linear relationship between collaborative skills (X) and construction drawing skills (Y). Secondly, the F-count is 1.193, Less than F-table is 1.63, and the F table is obtained by looking at the F value in the critical value table of F distribution guided by the df value of Deviation from linearity is 23, df Within Group is 105, with a probability of 0.05, the F table is 1.63. It means there is a significant linear relationship between X variable and Y variable. Thus, the requirements and assumptions for linearity in using the linear regression test have been fulfilled.

After finishing the first and second requirement analysis, the study conducted the third requirement examination, autocorrelation test, to confirm the data is independent and there is no autocorrelation in the residue by using the Durbin-Watson test. The assumption is by comparing d (or 4 - d, whichever is closer to zero) with dL and du in Table of Significance Points of d_L and d_U: 5%. If $d < d_L$, it concludes that positive serial correlation is possible; if $d > d_U$, there is no serial correlation. (If $4 - d < d_L$, it concluded that negative serial correlation is possible; if $4 - d > d_U$, there is no serial correlation). If the d (or 4 d) value lies between d_L and d_U, it means the test is inconclusive [171][172][175]. The summary of the data autocorrelation test is presented in Table 5.5 as follows.

Table 5. 5 The Summary of Autocorrelation Test

	Durbin-Watson (d)	**4-d**	**d_L**	**d_U**	**k,n**	**Conclusion**
X-Y	2.0007	1.993	1.692	1.726	1,130	No Autocorrelation

From Table 5.5, the summary of autocorrelation test, where critical values for probability level α is 0.05, d is Durbin-Watson value, respectively called (d_L, d_U) where L = Lower and U = Upper, these are given for various numbers of observations n, and k is predictor variables. According to the autocorrelation test, the value of d is 2.0007 More than d_U is 1.726, which means there is no serial correlation. After that, 4 - d is 1.993 More than d_U is 1.726, which means there is no serial correlation. So, it can be concluded that the data is independent, and there is no autocorrelation in the residue. Thus, the requirements and assumptions for no autocorrelation in using the linear regression test have been fulfilled.

After the first, second, and third requirement analysis was successfully implemented, the next activity was carrying out the fourth analysis requirement test, the heteroscedasticity test, which was conducted to determine whether the absolute residual variation is the same or not. If heteroscedasticity is not fulfilled, the assessment will no longer be efficient in both small and large samples, and the coefficient estimation can be said to be less accurate [172]. The analysis used to detect the presence or absence of heteroscedasticity was the Spearman rank test. The assumption, if the value of Sig. (2-tailed) More than 0.05 probability, it means there is no heteroscedasticity. In contrast, if the value of Sig. (2-tailed) Less than 0.05 probability means there is heteroscedasticity. Secondly, the assumption of Spearman correlation coefficient arithmetic ($r_{s\ count}$) Less than $r_{s\ table}$ with 0.05 probability written in the Critical Value Table of Spearman correlation distribution, which means heteroscedasticity does not occur [175][172][176][174]. A summary of the data heteroscedasticity test is presented in the Table 5.6 below.

Table 5.6 The Summary of Heteroscedasticity Test

Spearman's rho	**Sig. (2-tailed)**	**Correlation Coefficient ($r_{s\ count}$)**	**df**	**$r_{s\text{-}table}$ with 0.05 probability**	**Conclusion**
Collaborative skill	0.149	0.127	128	0.197	No heteroscedasticity

According to Table 5.6, the heteroscedasticity test showed that the value of Sig. (2-tailed) is 0.149, it is More than 0.05 probability, which means there is no heteroscedasticity. While $r_{s\ count}$ = 0.127 Less than $r_{s\ table}$ is 0.197, it means there is no heteroscedasticity. Where $r_{s\ table}$ obtained by looking at $r_{s\ table}$ with 0.05 probability dan df 128 pada critical value table of Spearman correlation distribution, so it can be concluded that the data there is no heteroscedasticity. Thus, the requirements analysis and assumptions for no heteroscedasticity in using the linear regression test have been fulfilled.

5.4.2. Data Analysis Result

The purpose of this study is to provide accurate information about the characteristics of vocational students. The phenomena that occur in the research variables are analyzed to find the cause and effect of the problem to formulate proposals for the right solution to solve the problem. After completing the analysis requirement test, the next step is to test the hypothesis using regression analysis. Data analysis was aimed to examine the contribution of the independent variables of collaboration skill (X) toward the construction drawing skill (Y) as the dependent variable. The regression analysis was employed in two ways. Firstly, by comparing the value of Sig. with 0.05 probability. The assumption, if the value of Sig. Less than 0.05 probability means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. With an interpretation, there is a significant and positive influence of collaborative skills toward construction drawing skills, on the contrary, if the value of Sig. More than 0.05 probability means the Null Hypothesis is accepted, and the Alternative Hypothesis is rejected. With an interpretation, there is no significant positive influence of collaborative skills toward construction drawing skills. Secondly, by comparing t-count with t-table of 0.05 probability (2-tailed) written in the critical value table of the t distribution. The assumption, if t-count More than the t-table of 0.05 probability (2-tailed), which means the Null Hypothesis is rejected and the Alternative Hypothesis is accepted, the interpretation, there is a significant and positive influence of collaborative skills toward construction drawing skills. In contrast, if the t-count Less than the t-table of 0.05 probability (2-tailed) means the Null Hypothesis is accepted, and the Alternative Hypothesis is rejected, the interpretation is no significant positive influence of collaborative skills toward construction drawing skills [171][172][175][176]. We can see the linear regression analysis result between (X) variable and (Y) variable in Table 5.7.

Table 5. 7 Summary of Regression Analysis

	R	R Square	Adjusted R Square	t-count	df	t-table	Sig.
X-Y	0.644	0.415	0.41	9.524	128	1.96	0.000

According to Table 5.7, the summary of regression analysis displays several analysis results, including the existing variables, the value of R, R squared, Adjusted R Squared, t-count, df, t-table, and Sig. Value. The table explains that the correlation coefficient of collaborative skills (X) is r = 0.644 with a positive value from the analysis results. While Sig's value = 0.000, Less than 0.05 probability, it means the Null Hypothesis

is rejected, and the Alternative Hypothesis is accepted. With an interpretation, there is a significant and positive influence of collaborative skill toward construction drawing skill.

Furthermore, t-count = 9.524 is More than t-table = 1.96, where t-table obtained by looking at t-table value in the Critical Value Table of t Distribution with guided from the df value = 128 with 0.05 probability. It is obtained 1.96 for the t-table, which means the Null Hypothesis is rejected and the Alternative Hypothesis is accepted. The interpretation, there is a significant and positive influence of collaborative skills (X) toward construction drawing skills (Y). The coefficient of determination or the contribution (R squared) of collaborative skill variables (X) on the construction drawing skill variable (Y) is 41.50% (0.415). According to the regression analysis results, the interpretation is collaborative skills (X) contribute 41.50% to the construction drawing skill (Y).

The coefficient of determination (R squared) value varies from zero to one. It means that the higher the R squared value indicates that the dependent variable (Y) variance can be explained by the independent variable (X) and vice versa. However, the higher the R squared does not automatically describe the relationship between variables in the model, primarily whenever other independent variables were added, the more independent variables used, the more "noise" in the model. Therefore, to determine the predictor's contribution to the regression model, this study used the Adjusted R squared, where the value is not biased towards the number of predictors in the model. According to Duncan et al., the linear regression model categorized by Adjusted R squared values, where 0.70 is strong, 0.45 is moderate, and 0.25 is weak [174][175]. The greater the Adjusted R squared value, the better the predictor model explains the dependent variable's variance. Based on the regression analysis, the Adjusted R squared value of 0.410. It can be concluded that the regression model category is moderate, which means the collaborative skill as a predictor model can explain variants of construction drawing skill variable in the moderate category.

Table 5. 8 Regression Analysis

Coefficients[a]

Model		Un Standardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	31.443	5.042	0.644	6.236	0.000
	Collaborative skill	1.952	0.205		9.524	0.000

a. Dependent Variable: Construction Drawing Skill

Based on the regression analysis results shown in Table 5.8, the constant value is 31.443, the regression coefficient of Y on X is 1.952. In line with equation (3), the

regression equation for the linear regression model becomes $\hat{Y} = 31.443 + 1.952X$. Furthermore, Table 5.8 clearly shows a significant and positive effect of collaborative skills (X) toward construction drawing skills (Y), which is proven by the results of Sig. Value of 0.000, Less than 0.05 probability, means there is a significant and positive effect of collaborative skills (X) toward construction drawing skills (Y). After that, the t-count is 9.524 More than the t-table of 1.96, which means there is a significant and positive effect of collaborative skills toward construction drawing skills. Furthermore, the correlation coefficient is 0.644, the coefficient of determination (R-squared) of collaborative skill variables (X) on the construction drawing skill variable (Y) is 0.415, and the Adjusted R-squared of 0.41. It can be concluded that the variable X as a predictor in the regression model includes the moderate category [174], which gives a 41% contribution in explaining the variants of the construction drawing skill (Y) as the dependent variable.

5.5. Discussion

5.5.1. Summary of Principal Findings

The study has carried out a series of analyses, including descriptive and inferential statistics with regression analysis, besides confirming the analysis requirements by examining the analysis requirement test in ensuring instrument feasibility with validity and reliability test by Aiken V and ICC for the instrument employed. From the result of the descriptive statistics, the study tried to show the investigation's critical finding as valued information needed to enhance learning outcomes in a vocational environment. A fundamental finding of the descriptive analysis is presented in Table 5.9, three students' collaborative skills indicators with the lowest score that need to have further followed up. The first is prioritizing collaboration over individual competition, and secondly, prioritizing team responsibilities and learning interdependence. Moreover, the third, prioritizing the team choices and expectations.

Table 5. 9 Summary of Three Lowest Collaborative Skill Indicators

Indicator Number	Collaborative Skill Indicators	Mean	Category
5	Prioritizing collaboration over individual competition	54.42	Fair
6	Prioritizing team responsibilities and learning interdependence	55.77	Fair
4	Prioritizing the team choices and expectations	56.15	Fair

Having implemented the descriptive analyses, examined the regression analysis requirement, and finished the linear regression analysis, then this study obtained the results

and unveiled the hypothesis. The regression analysis test has given a value of Sig. = 0.000, Less than 0.05 probability means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. So, there is a significant and positive influence of collaborative skill (X) toward construction drawing skill (Y). Moreover, the t-count = 9.524 is More than t-table = 1.96 (from the Critical Value Table of t Distribution with referred the df = 128 of 0.05 probability). So, the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. It can be concluded there is a significant and positive influence of collaborative skill (X) toward construction drawing skill (Y).

Furthermore, the analysis has presented a linear regression model $\hat{Y} = 31.443 + 1.952X$. It also exhibited a correlation coefficient of 0.644, a coefficient of determination (R-squared) of 0.415, and an Adjusted R-squared of 0.410 where it can be concluded that the independent variable, collaborative skill (X) can explain the variants of the dependent variable, construction drawing skill (Y) with 41% contribution.

According to Duncan et al., the linear regression model categorized by Adjusted R squared values, where 0.70 is strong, 0.45 is moderate, and 0.25 is weak [174]. In comparison, the collaborative skill R squared value includes near the moderate category. It reinforces us in our efforts to develop students' collaborative mindset, whereby developing this collaborative mindset, students realize and have strong motivation to improve their collaborative skills. In line with Weinstein and Hume, every student plays an integral role in his individual learning experience to achieve learning goals [177][178]. Therefore, the research tries to make students aware of collaborative skills for their better future. The learners' awareness of their collaborative skills will increase the construction drawing skill. Statistically, the research gives the linear regression model with 41% contribution of collaborative skills toward construction drawing skills.

Murphy and Alexander strengthened, where the collaborative learner enjoys working in a group or cooperative learning to achieve a specific learning goal [179]. Besides collaborative learner often minimizes the learning problem and often breaks down tasks into specific roles that are then assigned to members of the group [177]. It gives a better advantage to vocational education when the students learn in the class, workshop, and workplace as industrial apprenticeships. Furthermore, collaborative skills are also indispensable skills in the world of work, the industry's need for collaborative skills is an absolute necessity. According to Jerald and Laux et al., employers' expectations for

employees in the workplace are to adapt to change, use critical thinking skills, and collaborate professionally [180]. Collaborative work is more productive because many works are becoming too heterogeneous for one person to achieve ultimately [181]. While the industry is the center of productions, a gathering place for work in teams that produce all products, goods, or services is impossible to work individually but collaboratively.

5.5.2. Unique Phenomenon of Collaborative Skill in Indonesia

The frequency distribution of collaborative and construction drawing skill scores illustrated in Figure 5.2 shows that most students get a Fair category of collaborative skill, 65 students, 43 students in a Good category, eight students in the Very good category, and 14 in a Poor category. While the regression analysis speaks the collaborative skill (X) has a significant and positive influence on construction drawing skill (Y), with a 41% contribution. According to the analysis and discussion, it is possible to improve the contribution by giving special attention to the students' specific behavioral details related to the collaborative skill indicators and managing students' collaborative mindset. The resulting statistical figures should be discussed in detail by tracing each indicator item used to measure the skills studied. It is necessary, considering that the collaborative skill indicator items have specific behavioral details that need to be observed one by one.

Table 5. 10 Lowest Collaborative Skill Indicators for Each Zone from Descriptive Analysis Result

Indicator Number	Collaborative Skill Indicators	Research Zone
6	Prioritizing team responsibilities and learning interdependence	Yogyakarta (DIY)
5	Prioritizing collaboration over individual competition	
4	Prioritizing the team choices and expectations	
4	Prioritizing the team choices and expectations	Surakarta (Central Java)
5	Prioritizing collaboration over individual competition	
1	Being an active problem solver, idea maker, and like discussion	
5	Prioritizing collaboration over individual competition	Cilacap (Central Java)
7	Believing that peer discussion is also a source of learning	
6	Prioritizing team responsibilities and learning interdependence	
5	Prioritizing collaboration over individual competition	Sorong (Papua)
6	Prioritizing team responsibilities and learning interdependence	
4	Prioritizing the team choices and expectations	

Regarding collaborative skill indicators, there are details of specific skills and behaviors that need to be observed rigorously. From the fundamental finding described in Table 5.9, it is clear that the lowest score needs further follow-up. The first lowest score of prioritizing collaboration over individual competition plays a vital role in collaborative

skills. A collaborative student is supposed to be collaborative-minded, not an individualist one. The study discovers the vital indicator of prioritizing collaboration over the individual competition to be the lowest one. Therefore, the next activity is encouraging students to gain this low indicator score. At the same time, the different conditions of each student are also needed to be considered seriously. It is in line with the different school conditions and the area where the school is located. The personal conditions of the students and their families are also different. The customs and culture of each area have different conditions and characteristics. These differences could lead to different habits, motivations, and behaviors, thus making the characteristics skills different.

From the analysis discoveries, each research zone presented different collected data of students' collaborative skills. As described in Table 5.10, it is manifest that each research zone gives different data. The lowest score between each zone is different from one another. The first lowest score of Yogyakarta is prioritizing team responsibilities and learning interdependence. While in Surakarta, the first lowest score is prioritizing the team choices and expectations. Follow by Cilacap with the first lowest score of prioritizing collaboration over individual competition, and Sorong with the first lowest score of prioritizing collaboration over individual competition.

Indonesia has an extreme cultural diversity. There are many ethnic groups in Indonesia's territory; each tribe has its language and culture. Indonesia is an island country with approximately nine million km^2, which is located between two oceans and two continents with 17,500 islands with a coastline of about 95,181 km [182]. Every island in Indonesia has its original tribe, islands like Kalimantan and Papua have tens or even hundreds of tribes who live there.

This high social heterogeneity requires different treatment from other countries that have more homogeneous conditions. For example, Japan has low heterogeneity. Japanese society tends to be relatively homogeneous, and society's character that obeys the rules causes this condition to be well preserved. This condition generally provides excellent opportunities for students in Japan to have high collaborative skills easily. Students in Japan are educated from an early age with an educational pattern that prioritizes togetherness and does not overly emphasize individual competition. This Japanese culture of togetherness provides support for students to work together in achieving community goals. In Japan, the government delivers the holistic education system effectively, teachers are skilled and take

good care of all the students, students participate and work collaboratively, parents support extra learning after school, and learning support by communities. All parts of the educational system working together cohesively [183].

Table 5. 11 Summary of Students' Collaborative Problem Solving, Programme for International Student Assessment (PISA)

Rank	Country	Students' Collaborative Problem Solving		
		All Student	Boys	Girls
		Mean Score	Mean Score	Mean Score
2	Japan (East Asia)	552	539	565
13	USA (America)	520	507	533
44	Thailand (Southeast Asia)	436	416	451
-	Indonesia (Southeast Asia)	-	-	-

Source: OECD, PISA 2015 [184]

Table 5.11 speaks about the OECD Programme for International Student Assessment (PISA) 2015 [184]. Across OECD countries, 8% of students are top performers in collaborative problem solving, meaning that they can maintain an awareness of group dynamics, ensure team members act following their agreed-upon roles, and resolve disagreements and conflicts while identifying efficient pathways and monitoring progress towards a solution. Students in Japan are the second higher in collaborative problem solving than students in all other countries, followed by students in Japan. The United States is at the 13th, and Thailand is at the 44th position, while Indonesia is still not joint the assessment.

In the United States, collaborative lesson research focused on implementing the new learning standards piloted at 15 urban schools improved teaching and learning within the team and improved teaching and learning more broadly [185]. Research by Heng Yu-Ku et al. in the USA shows that the learners believe working in a group improve the quality of work because each step of the learning process is verified and corrected by group members, the learners were able to discuss and understand each other perspective of the reading materials, and what is needed to complete the assignment [186]. So far, there is not much data on Indonesian students' collaborative assessments carried out internationally by independent institutions, which can be a definite reference. Therefore, this study is expected to become an authentic reference for designing a vocational lesson and learning strategy following students' actual condition.

5.5.3. Students' Skill Achievement Characteristics

It is necessary to observe the students' behaviors. Learners automatically form their skills by implementing the learning experiences they had in the class and interacting with

the peers in a dynamic environment. The observation began by analyzing the descriptive statistics from the students' performance related to the collaborative skill and construction drawing skill. The frequency distribution analysis of the mean score of the collaborative skill and construction drawing skill that refers to the assessment criteria in Table 5.2 can be grouped into four criteria conditions as shown in the following Figure 5.3.

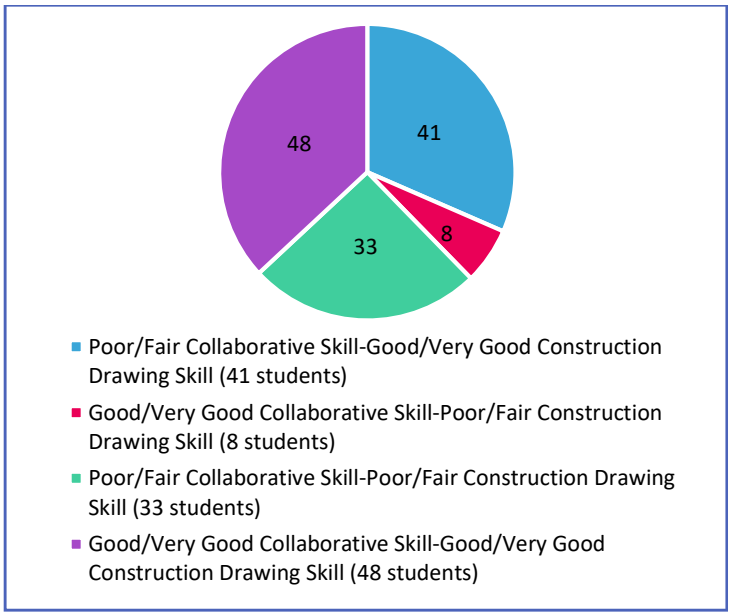


Figure 5. 3 Students' Skill Characteristics Related to the Level of Collaborative Skill and Construction Drawing Skill Criteria

According to Figure 5.3, students' characteristics related to the collaborative skill and construction drawing skill could be observed by comparing each students' skill characteristics in the four-level category as follow:

1) Poor/Fair collaborative skill - Good/Very Good construction drawing skill
2) Good/Very Good collaborative skill - Poor/Fair construction drawing skill
3) Poor/Fair collaborative skill - Poor/Fair construction drawing skill
4) Good/Very Good collaborative skill - Good/Very Good construction drawing skill.

Figure 5.3 speaks that there are 41 students with Poor/Fair collaborative skill - Good/Very Good construction drawing skill, eight students with Good/Very Good collaborative skill - Poor/Fair construction drawing skill, 33 students with Poor/Fair collaborative skill - Poor/Fair construction drawing skill, and 48 students with Good/Very Good collaborative skill - Good/Very Good construction drawing skill. Figure 5.3 shows that more than one-third of students got a non-linear score. There are 49 students from the total samples of 130, including 41 students with poor/fair collaborative skills, on the other

hand, getting good/very good construction drawing skills, and eight students with good/very good collaborative skills and at the same time getting poor/fair construction drawing skills.

The hypothesis claimed a significant and positive influence of collaborative skill (X) toward construction drawing skill (Y). It is a fact that the regression analysis test has given a value of Sig. = 0.000, Less than 0.05 probability means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. Moreover, the t-count = 9.524 is More than t-table = 1.96 (from the Critical Value Table of t Distribution with referred the df = 128 of 0.05 probability). So, it is emphasized that the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. It can be concluded there is a significant and positive influence of collaborative skill (X) toward construction drawing skill (Y). On the other hand, the analysis has presented the Adjusted R-squared of 0.410, which means that collaborative skill (X) contributes 41% to explain the dependent variable's variants, construction drawing skill (Y). According to Duncan et al., it is in a moderate category. It is also a fact that there are 48 students with a linear score result, Good/Very Good collaborative skill - Good/Very Good construction drawing skill and 33 students with Poor/Fair collaborative skill - Poor/Fair construction drawing skill.

Hence, the students' skill condition is still good, where the collaborative skill (X) as a predictor contributes in a moderate category. There is a possibility to increase the skills systematically by designing a lesson and learning strategy following the students' characteristics.

5.5.4. Students' Skill Characteristics Review

The research finds almost one-third of the students have a high construction drawing skill score, but on the contrary, their collaborative skill is lower than their construction drawing skill score. Besides, there are 6% of the sample, eight students with a high collaborative skill score, and at the same time, they have a Low construction drawing skill. These conditions practically need to be concerned and given special attention to reveal the phenomenon, propose solutions, and provide special treatment to get better learning outcomes for the students and a feasible learning model for the researcher to be designed. From an interview with the head of a vocational civil engineering education study program in Surakarta, some students were accustomed to having independent education, facing

various problems without others' help, doing all tasks individually, having self-responsibility, and living in an individualist family.

In line with Popov et al., with research of perceptions and experiences of university students in culturally diversified, where students from an individualist cultural background resulted in a more negative perception of collaborative learning and students from an individualist cultural background achieved better learning outcomes than did students with a collaborative background, regardless of group composition [187]. These findings suggest that cultural background adds a vital dimension to collaborative learning, which requires students to manage collaboration that is not only virtual but also intercultural.

While Montgomery and Groat also align it with comparative analysis research of the relationship between learning styles and student performance, where competitive learners often see all students in the class as working towards the same goal of learning. However, the competitive learner wants to become the first in achieving that goal and achieve that goal more outstandingly than the peers [188][177]. This kind of education is usually meet in many families in Indonesia. According to an interview in a group discussion with 13 vocational teachers and lecturers, many parents encourage their children to get high grades at school, and even they prefer their children to be considered the smartest student in the class. They assume that class is the stage of the championship. On the contrary, some students who live with a collaborative family are accustomed to cooperating, helping each other, and caring for the environment. While the result of descriptive analysis of students' skill achievement characteristics in Figure 5. 3 shows the percentage of the students' achievement as follow:

1) 31.54% students with low collaborative skill and high construction drawing skill
2) 6.15% students with high collaborative skill and low construction drawing skill
3) 25.38% students with low collaborative skill and low construction drawing skill
4) 36.92% students with high collaborative skill and high construction drawing skill.

From those four characteristics, it can be classified into two groups:

1) Linear score group, which can be interpreted as the collaborative group, 25.38% and 36.92% = 62.31%
2) Non-linear score group, which can be interpreted as the non-collaborative group, 31.54% and 6.15% = 37.69%.

The classification above shows a more considerable percentage of students in the collaborative group than the non-collaborative group, 62.31%:37.69%. It is indicated that most of the student accepts the collaborative approach, while at the regression result it stated there is a significant and positive contribution of collaborative skill toward construction drawing skill. Furthermore, regarding the research finding, the designing of the ECD learning model will consider observing the students' perception and satisfaction with the proposed learning model to adapt the student needs, primarily to accommodate the non-collaborative students.

The adaptation for the uncollaborative group is expected to be a friendly solution for heterogeneous students in Indonesia. It is in line with Islam as the majority religion in Indonesia encourages collaboration which teamwork, democracy, and leadership are promoted in all aspects of life. As the concept of shura, a part of Islamic teaching, is considered a significant attribute for successful leadership and managerial in collaborative teamwork [154][189][190][191]. Moreover, from the perspective of a collaborative mindset, it is believed that one person's success depends on the group's success referred to a collaborative setting as a positive interdependence [192][193]. Empowering students through developing a collaborative mindset is the right alternative solution. It is recommended to prepare a lesson and learning strategy following the students' characteristics to improve collaborative skills that emphasize prioritizing collaboration between peers and learning interdependence, strengthen and develop the students' collaborative mindset to optimize collaborative skills to gain essential civil engineering competencies, especially construction drawing skills.

5.6. Conclusion

After obtaining the results and discussion, the study exposed the hypothesis with the Null Hypothesis (H_0) is rejected, and the Alternative Hypothesis (Ha) is accepted. There is a significant and positive influence of collaborative skill (X) toward construction drawing skill (Y). Besides, the analysis has presented a linear regression model $\hat{Y} = 31.443 + 1.952X$. It also exhibited a correlation coefficient of 0.644, a coefficient of determination (R-squared) of 0.415, and an Adjusted R-squared of 0.410 where it can be concluded that the collaborative skill variable (X) as a predictor in the regression model includes the moderate category, which gives a 41% contribution in explaining the variants of the construction drawing skill (Y) as the dependent variable. While the descriptive analysis

results showed the collaborative skill is in a Fair category of 60.00, and the construction drawing skill is in a Good category of 67.49 on a 100 scale.

On the other hand, however, the collaborative skill (X) has a significant and positive influence on construction drawing skill (Y), with a 41% contribution. According to the discussion, it is possible to be improved by giving special attention to the students' specific behavioral details related to the collaborative skill indicators and managing students' collaborative mindset.

Students' various customs and cultures offer different characteristics, which lead to different motivations, habits, and behaviors, thus making different collaborative mindsets that build different collaborative skills and construction drawing skills.

Indonesia has an extraordinary cultural diversity with various social heterogeneity that requires different treatment to develop a better collaborative mindset. Regarding the finding of students' skill achievement characteristics, the designing of the ECD learning model will consider observing the students' perception and satisfaction of the proposed learning model to accommodate the demand of the non-collaborative students.

The next activity is preparing a lesson and learning model to improve the collaborative mindset that emphasizes prioritizing collaboration between peers and learning interdependence.

The lesson and learning model will be designed to strengthen and develop the students' collaborative mindset to optimize collaborative skills and gain construction drawing skills. Besides increasing the construction drawing skills, collaborative skill is also indispensable for survival and work properly in the industry.

CHAPTER 6 DESIGNING THE E-VOCATIONAL CONSTRUCTION DRAWING (ECD) LEARNING MODEL

6.1. Summary

This chapter is a designing phase of the ECD learning model as a part of developing research for developing a relevant learning model to improve student skills to provide the industry requirement. The study aims to design the ECD and evaluate its feasibility for a learning model for the civil engineering education program's CAD construction drawing course. The learning model implements Regulation Number 44, 2015, Article 17 of The Minister of Research, Technology and Higher Education of the Republic of Indonesia, employs flipped classroom as the strategy for managing the meeting schedule, and adapts the project-based learning with the e-vocational learning platform support. It supports collaboratively learning in or outside the class and changes negative feelings such as feeling anxious and failing to learn in the class with a positive mindset. It uses blended online platforms, including WordPress, SNS WhatsApp, the eFront LMS, YouTube, Zoom, Imgbb, and Google Apps for Education that integrated into a learning package for better advantages. The platform provides a project showroom, collaborative learning material and creates tutorial videos from students' assignments. Nine raters evaluate the ECD in technology, pedagogy, and content knowledge expertise on the alpha testing. Furthermore, the beta testing is including preliminary field testing involving seven students and field testing involving 30 students of a civil engineering education study program. The alpha testing results from the nine raters' assessments are (1) technology 91.11, (2) pedagogy 93.15, and content knowledge 91.30 on a scale of 100. While the beta testing result of the preliminary field testing is 82.94, and the field testing is 85.31 on a scale of 100. The conclusion stated that the ECD learning model for the CAD construction drawing course is declared feasible to be used and recommended for further development.

Keywords: ECD learning model, flipped classroom, collaborative, learning experience

6.2. Introduction

UN SDG4 education agenda is indispensable for national development, especially on creating a skilled and competent workforce in their fields to get decent work to ensure society's welfare [3][2]. Nowadays, Indonesia is undergoing a transformation stage towards a knowledge economy, employment performance growth, skill gaps between labor and the industry requirement are seen as significant barriers in developing this country [7][8][9].

The employment performance growth for increasing better industrial production needs to be prioritized, while vocational education as the primary resources of the potential human resources to be skilled and trained employees in increasing economic development to achieve a wealthy and stable country is an important work to be attempted [10][11][6]. Vocational education has a decisive role in developing the employer's quality and promoting welfare to respond to social and economic interests. Vocational students should be ready to be professional, provide services for business ventures, having economic value, producing better commodities and services to meet society's needs [12][13]. Carrying out proper apprenticeship accompanied by learning in the classroom and adopting work conditions is needed to train students to be technically skilled and adapt quickly in the workplace. Besides the technical skill enhancement and technological development, a crucial part of the strategy also concerns the work application and the adoption by actual practices in the industry [23].

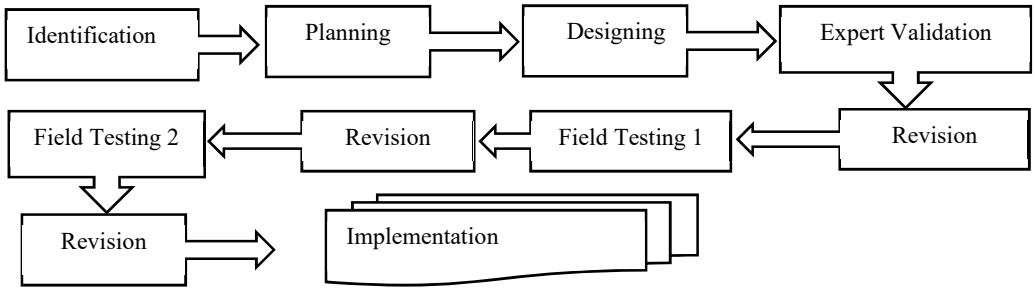
The specific and various learning facilities and equipment for each expertise make the condition more difficult for vocational education providers to realize an excellent vocational school. Instead of creating a perfect vocational school that can produce graduates ready to work, many schools have difficulty keeping minimum operation sustainably. Many vocational schools closed because they could not finance educational operation, which is relatively expensive, and many requirements must be fitted as the right workforce providers [24][25]. This research was initiated from the concern over the harsh conditions in which vocational education must educate students to become trained graduates who can adapt well in the workplace but with limited expenses. The collaborative skill then became the main idea to decompose the project-based learning approach and adapt them into the contextual vocational condition using the flipped learning strategy supported by e-learning.

6.3. Methods

6.3.1. Research Method

After conducting several preliminary research in the previous chapter, This study carried out the developmental research phase with a developmental method adopted from the Borg and Gall model 1983 [12][114][194][195][196] with an adaptation procedure of Sugiyono 2019 [197]. It begins with identification, survey, course review, determining course subject, facility needs, and student readiness investigation. After determining the course and identifying the student's facility needs and readiness. Investigation research was

conducted to reveal the student skill condition to support the planning and using the data to design the learning strategy and e-learning.



Adapted from Sugiyono 2019 [197]

Figure 6. 1 The Development Steps of the Designing Phase

The developing phase involving nine raters to assess the ECD learning model in the stage of alpha test with assessment instrument is developed by adapting the Technological Pedagogical Content Knowledge (TPACK), the Unified Theory of Acceptance and Use of Technology (UTAUT), and the Technology Acceptance Model (TAM). The development study then revises the ECD according to the assessment in the alpha test. The next step is to examine the design by preliminary field testing and revision followed by second field testing. The evaluation uses the Kirkpatrick model's reaction stage. The field-testing result recommends the model. If the field testing states that the result is feasible, the model is declared feasible and ready to use for implementing the learning in the class.

The alpha test involves nine raters to assess the ECD learning model. The assessment instrument was developed by adapting the TPACK, UTAUT, and the TAM. The development study then revises the ECD according to the assessment in the alpha test. The next step is examining the design by preliminary field testing and revision followed by field testing. The evaluation uses the Kirkpatrick model's reaction stage. The field-testing result recommends the model to be feasible or not. If the result is feasible, then the model will be implemented.

6.3.2. Population and Sampel

This research started from a learning condition in a civil engineering education study program with limited computer equipment facilities for drawing. The learning model development was started from this study program, while it will be developed for a wider area for the long term. The population of this chapter are the second-year students of a civil engineering education study program, 75 students in two classes. 39 students in class A and

36 students in class B. The population is a generalization area consisting of objects or subjects that become specific quantities and characteristics determined by researchers to be studied, and then conclusions are formed [197].

The study refers to Roscoe 1975 of feasible sample size in a study is between 30 to 500 to determine the number of samples used in this chapter [198]. The online platform was developed with nine raters involved in alpha testing as expert in the field of technology, pedagogy, and content knowledge in civil engineering (construction drawing). From the total population of 75 students in the Civil Engineering Education Study Program who will take the course, 30 students were involved in the field testing to develop the ECD learning model, including seven students for the preliminary field testing as using the assessment instrument with a model of the Kirkpatrick evaluation model's reaction stage.

6.3.3. Data Analysis

It used descriptive statistical analysis techniques that analyze the data by describing without intending to make conclusions that apply to the public or generalize them. The data analysis was carried out interactively. According to Sugiyono 2010, the activities in qualitative data analysis are carried out interactively and take place continuously until they are completed [199]. Then, it is explained and concluded by linking it to the theory used.

A measurement scale developed with the primary reference of TPACK, UTAUT, and TAM using the Likert scale is designed to assess the feasibility of the learning model. First, the variables to be measured are translated into variable indicators. Then the variable indicator is used as a starting point for compiling instrument items in the form of statements or questions. Each instrument item that uses a Likert scale has a gradation score from very low to very high.

6.3.4. Feasibility Criteria Based on the Assessment of Experts and Students

The ECD learning model is designed with an interactive evaluation with raters. The alpha test results will be interpreted for proposing the product validation. After getting the measurement results from the score table, the score calculation is taken from the Likert scale, based on Sugiyono 2019 [197], as presented in Table 6.1.

$$\text{100 scale score} = \frac{Score\ result}{Ideal\ Score} \text{ x } 100 \qquad 6.\ (1)$$

The calculation score process is done by comparing the frequency obtained with the expected frequency. The 100-scale score is calculated using Equation 6. (1).

Table 6. 1 Feasibility Criteria for the ECD Learning Model

Feasibility Criteria	Score
Very High	5
High	4
Quiet High	3
Low	2
Very Low	1

The assessment results are presented in the form of numbers which are further categorized according to the Likert scale measurement based on Sugiyono 2019 [197]. Furthermore, the feasibility of the ECD learning model is classified into five feasibility categories using a scale. The feasibility scale is shown in Figure 6.2.

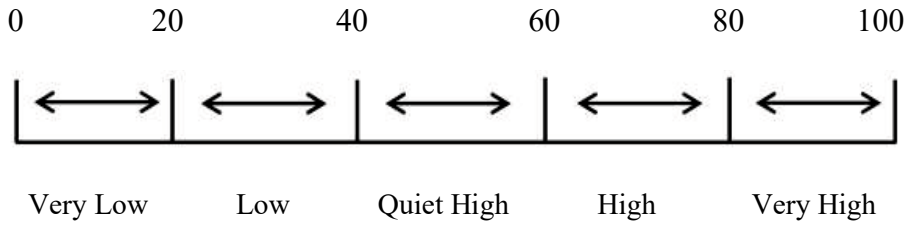


Figure 6. 2 Assessment Scale of the ECD Learning Model

Nine raters evaluated the ECD learning model, including three experts in the field of technology (information technology), three experts in the field of pedagogy (educational method), and three experts in the field of content knowledge (professional structure material in civil engineering). The assessment instrument mainly refers to the Technological Pedagogical Content Knowledge (TPACK) is an emergent form of knowledge that goes beyond all three “core” components (technology, pedagogy, and content). As a product of educational technology, a new model needs an understanding of the emerges from interactions among content, pedagogy, and technology knowledge [27].

6.4. Result

6.4.1. Survey and Identification

The survey and identification phase were conducted in the previous chapter. In Chapter 3, literature studies are carried out by searching and reviewing references related to construction drawing and vocational pedagogical approaches. At the same time, field studies are observations in the field by comprehending information, exploring problems,

and analyzing problems. Observations were made based on experience while participating in the course and conducting discussions with the teachers and lecturers in the Civil Engineering Education Study Program. The teacher and lecturer discussions were held several times, including with the CAD construction drawing lecturers. The material is distributed based on the syllabus and the lesson plan of the CAD construction drawing course. Then review for literature references relevant to the problems that have been analyzed following the required material. Some of the references taken include books, journals, and research report articles. The output of the literature study obtained is then collected and selected references relevant to the formulation of the problem and the materials and materials needed to determine the objectives achieved from the research and analyze the feasibility of the learning media.

6.4.2. Designing the ECD Learning Model

1) Development Phase

a) Lesson Material Review

Reviewing the lesson material by involving teachers and lecturers in CAD construction drawing courses based on the existing curriculum. The existing curriculum is then reviewed together to find the shortcomings to be improved and revise. The industries review and gives corrections to the competencies that are not following the needs of the industry or are no longer relevant to the needs of the current workplace. There are several principal competencies in the CAD construction drawing course, including:

(1) Applying the building regulation and requirements, both administrative and technical, following the function of the buildings
(2) Arrange the concept of building shop drawings
(3) Employ the AutoCAD application in drawing buildings
(4) Design a building shop drawing using AutoCAD by following the building requirements and regulation
(5) Presenting shop drawings.

The principal competencies above are then translated into several competencies that are applied at each meeting. From each meeting, there are specific indicators of competency for implementing the student's skill. The competency indicators are as follow:

(1) Lesson 1-2, the indicators are:

(a) Explain the function and classification of the building requirements, which include administrative requirements (land title status, building ownership status, building permit or in Indonesia, *Ijin Mendirikan Bangunan* (IMB))

(b) Applying the requirements for building layout (requirements for designation and building intensity, requirements for building architecture, requirements for controlling environmental impacts, building and environmental planning/ *Rencana Tata Bangunan dan Lingkungan* (RTBL))

(c) Implement building reliability requirements (safety, health, comfort, convenience requirements).

(2) Lesson 3-4, the indicators are:

(a) Able to explain the concept of architectural drawings

(b) Identify components in designing floor plans which include function room modules, structural grids, stairs, bathrooms and kitchens, space positions and configurations, walls, and openings

(c) Explain the concept of structural drawings that include the lower, middle, and upper structures of the building

(d) Analyze the type of structure and the provisions in drawing plans and construction details

(e) Identify the types of building utilities.

(3) Lesson 5-7, the indicators are:

(a) Able to operate AutoCAD application to draw some elements of buildings

(b) Set the units according to the conditions before starting the working drawing

(c) Create a layer by adjusting the thickness of the line, the type of line layer according to the provisions of the technical drawing

(d) Operate the basic menu of drawing, draw, modify, hatch, dimension, text, block, and layout

(e) Drawing applied objects in buildings (door frames, windows, truss, and foundations).

(4) Lesson 8-14, the indicators are:

(a) Able to operate AutoCAD application to draw shop drawings of two-dimensional buildings by applying building requirements and technical drawings

(b) Drawing a building plan using the multiline style technique or with the block editor technique
(c) Drawing the Plan and Foundation details using multiline style technique
(d) Drawing plans and details of doors and windows using the block editor
(e) Drawing a building view with the help of the construction line command
(f) Drawing the building sections
(g) Drawing plans and details of roof construction
(h) Drawing plans and details of staircase construction
(i) Drawing plans and details of columns, beam rings, beams, and floor slabs
(j) Drawing ceramic and ceiling plans
(k) Drawing a plumbing plan
(l) Drawing the Mechanical and Electrical (ME).

(5) Lesson 15-16, the indicators are:
(a) Able to present the results of the shop drawing design using AutoCAD with confidence
(b) Explain the concept of building construction planning according to the function and user
(c) Explain the type and details of the construction used.

b) Analyzing

In this analyzing stage, the researcher collects information by observing the CAD construction drawing course subjects. The curriculum and the gap of performance in the class. In this development phase, there are five steps of analyzing the existing problems and find the right solution to deal with them, including:

(1) Analyzing the Performance Gap in the Learning Process

Conduct observations in the learning process to find out whether there are performance gaps. Performance gaps include problems that have an impact on not achieving learning objectives. By measuring the current performance and determining the performance to be achieved, the problems that cause the learning objectives not to be achieved can then be identified.

(2) Analyzing the Basic Competencies of CAD Construction Drawing

In this process, the research focuses on analyzing the principal competencies determined by matching their relationship with competency indicators at each meeting.

Analyze the principal competency in the cognitive domain with the indicator competencies applying and using theoretical concepts that underlie applying these theories in completing tasks and solving problems that arise in project work. Each lesson indicator competency is then considered being revised for achieving better learning outcomes.

(3) Analyzing the Initial Competency, Spirit, and Attitude of Students

Analyzing the abilities, enthusiasm, and attitudes of students in participating in learning activities. In this process, the researcher makes observations in learning activities and interviews with supporting teachers and students. This analysis result is important to involve the intellectual skills aspects in learning to strengthen students' critical thinking, creativity, and application of innovation. While the involvement of mental skill aspects in work includes self-ability to stand the test, be stable in emotions, not easily give up, high-spirited, confident, open, tenacious, tough, brave. Complex skills such as skills that are applied in work generally involve three aspects simultaneously.

(4) Analyzing Learning Facilities

Analyzing learning facilities is important to determine the implementation of learning. The facility analysis has been carried out in previous research, Chapter 3. Learning facilities determine the strategy to be used and provide important information for the development of learning media to be built to facilitate the learning model proposed, the ECD learning media facilitated by the e-vocational learning platforms.

(5) Analyzing the Right Learning Strategy to Overcome Problems

Understanding the types and characteristics of work and the community's needs is an important part of formulating the content of the curriculum and vocational learning. Likewise, the design and strategy of vocational learning must be more innovative by applying various learning resources, learning technologies, and learning methods. Vocational learning will be effective if designed and adapted to students' individual needs and future jobs.

c) Drafting The Model Design

The data obtained from field observations in the form of learning problems, inadequate learning facilities, entry behavior of students with specific characteristics, the results of research findings in the previous stage, as well as the theoretical basis of the literature study, discussions and consultations with groups of teachers and lecturers, then this study compiles a draft of the design of the learning media model. The lesson objective

of each meeting as a result of the lesson material review and the learning problem analysis are as follow:

(1) Lesson 1 objectives
   (a) Identify the building drawing projects
   (b) Plan the determined building construction project
   (c) Propose work time schedule
   (d) Identify the collaborative mindset to socialize with the team
   (e) Define the collaboration between peers is the best strategy to finish the project optimally.

(2) Lesson 2 objectives
   a) Planning the space utilization intensity
   b) Drawing site Plan space utilization intensity
   c) Practice the collaborative mindset to socialize with the team
   d) Illustrate the collaboration between peers is the best strategy to finish the project optimally.

(3) Lesson 3 and 4 objectives
   (a) Identify the concept of drawing the building shop drawing
   (b) Practice the concept of building shop drawing to design the floor plan (including doors and windows)
   (c) Illustrate the coordinate system
   (d) Practice the CAD drawing commands
   (e) Drawing the floor plan
   (f) Drawing doors and windows plan
   (g) Apply the collaborative mindset to socialize with the team on designing the floor plan.

(4) Lesson 5 and 6 objectives
   (a) Practice the concept of building shop drawing to design doors and windows details
   (b) Practice the concept of building shop drawing to design foundation plan
   (c) Drawing doors and windows details
   (d) Drawing the foundation plan

(e) Apply the collaborative mindset to socialize with the team on drawing the doors and windows details (including foundation plan).

(5) Lesson 7 and 8 objectives

(a) Apply the concept of building shop drawing to design foundation details

(b) Apply the concept of building shop drawing to design roof construction plan

(c) Manage the CAD drawing commands

(d) Drawing foundation details

(e) Drawing the roof construction plan

(f) Apply the collaborative mindset to organize the team on the foundation details and the roof construction plan.

(6) Lesson 9 and 10 objectives

(a) Apply the concept of building shop drawing to design building view drawing

(b) Apply the concept of building shop drawing to design building sections

(c) Drawing building view

(d) Drawing the building sections

(e) Apply the collaborative mindset to organize the team on drawing the building views and building sections.

(7) Lesson 11-13 objectives

(a) Manage the concept of building shop drawing to design building roof construction details drawing

(b) Manage the concept of building shop drawing to design building structural elements (columns, concrete slope, concrete floor plate, and beams)

(c) Drawing building roof construction details drawing

(d) Drawing the stairs plans

(e) Drawing columns, concrete slope, concrete floor plate, and beams plans and details drawing

(f) Apply the collaborative mindset to organize the team on drawing the roof construction details and building structural elements.

(8) Lesson 14-15 objectives

(a) Manage the concept of building shop drawing to design building utility drawing

(b) Manage the concept of building shop drawing to organize the result of construction drawing

(c) Drawing the plumbing system

(d) Drawing clean water installation

(e) Drawing of dirty water (used) and sewage installations

(f) Drawing the mechanical and electrical drawing

(g) Organize the whole construction drawing result

(h) Manage the collaborative mindset to finish the building shop drawing project with the team.

d) Employing PBL and Flipped Classroom Strategy on the ECD Learning Model

The survey and identification phase results in chapter 3 prepared principal learning syntax. The 7 PBL steps revised by the vocational teachers and lecturers are the main steps for the ECD learning model. It uses the flipped classroom strategy to implement Regulation Number 44, 2015, Article 17 of The Minister of Research, Technology and Higher Education of the Republic of Indonesia [31]. Figure 6.3 speaks about the application of the flipped classroom strategy as an implementation of the applicable regulation.

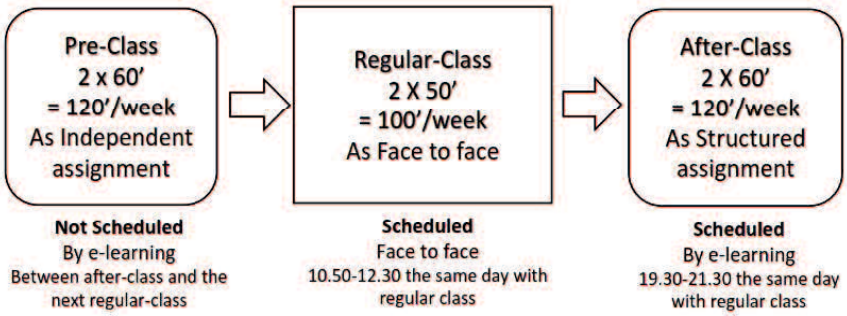


Figure 6. 3 The Flipped Classroom as an Implementation of the Minister Regulation

The principal learning steps of the preliminary ECD learning model are as follow:

(1) Teacher setting the challenging stage by giving examples of construction drawing project and essential sustained questions

(2) Student actively design the authentic construction drawing project by collecting information and negotiate the evaluating criteria sustainably

(3) Student actively create the schedule and work on the construction drawing project authentically

(4) Monitor the student activity and the progress of the drawing project

(5) Reviewing the construction drawing project to prepare for the presentation

(6) Present the project to collect critique and revision

(7) Doing reflection and evaluation as the criteria planned.

Besides implementing the regulation, the interaction between students and teachers will increase, the actualization of student-centered learning lies in the students' hands. They can learn the material at the best time and place which suits them as many times as they need to master the lesson before entering the regular class. While the student gets the better advantage of the flipped classroom strategy, they also get the better contextual learning experiences working at a civil engineering industry. It makes the students feel confident in facing the actual project in the future after they graduate.

Table 6. 2 Lesson 1 Pre-Class 1 of the ECD Learning Model (Teachers' Activity)

Class Information	Activity and Learning Experiences
Pre-class 1 **Schedule**: 1. Synchronous (Only for **pre-class 1**) Monday, Feb 15, 2021 **Time:** 10.50-12.50 Western Indonesia Time (WIB) UTC+07:00 2. Asynchronous Monday-Sunday, Feb 15-28, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 1 objective:** 1. Identify the building drawing projects 2. Plan the determined building construction project 3. Propose work time schedule 4. Identify the collaborative mindset to socialize with the team 5. Define the collaboration between peers is the best strategy to finish the project optimally	**Synchronous** 1. Greeting, motivating, and asking the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Introduction Module,** Pre-test topic (basic drawing), and join the embedded zoom link. (1') 4. Giving apperception and motivation. (10') a. Always do the best in every project for the best future. b. Collaborative mindset motivation, collaboration between peers is the best strategy to finish the project optimally. 5. Conduct Pre-test (basic drawing). (20') 6. Enter the **Introduction Module,** Challenges, and examples topic 7. **Setting the challenging stage by giving examples and essential sustained questions. (1)** Challenging to design a building construction drawing with various difficulty levels and determine the Project. (15') 8. Evaluate the Pre-test, creating teamworks. (20') 9. Announcing the teamwork members list. Create determining teamwork group topic (1') 10. Giving direction to organize the teamwork. (5') 11. Creating Zoom Discussion Rooms for teamwork working. (7') 12. Open all the Zoom discussion room, monitoring the **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (30') 13. Moving to the Zoom mainroom. (10') a. Concluding the lesson together with the students and following up by giving assignment for the activity in the asynchronous pre-class 1. b. Giving lesson connection and guiding for the next meeting, (synchronous pre-class and regular class 1). **Asynchronous** 1. Greeting, motivating, asking the student to prepare for learning, and informing about the learning activity by the Whatsapp SNS group. (at the beginning of the **Asynchronous** class) 2. Giving apperception and motivation. (by asynchronous e-learning) a. Always do the best in every project for the best future. b. Collaborative mindset motivation, collaboration between peers is the best strategy to finish the project optimally. 3. Enter the **Introduction Module,** Pre-test topic (monitoring the students in doing the pre-test of Student skill assessment for construction drawing) 4. Conduct and monitor the teamwork working in collecting information about the designing Project, including the project location, land area, and the building regulations set at the area. (by Whatsapp SNS Group and information at the e-learning) 5. Monitor the determining of the best building construction project to design in a teamwork discussion. (by Whatsapp SNS Group and elearning) 6. Monitor Teamwork in giving each team a chance to find and get a client who needs to build the building project. (by Whatsapp SNS Group and elearning) 7. Monitor each teamwork member involves communicating with the client to get the land area measurement data and government regulations data for doing the project planning. (by Whatsapp SNS Group and elearning) 8. Negotiating the evaluating criteria of the Project in teamwork and lecturers. (by Whatsapp SNS Group and elearning forum) 9. Challenging to create the schedule and work on the Project. (by Whatsapp SNS Group and elearning forum) 10. Encouraging to creating the schedule and work on the Project. (by Whatsapp SNS Group and elearning)

Developing the ECD learning model should be as effective as possible and be oriented to work. The teaching materials delivered are oriented to authentic work problems. The context of work in the ECD is also prepared for well taught. Table 6.2 is the summary of the lesson plan of the ECD learning model (Lesson 1 Pre-Class 1).

The ECD learning model started from pre-class 1 on Monday, February 15, 2021, by synchronous. It is only for pre-class one because it is the beginning of the meeting. It began at 10.50-12.50 Western Indonesia Time. The lesson 1 objectives are identifying the building drawing projects, planning the determined building construction project, proposing a work schedule, identifying the collaborative mindset to socialize with the team, and recognizing that collaboration between peers is the best strategy to finish the project optimally. The lesson objectives are for lesson 1 pre-class, regular-class, and after-class. In lesson one, the pre-class, there are two kinds of meeting methods, the first is synchronous, and the second is asynchronous. It is also because the first meeting is very important to build a good student mindset. Summarizes the lesson plan of the ECD learning model (Lesson 1 Regular-Class 1) is at Table 6.3.

Table 6. 3 Lesson 1 Regular-Class 1 of the ECD Learning Model (Teachers' Activity)

Class Information	Activity and Learning Experiences
Regular-Class 1 Time: Monday, Feb 22, 2021 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous Methods: Lecture, demonstration, discussion Media: e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting **Lesson 1 objective:** 1. Identify the building drawing projects 2. Plan the determined building construction project 3. Propose work time schedule 4. Identify the collaborative mindset to socialize with the team 5. Define the collaboration between peers is the best strategy to finish the project optimally	1. Greeting, motivating, and asking the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the Modul 1 **Building Regulations** topic, and join the embedded zoom link. (1') 4. Giving apperception and motivation to prioritizing group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to create the schedule and work on the Project actively. (3)**. Planing the determined building construction project (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to create the schedule and work on the Project actively. (3)** Planing the determined building construction project (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation. (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together with the students and following up by giving assignment for the activity in after-class 1. b. Giving lesson connection and guiding for the next meeting (after-class 1).

The learning materials used to do assignments in regular-class are already available in the learning module. So that they can study before students enter the regular class, learning cases, sample questions, learning media are oriented to the actual work that exists

and is easily recognized by students. Such methods support the growth of student work appreciation so that students increase their learning motivation. Vocational learning will be successful if it can develop students' appreciation of jobs and careers appropriate and related to the field being studied. It is important to pay attention to the transition from school to the workplace in the ECD learning model. In working on construction drawings, each group member always coordinates with the team and building owners. Working climate with contextual work responsibilities is a valuable experience for each student. After the teamwork doing a job together in a regular class, they must review their work again and prepare to present their work in after-class 1 lesson 1, the activity can be seen on Table 6.4.

Table 6. 4 Lesson 1 After-Class 1 of the ECD Learning Model (Teachers' Activity)

Class Information	Activity and Learning Experiences
After-Class 1 Time: Wednesday, Feb 22, 2021 19.30-21.30 (120') Western Indonesia Time (WIB) UTC+07:00 Synchronous Methods: Lecture, demonstration, discussion Media: e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 1 objective:** 1. Identify the building drawing projects 2. Plan the determined building construction project 3. Propose work time schedule 4. Identify the collaborative mindset to socialize with the team 5. Define the collaboration between peers is the best strategy to finish the project optimally	1. Greeting, motivating, and asking the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the Module 1 **Building Regulations** topic, and join the embedded zoom link. (1') 4. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 5. Guiding the students in **presenting the Project to collect critique and revision. (6)** (13'x7=91') Monitor the student in learning to socialize and interact with people in a presentation forum Monitor the student in collecting critique and revision 6. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 7. Giving connection and guiding for the next pre-class 2. (7')

Entering the after-class 1, the teacher greets the student by SNS WhatsApp group, motivating and asking the student to prepare for learning before the class start. After that, the students access the e-vocational platform. Enter the Module 1 building regulations topic and join the embedded zoom link. After entering the Zoom link, the teacher gives apperception and motivation of prioritizing team choices for the best achievement, guiding the students in presenting the project to collect critique and revision, and the team presents the work result**.** Monitor the student in learning to socialize and interact with people in a presentation forum. Monitor the student in collecting critique and revision. Moreover, at the end of the after-class session, the student is conducting reflection and evaluating the criteria planned. After that, giving a connection and guide for the next pre-class.

Furthermore, the ECD is designed into 16 lesson plans (available on the appendix). Each lesson includes one pre-class, one regular-class, and one after class. Each lesson plan contains seven principal steps of the ECD learning model with enriched learning experiences that motivate the student to do the best and grow the collaborative spirit. The

synchronizing of seven ECD learning steps into the civil engineering industry discovers that the seven steps are relevant. The steps are familiar with the civil engineering working step related to the construction drawing project of the civil engineering work environment. Here are the short names of seven main stages of the ECD learning model, which are familiar with the civil engineering working step related to the construction drawing project:

(1) Project auction (construction drawing challenging stage, giving examples and questions)
(2) Proposing project (construction drawing project and negotiation by collecting information and evaluation criteria/find the real project)
(3) Proposing work schedule (construction drawing project schedule)
(4) Proposing progress report and monitoring
(5) Reviewing and preparing for project presentation
(6) Presenting the project (collecting critique and revision)
(7) Reflecting and evaluating (based on evaluation criteria number 2).

The ECD learning model is designed to foster the collaborative spirit. In addition, before entering class, pre-class, regular-class, and after-class, students receive motivational messages to be enthusiastic in collaborating and performing the best. Furthermore, when entering the provided learning module, the ECD motivates each student to instill a spirit of collaboration with priority indicator levels, prioritizing learning steps according to student needs. The ECD learning model combines a collaborative and professional attitude with suitable learning methods, strategies, and approaches. A workplace project-based, supported by a collaborative spirit strengthening the mental power, flipped classrooms that comply with regulations and provide effective learning for boosting students' skills.

e) Designing the ECD Online Learning Platform (e-vocational)

(1) Problem Identification

The survey and identification were conducted as the preliminary studies at the Civil Engineering Education Study Program. Observations were conducted to see the learning problem which happens in the vocational course. Nowadays, drawing skills are essential for supporting many courses in vocational education, especially in civil engineering. For this reason, drawing skills should be learned effectively. However, there are unsolved problems in the CAD construction drawing's learning process. There are major problems:

(1) the needs of facilities; (2) the duration of the course; (3) mastering the lesson; (4) doing project activity in a team; and (5) supervising the project.

Regarding these findings, designing the ECD with an online learning platform is expected to answer the problems. Students access the e-learning by their computer could minimize the school computer facilities, even the school has minimum computer laboratory facilities, the course can still be conducted. The availability of the course that does not depend on the school computer facilities makes the arrangements of the course schedule easy. The course duration will be easy to fulfill without getting a problem with the laboratory using the schedule. Moreover, the students could have more time to study individually. Understanding the lesson is a big problem when some students fail in studying in class. It will make them feel anxious, lose motivation, and make it challenging to finish the course, as they have to do assignments without understanding and guidance.

The e-learning will give guidance to be followed and learned by self-doing experiences or groups. In this case, the e-learning will give much support to the students by giving guidance, demonstration video, and job assignments. The student who fails to understand the lesson in the class could use the tutorial video. They can learn in class for the demonstration session, and this will allow increasing the student competence with a minimum cost. The ability to share information with team members, make decisions together with the team, and communicate in the project supervising will be gained by the PBL approach.

(2) Drafting The Model Design of the ECD Learning Platform

The principal idea is to compose a more beneficial practical vocational e-course at a low price. Concerning this purpose, the strategy is to develop the ECD with an online learning platform by combining various economical devices, moreover, are free open source. Besides, we attempt to use the previously owned facilities and ordinarily applied by learners in common. Without neglecting other research in developing modern and sophisticated learning platforms, this research expects to optimize the use of the existing available user-friendly platform to support learning activities and become an essential reference for improving student skills economically.

By considering the survey and identification research, the study focuses on arranging the online platform using the simple platform, easy to use and available everywhere. This study proposes the combination of platforms, chooses the platform based

on the needs of learners. The online instruction uses blended online platforms, including WordPress as the CMS, WhatsApp SNS, the eFront as the LMS, YouTube, Imgbb image hosting, and Google for education integrated into a learning set for better advantages in supporting learners. The e-vocational platform provides a project showroom to publish students' projects, collaborative learning materials, and sustainably developed tutorial videos. It also gives the student the chance to create the video to support their project. Figure 6.4 shows the proposing framework of the ECD online platforms, which formed by several different open-source platforms.

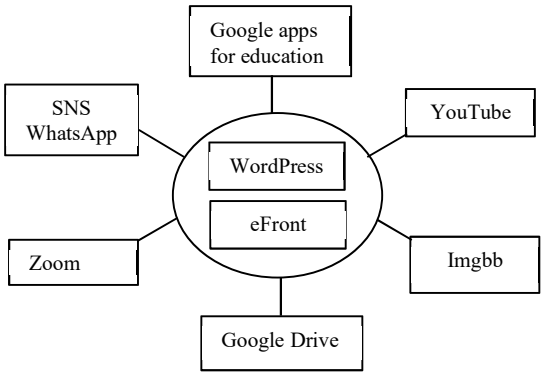


Figure 6. 4 The Proposing Framework of the ECD Online Platform (e-vocational)

The e-vocational propose to use two central platform, WordPress as the content management system (CMS) and eFront as the learning management systems (LMS). Choosing WordPress is considered correct because of its ease of use, and it is free/open-source. WordPress is a free and open-source content management system (CMS) written in PHP and paired with a MySQL or MariaDB database. Features include a plugin architecture and a template system, referred to within WordPress as themes. WordPress was created as a blog-publishing system but has evolved to support other web content types, including more traditional mailing lists and forums, media galleries. WordPress is used by 41.4% of the top 10 million websites as of May 2021. Therefore, WordPress is one of the most popular content management system solutions in use. Figure 6.5 presents the principal WordPress site architecture [200].

The eFront is a learning management system (LMS). It can assist the process of creating distant learning communities. It can be used as a training tool, a communication tool, an evaluation tool, a certification tool, a file management, and sharing tool. It can be used as an autonomous tool, but it can also be combined with traditional education in the classroom (blended learning). Key characteristics of eFront: standards compliance

(SCORM/AICC Certified), intuitive and attractive (icon-based interface), runs everywhere (any OS, any bandwidth), runs on anything (any browser), fast, new generation web application (AJAX), expansible (modular technology). Architecture of eFront [201], webserver: Apache/IIS. Database requirements: MySql 5+ – (eFront used an AdoDB layer and can be extended to support additional databases), browser: IE 6+, FF 2+, chrome, PHP 5.2+ (Object Oriented), 3-tiers: logic, database, presentation, Modular architecture, Ajax Interface. Figure 6.6 shows about the eFront architecture [201].

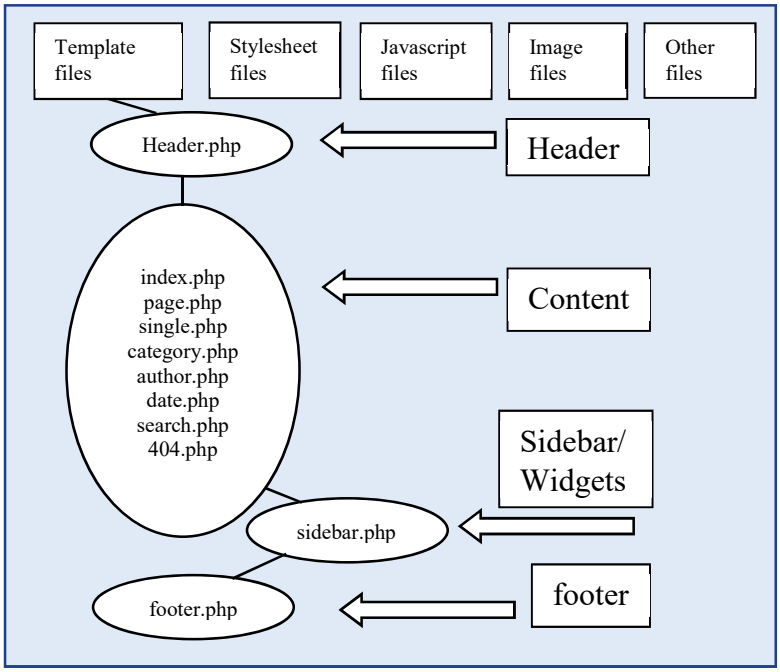


Figure 6. 5 WordPress Site Architecture

eFront is generally included in the list of well-known open-source learning systems and is widely cited as an alternative to Moodle. eFront has several open-source versions offered with various features and prices. There is also a community edition open-source version that is distributed free of charge but with limited features. In this study, the eFront used in e-vocational development is the community edition version. Although it uses the community edition, the existing features support its use as a virtual online class.

Course Management, various learning management features as a means of organized online classes. The arrangement of chapters and sub-chapters can be made directly by educators/trainers to make it easier for students to find the learning materials to be studied. Teachers can also determine the format used in the content of learning materials.

Course rules, teachers can control the classes that have been created, how the class will take place, the class schedule, and the rules that apply in class.

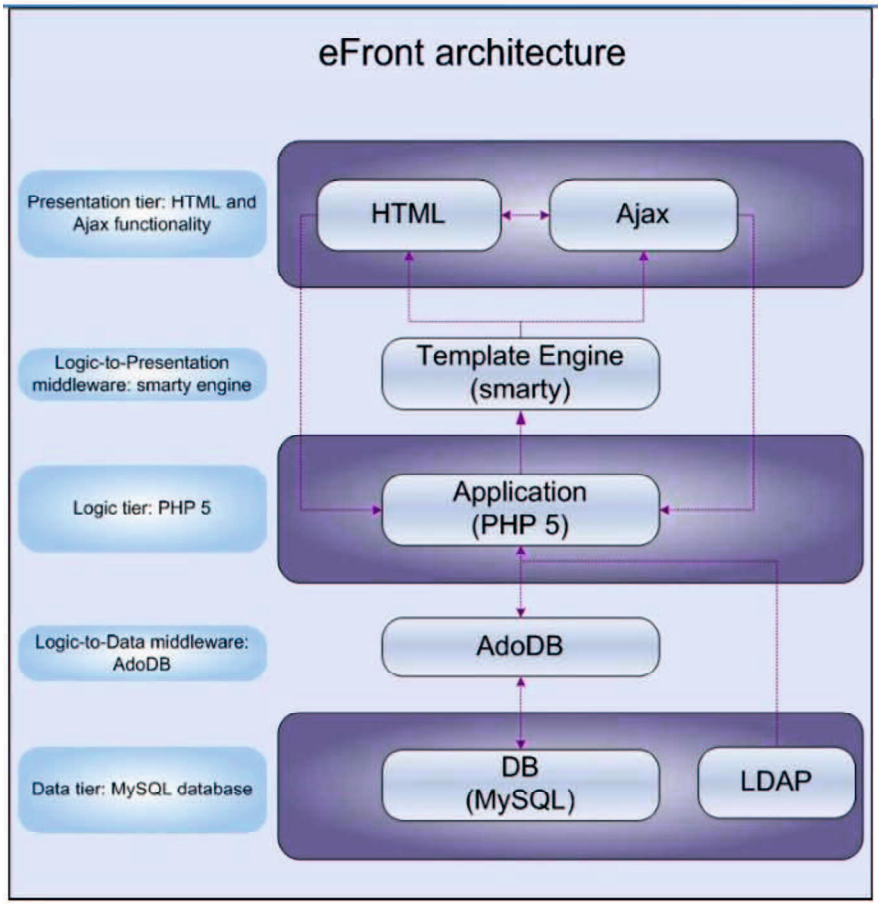


Figure 6. 6 The eFront Architecture

File management, various file formats can be uploaded or downloaded on eFront. In classes that have been created, educators can distribute learning materials in the form of documents that can be used as learning resources for students. Teachers can also put documents shared in one folder in each course created to make it easier to search. However, for the ECD learning model, the study proposes managing the assignment file in google drive to make the platform light and easy to use.

Assessments, learning evaluation can be done in various forms that can be adapted to the learning objectives. Various forms of evaluation contained in efront include multiple-choice questions, description questions, and fill-in questions. Evaluation can also be done using the timer feature and online so that the implementation can be controlled. The preparation of questions can also be done randomly for each student or automatically done by the system. The assignment feature on eFront makes it easy for teachers to collect

assignments because they are on the same system. Besides that, students can also collect assignments in various formats more quickly, cheaply, and efficiently.

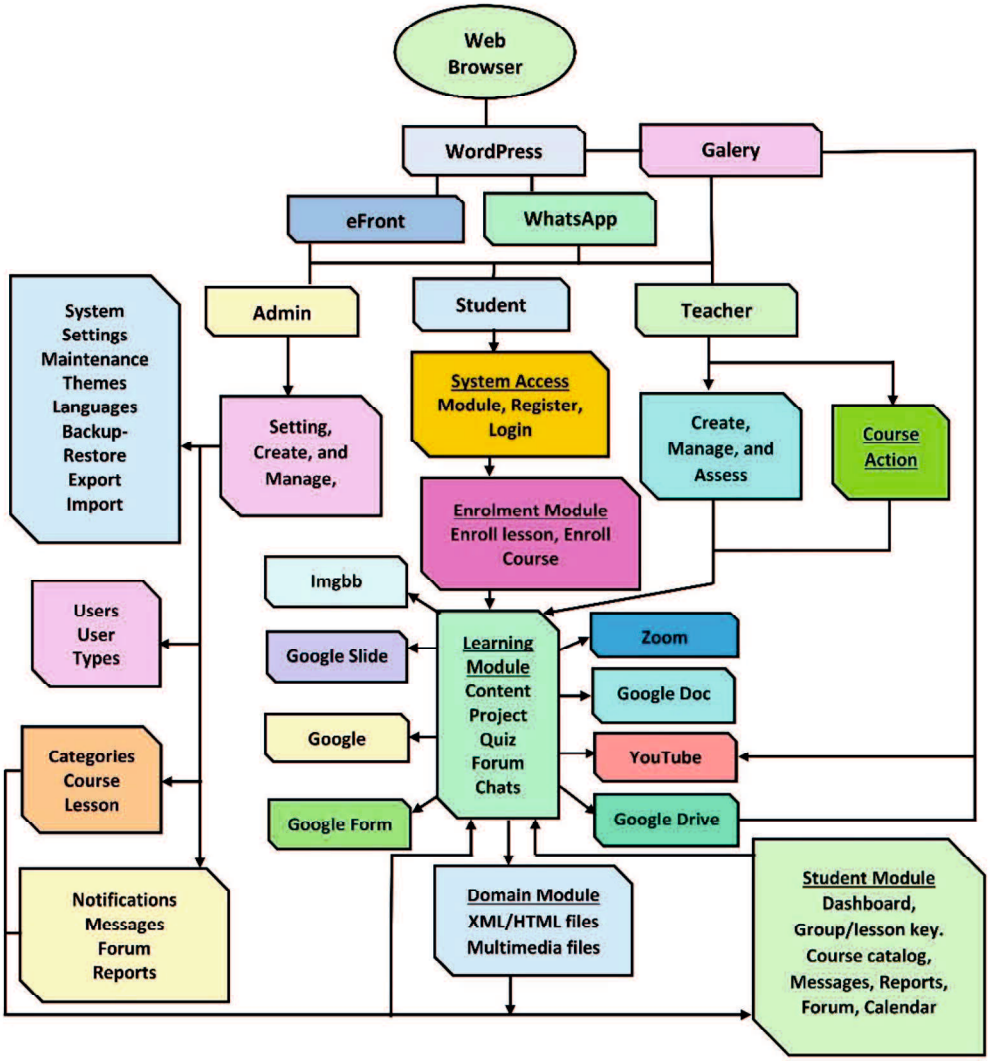


Figure 6. 7 Technical Framework of the ECD Learning Platforms (e-vocational)

The reporting feature supports openness in terms of assessment. Because the exam is conducted online and systematically, the assessment will be more objective. Supervision of students' academic progress can also be done more quickly with this feature. The system can automatically send notifications via e-mail to each registered student if there is an announcement or assignment from the teacher in the class that is being attended. The eFront platform can be installed on Linux and Windows operating systems. Although not on all operating systems can be installed, eFront can be accessed through all browser applications. As eFront has one database, the teacher can manage learning in online classes. The platform can store many learning materials so that e-vocational can become a container for a collection of learning materials. Both students and educators are easy to find the learning

materials. As well conducting learning interactions easier because it is possible to implement the learning process in a virtual classroom. At the same time, the learning activity can be performed face-to-face or online. Figure 6.7 speaks about the ECD technical framework.

The ECD's online learning platform (e-vocational) consists of four main subsystems, including access system, enrolment system, learning center, and domain model, as presented in Figure 6.8 [202] below.

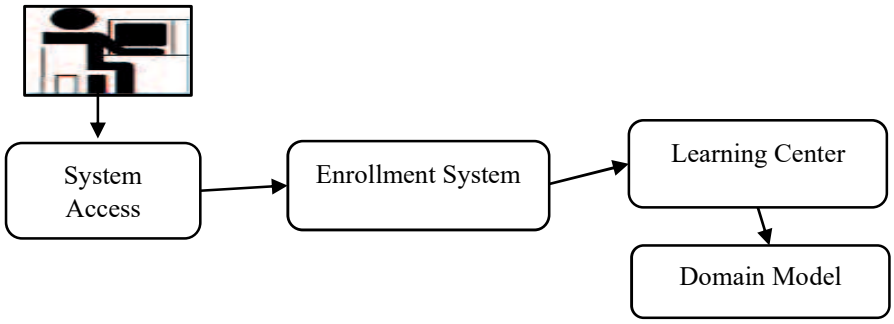


Figure 6. 8 E-vocational Subsystem Structure

(a) System Access

System Access is the part where there is user registration, login, and logout. For example, a student can access the e-vocational by registering in the available registration column. Registered students can access entry or login and logout when they have finished using the e-vocational.

(b) Enrollment System

The function of this system is for students to take appropriate classes or materials. Thus, students can access the desired class or material.

(c) Learning Center

The learning center accommodates communication between students and the system during learning activities. Student learning activities that are accommodated include learning materials, exams, exercises, messages, forums. From the function of this system, it is easier for students to use the main functions of the e-vocational.

(d) Domain Model

It consists of learning materials and multimedia as well as additional files to support learning activities. Students and teachers can add files with HTML/XML extensions supported by this system with its use. So that it can be adapted for use in learning activities. Figure 6.9 shows the front page of the ECD online learning platform.

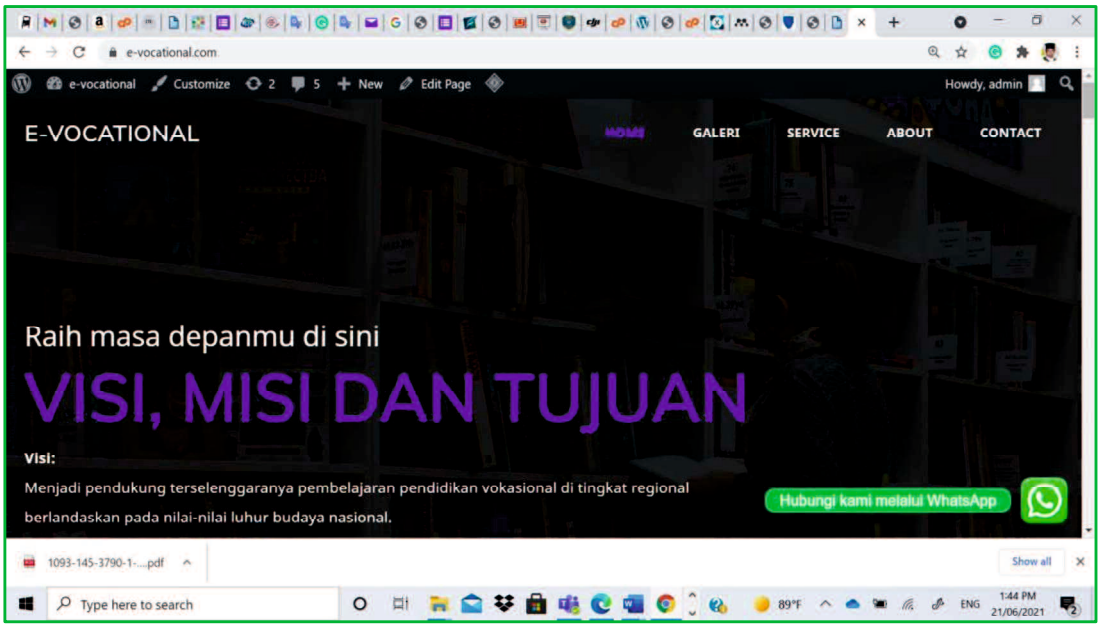


Figure 6. 9 The Front Page of the ECD Online Learning Platform (e-vocational)

E-vocational was developed with an easy-to-use and lightweight interface with all the functions working well. Using the e-vocational does not require special skills in programming. Every student can use the platform.

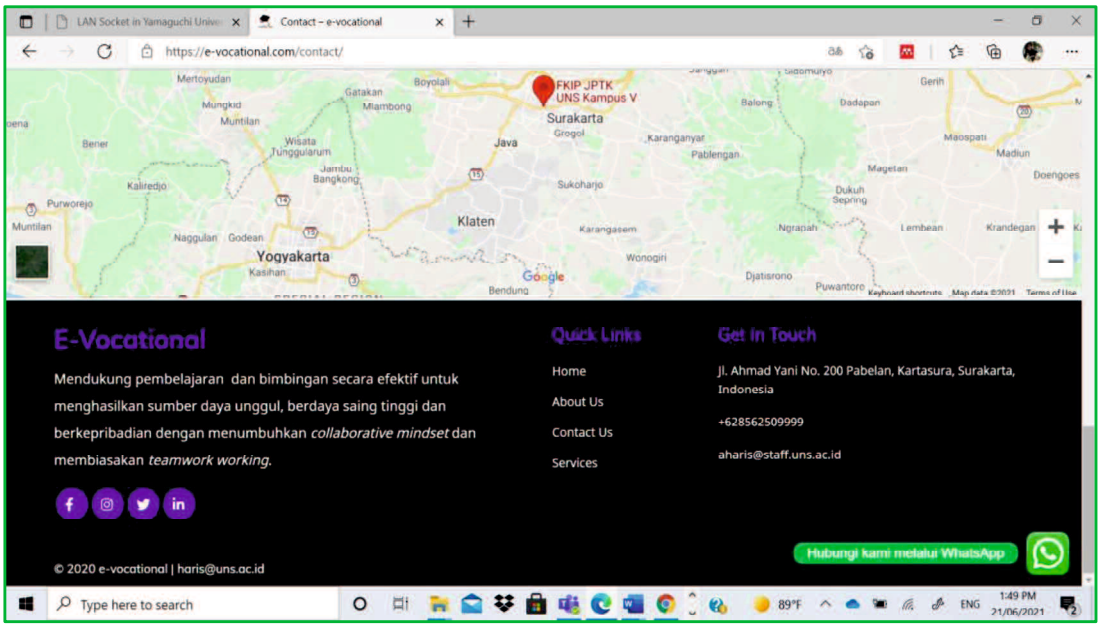


Figure 6. 10 The Footer of the ECD Online Learning Platforms (e-vocational)

The e-vocational learning platform supports the ECD learning model by providing an online learning platform and publishing the project on a gallery page. Figures 6.10 and 6.11 show a footer and a project showroom of the ECD platforms.

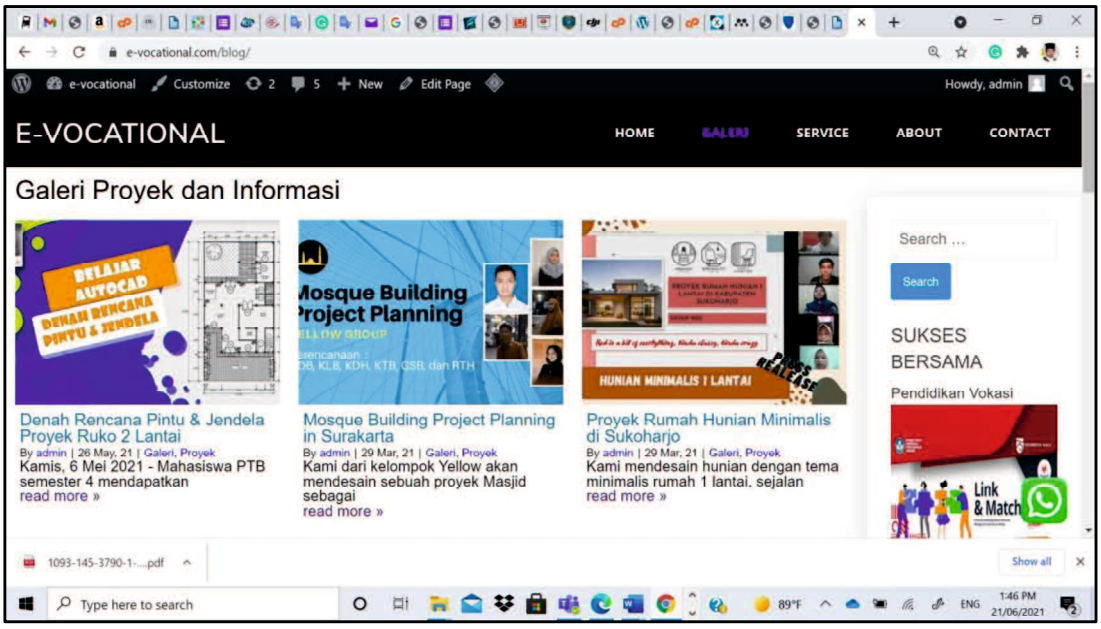


Figure 6. 11 The Project Show Room of the ECD Learning Platforms (e-vocational)

The first page accessed by students or educators to enter the e-vocational is the front page (WordPress). There is a project showroom on the gallery page. To join the course, new student needs to contact by SNS WhatsApp by clicking the WhatsApp message button at the corner of the page.

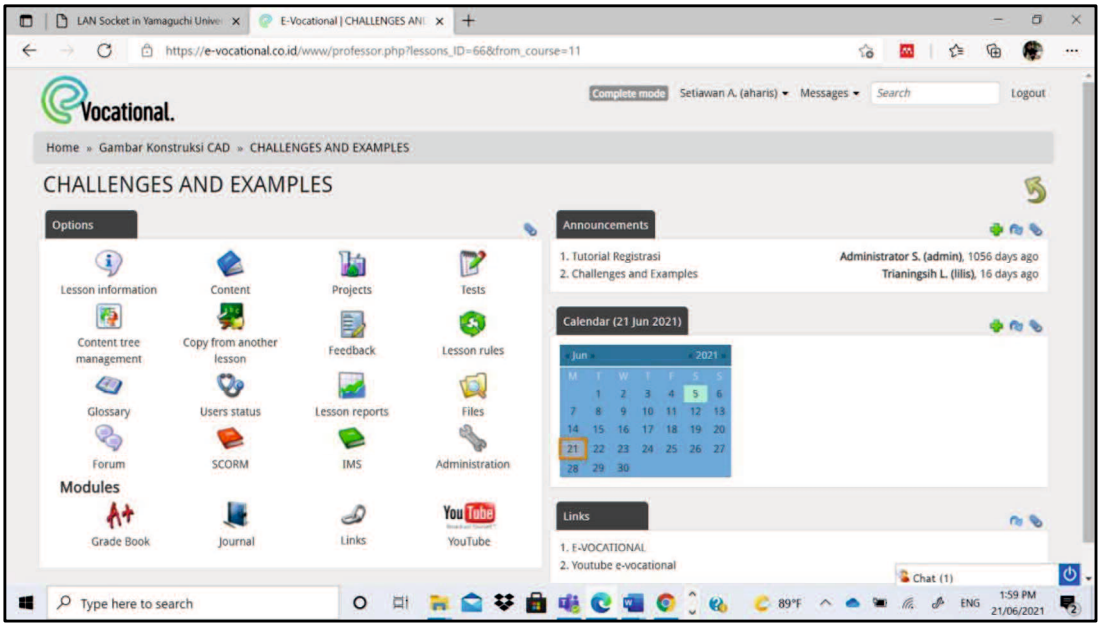


Figure 6. 12 The Challenges and Examples E-learning Page (introduction module)

The project showroom on the gallery page aims to publish the project results, including the project design proposal. In addition, each team writes a press release about their project name, information, and drawing concept. Besides, they make video

presentations of the design and drawing steps of their works. The videos are then uploaded to the e-vocational YouTube channel and embedded into the website for publication. Thus, the students are expected to feel the actual condition of a civil engineering industry workplace with a real challenge to be a responsible building designer or a draughtsman.

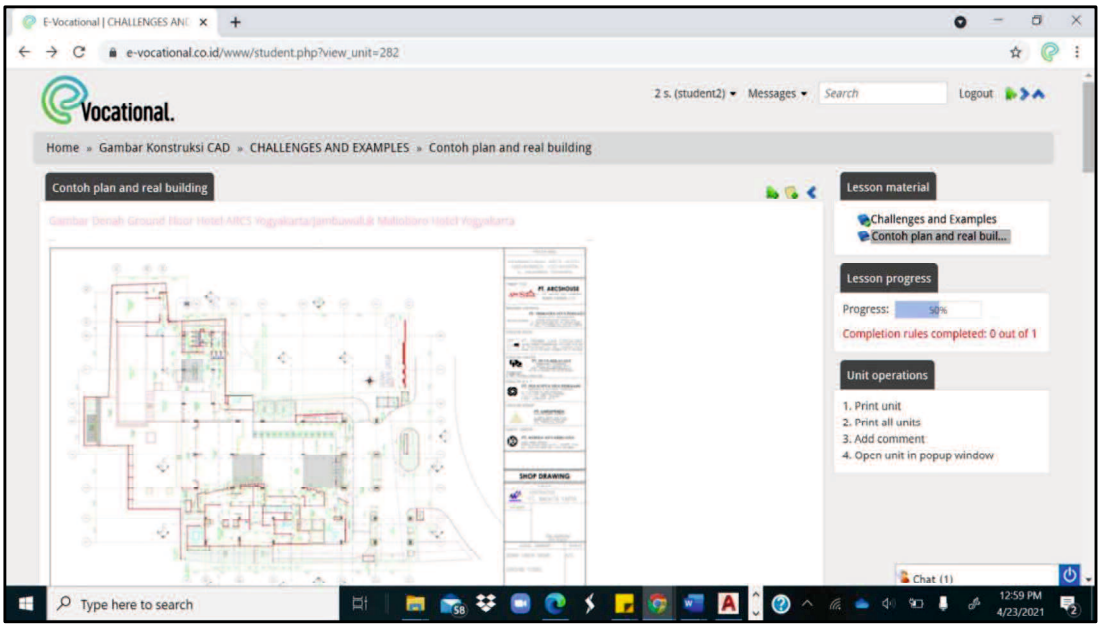


Figure 6. 13 The E-learning Page on Example of Building Plan

When students want to enter the e-learning. They need to enter the access page by clicking join on the front page. Then the student will enter the access page. This page consists of an HTML file containing several forms for new user registration, user login, and material catalogue list view. The student who has already registered and has an account and password may login. After successfully logging in, a dashboard page will appear. In addition, there is information on the material that has been taken, a list of tools such as dashboard, group/lesson key, course catalogue, messages, reports, forums, and forums calendar. This page also contains an HTML file containing links to the functions of each tool list. Figures 6.12 and 6.13 show the e-vocational introduction module in option page and example of building plan.

2) Evaluation of the ECD Learning Model

a) Alpha Testing

The ECD assessment as a feasible learning model to improve student skills on the CAD construction drawing course was carried out by nine assessors in three expertise

groups. There are three material experts (content knowledge), three learning experts (pedagogy), and three media experts (technology).

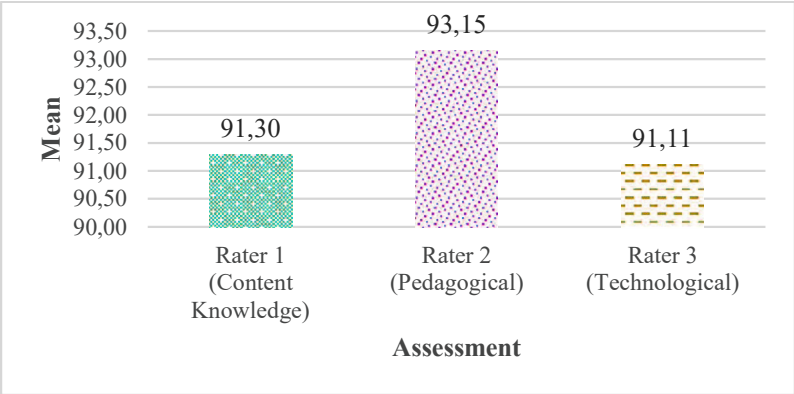


Figure 6. 14 The Mean of Raters Assessment Scores

In developing a learning model, the researcher discusses with a group of experts to revise the learning model development. It was implemented to improve the quality of the ECD learning model, every lesson content, and designed from the beginning. In this revision, the guidelines used are the results of assessments carried out by material experts (content knowledge), pedagogy experts, and multimedia experts (technology).

We can see the experts' group assessment results from the existing tables and graphs. The civil engineering construction drawing experts (content knowledge), the pedagogy experts, and the multimedia (technology) experts have assessed the ECD learning model with the results written in Figure 6.14. It states that the score of content knowledge is 91.30, pedagogy is 93.15, and multimedia (technology) aspect is 91.11. Table 6.5 shows the summary of three expert groups' assessment results. The total mean of the raters assessment is 91.85.

Table 6. 5 The Summary of Three Expert Groups Assessment Result

No	Assessment Indicator	Rater 1 (Content Knowledge)	Rater 2 (Pedagogical)	Rater 3 (Technological)
1	Professional structured materials	95.56	95.56	91.11
2	Relevant educational content	91.11	88.89	88.89
3	Collaborative support	83.33	93.33	93.33
4	Visual design quality	91.11	97.78	93.33
5	Innovative feature	93.33	83.33	86.67
6	Usability	93.33	100.00	93.33
Expert Groups' Means		91.30	93.15	91.11
General Result		**91.85**		

The first revision of the material expert contained in the notes on the learning media stated that from some parts of the work and the appearance of the material, it was possible to build and complete it to be better so that it would be developed continuously.

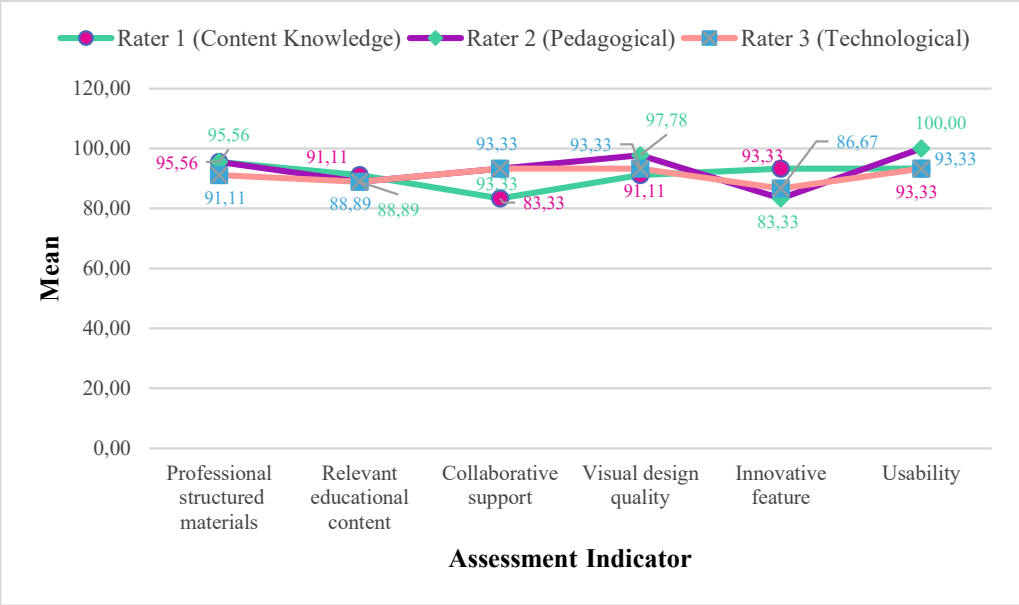


Figure 6. 15 Assessment Result Distribution by Three Expert Groups

In the second revision, the multimedia expert gave notes on the learning model. They stated that it is necessary to add a description of the lesson material to its title on the e-vocational online learning platform. Then the previous lesson material includes in the module also needs revision in the same topic. The source of lesson material should be more varied and cover all the basic competencies. Need to create more tutorial video for supporting the practical lesson. Add videos, create discussion forums, and add assignments and tests to complete the learning model lesson material.

Table 6. 6 The Mean of Assessment Result by Raters

No	Assessment Indicator	Mean
1	Professional structured materials	94.07
2	Relevant educational content	89.63
3	Collaborative support	90.00
4	Visual design quality	94.07
5	Innovative feature	87.78
6	Usability	95.56
Assessment Result		**91.85**

The third revision of the learning expert gave notes on the learning media, stating that the research is better than before. However, it is necessary to review the model by other learning situations and environments, so it was recommended to include Indonesian in the

e-vocational. Furthermore, it can improve the quality of the Civil Engineering Education Study Program.

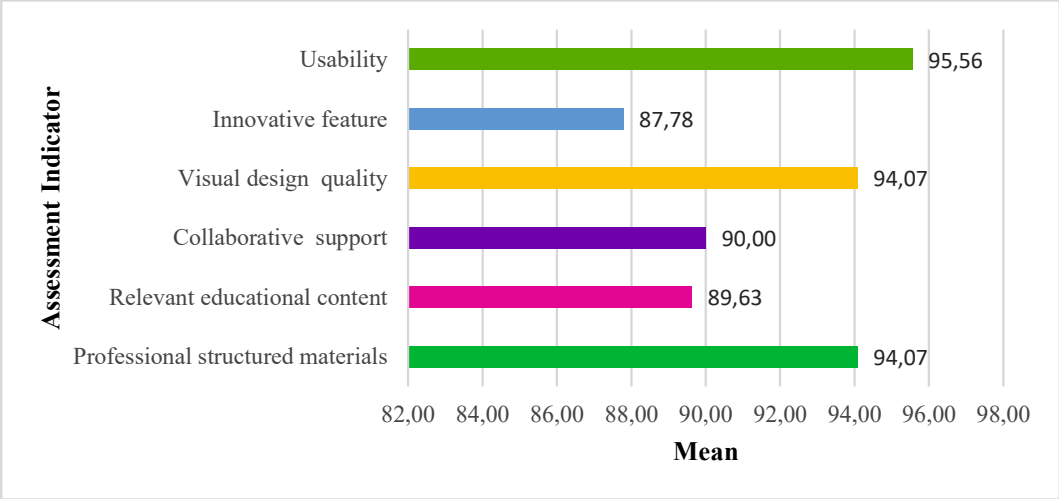


Figure 6. 16 Mean of Assessment Scores by Raters

We can see the preliminary field assessment results of the ECD learning model from the explanation of the tables and graphs presented. Table 6.6, which presents the assessment result mean by raters, states that the score of professional structured materials aspects is 94.07, relevant educational content is 89.63, collaborative support is 90.00, visual design quality is 94.07, the innovative feature is 87.78, and usability of 95.56. The mean of assessment results of the ECD learning model also can be seen in Figure 6.16.

b) Beta Testing

(1) Preliminary Field Assessment

The preliminary field testing was carried out after the revision stage of the expert team. The limited trial was applied to seven students of the Civil Engineering Education Study Program. The preliminary field testing was carried out by applying the ECD learning model designed to be applied to users. This test also assessed the feasibility of the ECD learning model as a learning model in the CAD construction drawing course. The feasibility test is prepared based on the learning model feasibility indicators according to the technological expert (information engineering) media assessment instrument developed. The data obtained from the assessment is the responsibility of media users to develop e-vocational as a learning model in the e-vocational construction drawing course during the learning process. The results of the preliminary field-testing assessments that have been obtained can be seen in Table 6.7.

We can see the preliminary field assessment results of the ECD learning model from the explanation of the tables and graphs presented. Table 6.7 states that the mean score of the ECD learning model is 82.94. This is the total score of professional structured materials aspects, relevant educational content, collaborative support, visual design quality, innovative feature, and usability. Table 6.7 speaks about the mean of preliminary assessment scores.

Table 6. 7 The Mean of Preliminary Assessment Scores

No	Assessment Indicator	Mean
1	Professional structured materials	84.76
2	Relevant educational content	82.86
3	Collaborative support	80.00
4	Visual design quality	82.86
5	Innovative feature	81.43
6	Usability	85.71
Assessment Result		**82.94**

According to the assessment, we can see the preliminary field assessment results of the ECD learning model from the explanation of the tables and graphs presented. Table 6.7 states that the score of professional structured materials aspects is 84.76, relevant educational content is 82.86, collaborative support is 80.00, visual design quality is 82.86, innovative feature is 81.43, and usability of 85.71.

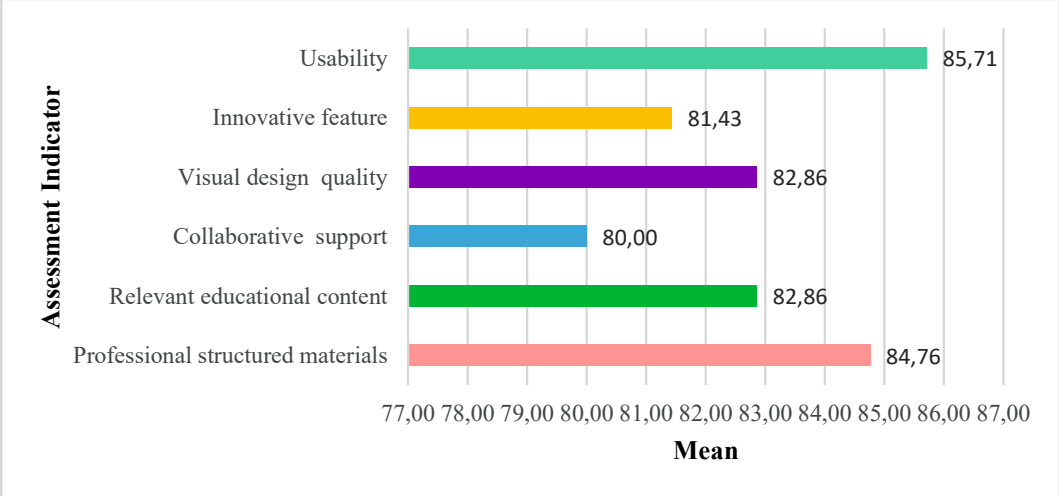


Figure 6. 17 The Mean of Preliminary Field Assessment Scores

The above Figure 6.17 explains that the highest score is the usability, 85.71, followed by the professional structured materials aspects, 84.76, the relevant educational content aspect and the visual design quality, 82.86, the innovative feature, 81.43, and the last position is collaborative support with a score of 80.00.

(2) Field Assessment

We can see the field assessment results of the ECD learning model from the explanation of the tables and graphs presented. Table 6. 8 states that the mean score of the ECD learning model is 85.31. This is the total score of professional structured materials aspects, relevant educational content, collaborative support, visual design quality, innovative feature, and usability.

Table 6. 8 The Mean Scores of Field Assessment

No	Assessment Indicator	Mean
1	Professional structured materials	85.56
2	Relevant educational content	85.33
3	Collaborative support	85.00
4	Visual design quality	85.33
5	Innovative feature	85.00
6	Usability	85.67
Assessment Result		**85.31**

According to the assessment, we can see the field assessment results of the ECD learning model from the explanation of the tables and graphs presented. Table 6.8, states that the score of professional structured materials aspects is 85.56, relevant educational content is 85.33, collaborative support is 85.00, visual design quality is 85.33, innovative feature is 85.00, and usability of 85.67.

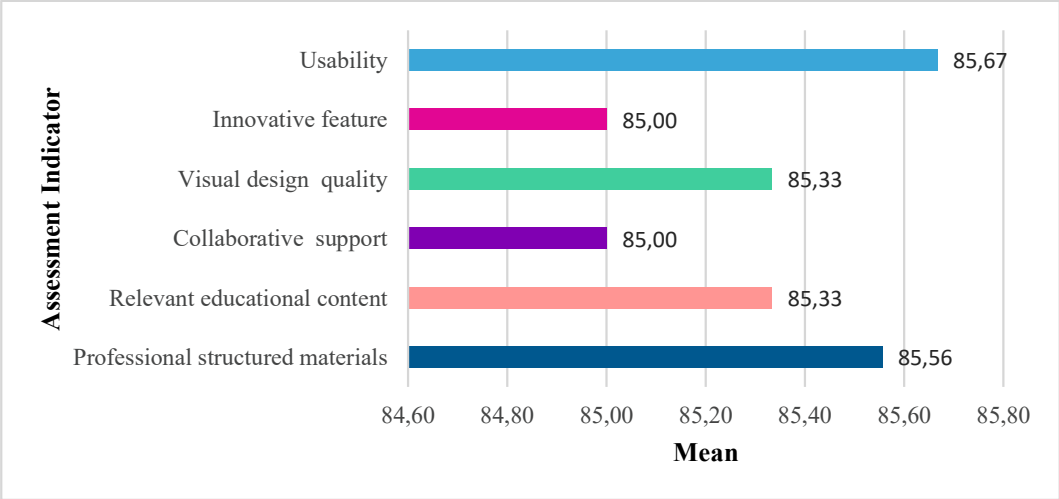


Figure 6. 18 The Mean of Field Assessment Scores

From Figure 6.18, it can be seen that the highest score is the ECD usability with 85.67 scores. It is followed by the professional structured materials aspects with an 85.56

score. After that, the relevant educational content and visual design quality with 85.33 scores. It is followed by collaborative support and innovative feature with an 85.00 score.

6.5. Discussion

6.5.1. Instructional Design Review

The development of the ECD as a construction drawing learning model is running well. Started from identification, literature studies, field observations, and some investigation research to obtain various reference sources to build the learning model and revise the curriculum based on the industries requirement. The Lesson plan promote collaborative skill enhancement in many places (before, inside, and after the class). The collaborative skills improvement will drive the complex engineering skills to increase progressively, where the prioritized construction drawing skills will be raised together in an interdependence learning environment. The prioritized engineering skills including presenting the drawing both verbally and written, exhibiting the drawing concept, drawing plan and construction detail, mastering section drawing, drawing the detailed roof construction plan, and carry out the drawing tasks according to the plan and the specified time. These prioritized construction drawing skills are trained at regular classes with additional motivation given in the pre-classes. Simultaneously, the engineering skills concerning personal attributes, interpersonal skills, and group process skills are necessary because they are demanded in managing projects at a professional company [203][204].

In a collaborative learning environment, information is transferred among students as they work towards learning goals. Students are active in their knowledge acquisition process as they engage in negotiations, explore knowledge, and exchange opinions with peers. Science is co-created and shared among peers, not occupied by one particular student after receiving it from the teacher [204]. Another study of collaborative web-based training of students with student and student with teacher reveals that collaborative practices, i.e., group work, team effort, instructor feedback, and consolidated support material, enhance the learning outcome [205]. The essence of improving the collaborative skill then became the main idea to considers the instructional design using the Project-Based Learning approach and adapting them into the contextual vocational condition using flipped learning strategy supported by e-learning. The learning experiences will be given to the student by seven main steps, including setting the challenging stage, design the authentic project, create the authentic work schedule, monitor the student activity and the progress, understanding the

project to prepare for the presentation, present the project and revising, and reflection. A study by Siemens identifies the influence of technology on community and ways of knowing. Learning in the digital age is no longer dependent on personal knowledge. Instead, it relies on the associated learning that requires interaction with multiple sources of knowledge, including the online learning systems, participation in common interest communities, and teamwork [206]. There are three structure classes provided, including pre-class, regular class, and after class prepared by synchronous and asynchronous learning activities. The class activities refer to Regulation Number 44, the year 2015, Article 17 of The Minister of Research, Technology and Higher Education of the Republic of Indonesia, one credit in the learning process consisting of 50 minutes of face-to-face activities, 60 minutes of structured assignment activities, and 60 minutes of independent assignment per week per semester.

The e-learning used blended online platforms, which provide a project showroom, collaborative learning material. It uses WordPress for the web content management system as the website front page and plugs SNS WhatsApp for instant messaging to contact the administrator. All students register their phone numbers by the SNS Whatsapp application available on the e-learning website. Then forming student groups, each group contains five students. The SNS WhatsApp is used for sharing course information, mechanism of future lectures, syntax, and methods used in the learning process.

The instructional design for the ECD learning model was reviewed by observing the project-based learning theories and adapting them into the contextual vocational condition. The learning steps are teacher setting the challenging stage by giving examples and essential sustained questions; student actively design the authentic project by collecting information and negotiate the evaluating criteria sustainably; student actively create the schedule and work on the project authentically; monitor the student activity and the progress of the project; understanding the project to prepare for the presentation; present the project to collect critique and revision; reflection and evaluation. Those are series of ideal learning steps which then need to be implemented in a real class for further evaluation.

Lesson material, strategies, and the e-learning platform have been developed based on the studies conducted. The lesson material follows the syllabus, and lesson plans are reviewed based on the distribution of the material that has been determined. Then prepare the model design by compiling a draft of the material and the primary draft of the learning

model and e-learning according to the literature reviewed. From the primary draft of the learning model and the e-learning to carry out an e-vocational installation that follows the draft material prepared, it is included in the e-vocational according to the previously reviewed material. After the e-vocational has been completed, a design validation draft is made following the appropriate e-learning criteria of the Borg and Gall model with an adaptation of Sugiyono 2019 as relevant literature. The appropriate validation draft is tested by material experts (content knowledge), media experts (technology), and appropriate pedagogy experts. Then make revisions according to the validation provided by the experts. The revision results followed the expert's revision, so a broad group test was conducted for the class of building engineering education students.

6.5.2. Evaluation

1) Experts Judgment

We can see the experts' group assessment results from the existing tables and graphs. The multimedia (technology) experts, the pedagogy experts, and the civil engineering construction drawing experts (content knowledge) have assessed the ECD learning model with the results written in Figure 6.14. It states that the multimedia (technology) aspects score is 91.11, pedagogy is 93.15, and content knowledge is 91.30. The assessment results show that in technology, pedagogy, and content knowledge, the ECD learning model gets 91.85, more than 90.00. It is included in the very high score category. All the raters agree that the ECD learning model is feasible for use in civil engineering education study programs and other equivalent places. The raters consider that the ECD model can be a suitable learning model for use at all levels of vocational education.

According to the experts as the raters, this ECD learning model is suitable for engineering education students. There are several advantages, including (1) a well-planned learning implementation program; (2) appropriate learning strategies for vocational students; (3) provide more learning opportunities for students; (4) students feel that it is easier for them to achieve the expected competencies; and (5) the stress level of students in learning is low. Furthermore, this model can help students to improve their learning quality in four main benefits, such as: (1) the collaborative approach that is continuously promoted sustainably makes students feel optimistic in learning, happy, and comfortable; (2) it makes the students' stress levels lower; (3) it reduces students' fear of learning failures; and (4) it

gains students confident, students can access it any time, whenever they encounter difficulties, they can immediately access to get solutions easily and economically.

2) Field Assessment

a) Preliminary Field Assessment

According to the assessment, we can see the preliminary field assessment results of the ECD learning model from the tables and graphs presented. Table 6.7 states that the score of professional structured materials aspects is 84.76, relevant educational content is 82.86, collaborative support is 80.00, visual design quality is 82.86, the innovative feature is 81.43, and usability of 85.71.

The preliminary results show that in content knowledge, pedagogy, and technology, the model gets 82.94, more than 80.00. It is included in the very high category and highly feasible. Based on the descriptive statistics, the mean value of the accumulative assessment is very high. Most of the respondents give positive responses to the model. Moreover, most of the respondents agree that the ECD learning model can be implemented in the actual class. The respondents consider that the ECD model is a suitable learning model for any vocational education. According to the respondents' opinions, this ECD learning model is suitable for everyone, especially vocational engineering education students.

b) Field Assessment

Based on the field assessment, the field assessment results of the ECD learning model from the explanation of Figure 6.18 and Table 6.8 as follow: the score of professional structured materials aspects is 85.56, relevant educational content is 85.33, collaborative support is 85.00, visual design quality is 85.33, the innovative feature is 85.00, and usability of 85.67.

From all the assessment results of content knowledge, pedagogy, and technology, the ECD learning model gets a mean score of 85.31, above 80.00. It is included in the very high score category, which is stated as highly feasible. According to the descriptive statistics, the accumulative assessment scores are all very high. The respondents give positive responses to the model in the very high category. Most of the respondents agree that the ECD learning model is feasible for vocational education. The respondents think that the ECD model is easy to follow, and the respondents do not worry about following the course.

According to the respondents' opinions, this ECD learning model is good for engineering student and everyone, especially vocational civil engineering education students. The opinions for the ECD learning model are as follow:

(1) The duration of the course takes very long time. Many of the students do not have many experiences about credits system. Some of them have opinion that pre-class, regular class, and after-class is too long. Not many students understand about the regulation
(2) Many of the student feel happy to follow the course
(3) The learning is designed well
(4) Students enjoy the collaboration
(5) Provide more learning opportunities
(6) Students like to use the e-vocational platform
(7) Students feel that it is fun for them to achieve competencies
(8) There is no worry and no stress.

6.6. Conclusion

The ECD learning model develops students' self-competence to perform in the world of work both as workers, entrepreneurs who develop their careers continuously. Students become the center of the learning process. Students must be creatively active to experience all the processes of forming their competencies. In students, there must be changes in themselves from not working to being able to work, proficient at work, skilled at work. The ECD learning model provides a real learning experience and is full of work values. The learning model trains and familiarizes students with the workplace, appreciates the work process, loves work as a form of self-motivation in learning.

From the technology, pedagogy, and content knowledge field assessment results, the model score is 85.31, above 80.00. It is included in the Very High score category or Highly Feasible. According to the descriptive statistics, the accumulative assessment mean value is all very high. The respondents give positive response to the model in a Very High category. Almost all the respondents agree that the ECD learning model is feasible for vocational education. The respondents think that the ECD learning model is easy to follow, and the respondents do not worry about following the course.

According to the experts and respondents' this ECD learning model is good for everyone, especially vocational civil engineering education students. Opinions regarding the ECD learning model are as follow:

1) Many of the student very happy to follow the course
2) It is a well-prepared course
3) Students enjoy the collaborative task
4) More learning opportunities, more fun
5) e-vocational web makes some respondents feel proud, and want to learn more
6) Sustainable learning model
7) Some student love to make the presentation video and act like youtuber
8) Some of the student want more. Even graduate, they ask permission to access even after they are graduate
9) Look easy for them to achieve competencies, collaboratively and assist from new friend
10) According to the respondents, the stress level is low
11) The duration of the course takes very long time. Many of the students do not have many experiences about credits system. Some of them have opinion that pre-class, regular class, and after-class is too long. Not many students understand about the government regulation.

According to the experts and the students, there are two main advantages of this ECD learning model:

1) The collaborative approach that is continuously promoted sustainably makes students feel optimistic in learning, happy, and comfortable, students' stress levels are low, the fear of failure in learning will be reduced, there is even no fear. Learn together, succeed together
2) The ECD learning model with online e-vocational learning platform support makes students more confident. Students feel they can access it at any time. whenever they encounter difficulties, they can immediately access to get solutions easily and economically.

CHAPTER 7 EVALUATION OF THE E-VOCATIONAL LEARNING PLATFORM ON THE ECD

7.1. Summary

As a part of development study in developing a relevant vocational course to improve student skills for meeting the industry requirement, this research aims to enhance collaborative mindset in CAD construction drawing course using e-vocational blended online learning platforms. The flipped classroom strategy is employed to conduct the learning process with a project-based approach. The platform facilitates the learning process and changes the negative mindset with the positive ones, inside and outside the class. It provides a project showroom embedded on the website with comment tools for discussion, learning material, and sustainably developed tutorial video. The blended online platform, including WordPress content management system (CMS), Zoom, YouTube, Google for Education, Imgbb, Whatsapp SNS, and eFront learning management system (LMS), which combined into an integrated learning media for providing the needs of the learning methods used in the course with better benefits, accessible and easy to follow by the students. A study was conducted to discover students' collaborative mindset improvement in two different classes, an experiment class B and a control class A. Class B consisted of 36 students use the blended online learning platform with a project-based flipped classroom strategy, and Class A use the regular learning model consists of 39 students. Data analysis was performed by descriptive analysis, paired sample t-test, and independent-sample t-test. The descriptive analysis showed collaborative mindset average scores of 70.90 in the pre-test and 73.91 in the post-test on a scale of 100 for class A. In contrast, class B collaborative mindset average scores are 70.28 and 79.93 for the pre-test and post-test, with an N-gain score of 0.3225, which means the collaborative mindset increased by 32.25% after being treated by applying the blended online learning platform for one month. The paired samples t-test analysis of the experiment class discovers a significant improvement of collaborative mindset with a highly significant correlation of 0.935 and Sig. 0.000 between pre-test and post-test. Moreover, the independent samples t-test revealed the two classes' initial behaviors are equal. In opposition, the post-test result asserts a significant difference of collaborative mindset between the experiment class and the control class with a t_{count} of 3.707 and the value of Sig. (2-tailed) 0.000. Based on all the analysis tests, it can be concluded that the blended online learning platform with project-

based flipped classroom strategy is significantly enhancing students' collaborative mindset. Furthermore, the next activity is conducting the summative evaluation and developing the platform based on further evaluation.

Keywords: collaborative mindset, student skill, construction drawing skill, civil engineering drawing skill, collaborative skill, vocational course

7.2. Introduction

7.2.1. Background

Education facilitates socioeconomic flow upward and is a key to leaving poverty in all countries. The global pandemic has far-reaching consequences that may endanger hard-won earnings made in improving global education as the aim of UN SDG4. The UNSDG4 generating a skilful and qualified workforce in their fields to get a proper job to assure society's well-being [2][3]. In line with Presidential Regulation Number 18 of 2020, the Indonesian national mid-term development plan 2020-2024 increases human resources' quality to be skilled, competitive, intelligent, adaptive, and innovative through quality education services improvement [5][6].

Vocational education aims to develop individuals' potential to have better work insight, better technical skills, and self-transformation to the industry's changing demands and the job market. It has a decisive role in developing the employer's quality and promoting welfare to respond to social and economic interests. With an ideal learning strategy and matching supporting tools for adapting the condition of industry and world of work, every vocational student should be ready to be professional in providing such services or business ventures, having economic value, producing better commodities and services to meet society's needs [13][22]. Vocational education needs to increase its relevance to industrial needs by implementing various strategies, including improving the quality of learning in synergy with industrial conditions. Carrying out proper apprenticeship accompanied by learning in the classroom with adopting work conditions is needed to train students to be technically skilled and adapting quickly in the workplace. Besides the technical skill enhancement and technological development, a crucial part of the strategy also concerns the work application and the adoption by real workplace practices [23]. Understanding the high expectation of vocational education, where students who graduate from vocational schools are required to be ready to work and be able to adapt to their work along with all the challenges faced in the world of work, the next question is how to provide

the best and logical solution to arrange. As it is known that vocational education management requires higher costs than the general one, where the vocational school must provide necessary learning facilities which at least equivalent to industrial conditions as the effort to give good learning experiences for the student to become professional workforce to work optimally after all, besides expensive, the needs of facilities and learning equipment in each field of expertise are varied, vocational education also faces enormous challenges with the various conditions of expertise needed by the industry. This diversity of areas of expertise adds to the burden on the government in providing vocational education services.

The specific and various learning facilities and equipment for each expertise make the condition more difficult for vocational education providers to realize an excellent vocational school. Instead of creating a perfect vocational school that can produce graduates ready to work, many schools have difficulty keeping minimum operation sustainably. Many vocational schools closed because they could not finance educational operation, which is relatively expensive, and many requirements must be fitted as the right workforce providers [24][25]. This research was initiated from the concern over the harsh conditions in which vocational education must educate students to become trained graduates who can adapt well in the workplace but with limited expenses. Meanwhile, generally, even with adequate finances, it is still not easy to build a vocational school that is adequate and can sufficiently carry out its duties. The collaborative mindset improvement then became the main idea to decompose the project-based learning approach and adapt them into the contextual vocational condition using the flipped learning strategy supported by e-learning in a CAD construction drawing course.

7.2.2. Identifying and Determining the Course

Studying in a vocational environment, students should have the corresponding learning experience as in the workplace to prepare their working readiness to afford such services or business ventures. However, making the learning process the same as the workplace is expensive. Moreover, it is not a simple task to arrange the learning experiences similar to the workplace condition. The effectiveness of all vocational education systems depends critically on teaching and learning in the classrooms, workshops, laboratories, and other learning spaces. Besides the educators' involved students in active learning, well-designed curricula, fit for purpose equipment, and an adequate reserve level are unavoidable components for excellent educational provision [112]. The preliminary study was

conducted at the Civil Engineering Education Study Program in Indonesia. Observations were conducted to see the learning problem which occurs in the learning process.

Table 7. 1 The 28 of 41 Major Skills Courses in Civil Engineering Education Study Program

Num.	Course Name	Num.	Course Name
1	Applied mathematics	14	Environmental Engineering
2	Carpentry equipment	15	Construction checks and repairs
3	Applied physics	16	Building Materials Science
4	Engineering mechanics 1	17	Soil Mechanics
5	Engineering mechanics II	18	Concrete Technology
6	Engineering mechanics III	19	Concrete Structures I
7	Engineering mechanics IV	20	Concrete Structures II
8	CAD Construction Drawing	21	Basic construction of roads and bridges
9	Building Construction I	22	Steel Structure
10	Building Construction II	23	Hydraulics and Water Building
11	Building Construction III	24	Foundation Engineering
12	Surveying I	25	Drawing Techniques
13	Surveying II	26	Construction Management
14	Environmental Engineering	27	Cost Estimation
15	Construction checks and repairs	28	Wood Structure

The study began by reviewed the courses and determined the CAD construction drawing course to be developed. The construction drawing skill is essential for supporting other courses in civil engineering education. For this purpose, drawing skills should be learned effectively in every stage of technical vocational education [22]. Totally 68 courses need to be passed to finish the Civil Engineering Education Study Program for Structure major and 67 for Drawing major, including ten general courses, five basics education courses, 41 major skills courses as the vocational courses, five major skills by interest, and 12 optional courses. Six learning process skill courses and one educational development course. The 41 major skills courses were observed (see Table 3.1 Chapter 3). The observation was based on (1) the linkages' level with learning outcomes; (2) facility problem; and (3) the difficulty in implementation [12]. The courses were observed and reviewed involving the course lecturers by interviews and discussions.

The discussion result stated that the highest urgency level is the CAD construction drawing course, with the highest score of 12 on a scale of 12, four scores in all three indicators. After determining the course, observation of the student competency in CAD construction drawing was conducted by investigating their performance when doing the

industry internship. The investigation contributes substantially to determining the strategy and learning experiences for the instructional design. The CAD construction drawing competency indicators are as follow:

1) Mastering general principles of building design, including building regulation
2) Planning the concept design of the building
3) Preparing to draw: determining the materials and tools needed; making a work schedule and procedures
4) Sharing the drawing tasks to the team member
5) Mastering the drawing process: software settings; coordinate system and CAD tools, analyzing drawing plans; doing the drawing process
6) Communicating with the team regarding the drawing process
7) Complying with the rules of technical drawing: drawing simple construction objects and modify; applying drawing layout; drawing construction line; applying the use of letters, numbers, and symbols; applying drawing title block; applying the correct construction shape; applying the drawing scale; drawing the building materials with the correct symbols; drawing construction details; determining the completeness of the drawing
8) Drawing construction plans and construction detail drawing including applied objects in buildings construction, modify with dimension, layers, and assembly the whole construction drawing: drawing floor plans; drawing the building view; drawing section; drawing the detailed foundation plan; drawing the detailed roof plan; drawing the plumbing and ME plans; drawing the title block; Setting and operating the plotter
9) Presenting the drawing project: presenting the drawing information both verbally and in writing; explaining the arguments of the drawing concept.

The course's instructional design was prepared using the project method stems from John Dewey's idea of the concept of learning by doing. The skills will develop as students meet new experiences that enforce building and modify the first knowledge. Student skills development is influenced by many new practices when studying and then strives to solve the problems raised by their experiences, the process of acquiring learning outcomes by working on certain actions following the objectives [106][207]. According to Piaget, student competence will rise as long as they face new experiences that push them to create

and adjust their primary knowledge. While Vygotsky states that individual intellectual development is faced with new and challenging experiences and then attempts to solve the problems by that experience. It is in line with constructivism which emphasizes knowledge built by using the experiences and cognitive structures they already have [104][107].

Project-based is an effective learning approach in the twenty-first century. Students drive their learning through inquiry and learn collaboratively to search and create projects reflecting their skills. The project-based principles refer to the Gold Standard [107], Edutopia, start with giving essential questions, designing a plan for the project, creating a schedule, monitoring the students and the progress of the project, assessing the outcome, and experience evaluation [108][208], and Hrbek & Stix [117]. The steps were then consulted with vocational teachers and lecturers in a group discussion to determine the ideal PBL syntax for a vocational course. The flipped classroom was employed as the instructional strategy to solve the problems. A type of blended learning reverses the common learning system by giving the lesson outside the class. It switches the normally done in class with the normally done outside as homework [62][65][72][209] with vocational context adoption.

7.2.3. The Facility and Students' Readiness

Accessing e-learning by students' personal computer could reduce the needs of school facilities. Although the laboratory has a minimum facility, the student still could have the course delivered. This study's first idea comes from implementing an ideal vocational course, which needs sufficient facilities to assist the student learning experiences, which is considered expensive. This study expected to get the right solution in an effective way that avoids the high cost. In a minimum facility, this proposing solution will solve the problem by giving the student a chance to have the lesson with their personal computer without waiting the available time to use the laboratory computer, which is entirely possible at the course schedule. The study investigated the students' computer availability. There are other alternatives, such as family and friends' availability. Besides the willingness to buy and rent a computer and agree with developing an e-learning.

7.2.4. Designing Blended Online Learning Platform

The online platform development is based on the analysis requirements of instructional design for the course. This phase including defining curriculum for the course, pedagogical approaches, Student skill characteristics, primary problem analysis (facilities

needed, the course duration, mastering the competency, working in teamwork, and project supervising), and designing online instruction. The framework is presented in Figure 7.1.

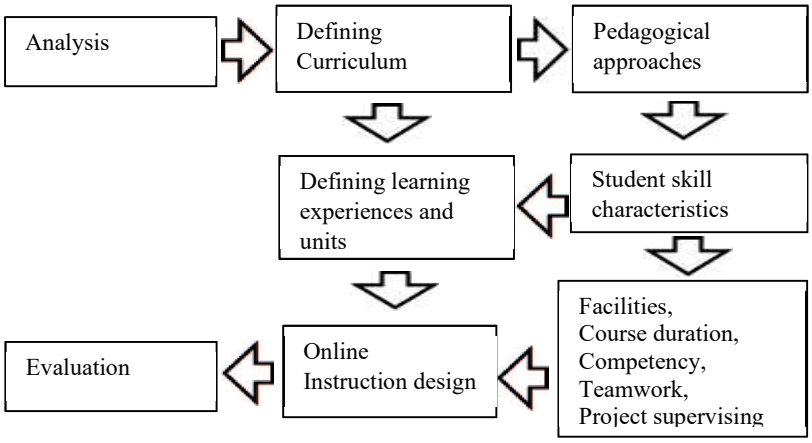


Figure 7. 1 The Framework of Online Platform Analysis Activities

The main idea is to design a better practical learning model at a low cost. Regarding this purpose, our strategy is to build the learning platform by integrating several inexpensive resources, some of which are free open source. Besides, the research strives to use the already owned equipment and commonly used by students in general. The online instruction used blended online platforms, including WordPress as the CMS, WhatsApp SNS, the eFront as the LMS, YouTube, Imgbb image hosting, and Google for Education that integrated into a learning package. It provides a project showroom to publish the project, collaborative learning material, and tutorial videos. Figure 7.2 shows the thinking framework for developing the e-vocational platforms to support the ECD learning model.

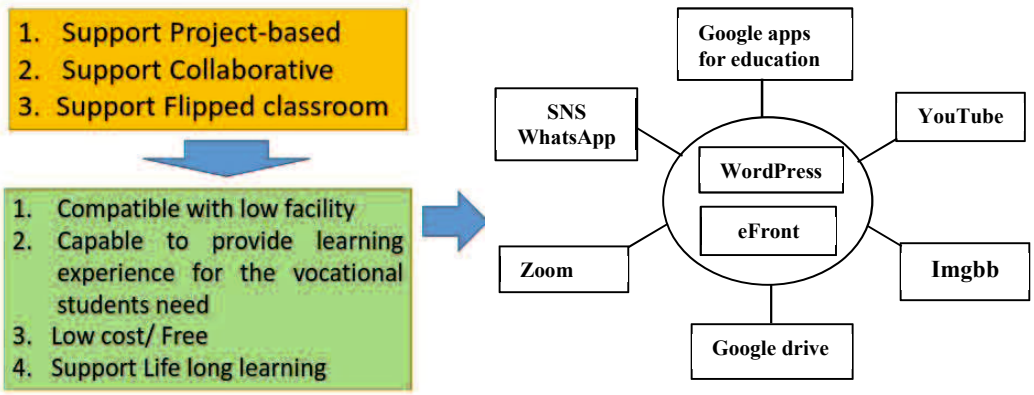


Figure 7. 2 The Thinking Framework of Blended Online Platforms

In this study, the blended online platforms were considered a viable and practical solution. Modern technology is changing every aspect of human lives. Every new

technology is having a huge impact on societies. However, one of the greatest challenges is not only about new technology. It is about managing cultural changes as we can see around us, how technology is adopted in different ways and how countries are digitally divided by access and availability [210]. Many facets of global communications today are influenced by cultural differences, such as email, zoom, social media or the telephone. The key to communicating successfully is understanding and respecting all of our differences to enable a positive impact. Why do people keep having both emails, zoom, social media and even the old telephone? Why not just have one of them that is believed to be the most modern and replace others. People keep using email to send formal messages, using Line to send casual messages, using a telephone to call the police. All those devices are all important for everyone with different kind of situation and certain needs. Besides, community habits also play an important role in using a platform. As in Japan, people commonly use Line SNS [211][212]. In China, people commonly use WeChat [213][214], while in Indonesia, almost all people use WhatsApp [215][216]. It is not easy to ask the Indonesian people to use Line instead of WhatsApp, and it also happens for the Japanese to use WhatsApp instead of Line. Regarding this situation, the study does not change or eliminate the existing platform with the new one, but on the contrary, the existing platforms are actually used and optimized for educational development at a low cost.

WordPress as CMS is used to build the main website for information center and showroom. To complete the website interactivity, WhatsApp SNS is pinned on it. Visitors can easily communicate using this platform. As for the e-learning platform, this study uses eFront LMS by utilizing several other platforms to accommodate various learning methods' needs. Zoom is used to meet the lecture, group discussion and presentation methods. Google Drive is used for task storage and various other storage needs. YouTube is embedded to support tutorial learning and save student work in video formats. Imgbb is used as a means of storing images and files displayed on the website. Other learning needs include doing group assignments online using google doc and google for education.

7.3. Methods

7.3.1. Research Method

The main research uses a development research method. It adapts the Borg and Gall for the model. While other supporting research uses survey, *ex-post-facto*, experiment and evaluation research. This chapter performs the Borg and Gall adaptation research cycle in

the previous chapter (Figure 3.1) with a modification in the implementation phase. Figure 7.3 presents the main developmental research cycle, which shows the position of chapter 7. This chapter is an implementation part of evaluation research aiming to discover students' collaborative mindset enhancement in CAD construction drawing course using blended online learning platforms.

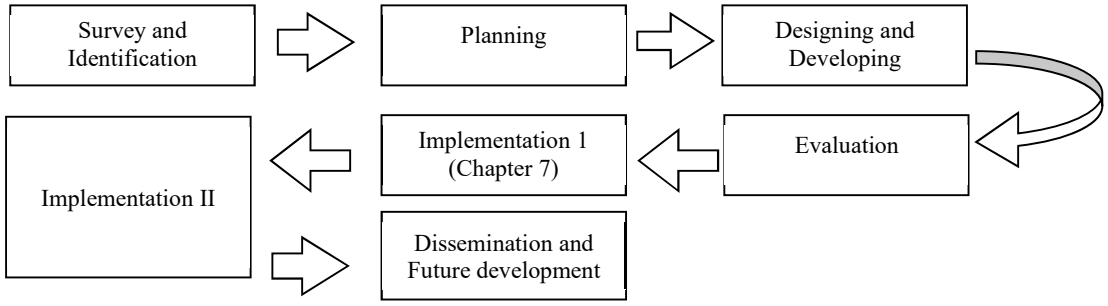


Figure 7. 3 The Main Research Cycle with Additional Implementation Phase

This study evaluates the blended online learning platforms in improving the collaborative mindset by experiment. It is quasi-experimental research using a quantitative approach to find the effect of certain treatments on others under controlled conditions [199]. It measured the enhancement level of student collaborative mindset using the blended online learning platform with project-based flipped classroom strategy in the experiment class, and the control class used the regular learning model without using the blended learning platform. Data analysis was performed by:

1) Descriptive Analysis

   The descriptive analysis illustrates the collaborative mindset in the pre-test and post-test of the experimental class and the control class by displaying the mean, frequency distribution, histogram, then the collaborative mindset data categorized by the criteria developed by Azwar [217] as presented at Table 7.2.

Table 7. 2 Assessment Criteria of Collaborative Mindset

Grade Range	Criteria of collaborative mindset
More than Mi +1.5 SDi or above ($\geq$ 81.25)	Very Good
Mi+0.5 SDi < X $\leq$ Mi + 1.5 SDi (68.76-81.25)	Good
Mi-0.5 SDi < X $\leq$ Mi + 0.5 SDi (56.26-68.75)	Fair
Mi – 1.5 SDi < X $\leq$ Mi – 0.5 SDi (43.76-56.25)	Low
Less than Mi – 1.5 SDi ($\leq$ 43.75)	Very Low

2) Paired Sample t-test

It analyzes student collaborative mindset improvement before (pre-test) and after the experiment (post-test) for both experiment class and control class. The paired samples t-test was employed in two ways, firstly, by comparing the value of Sig. (2-tailed) with 0.05 probability. If the value of Sig. (2-tailed) less than 0.05 probability, it means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted, with an interpretation there is a significant improvement of student collaborative mindset between pre-test and post-test. On the other hand, if the value of Sig. (2-tailed) more than 0.05 probability, it means the Null Hypothesis is accepted, and the Alternative Hypothesis is rejected, with an interpretation there is no significant improvement of student collaborative mindset between pre-test and post-test. Secondly, the assumption of $t_{count} > t_{table}$ with 5% probability (1-tailed) is written in the critical value table of t distribution, which means the Null Hypothesis is rejected and the Alternative Hypothesis is accepted. The interpretation, there is a significant improvement of student collaborative mindset between pre-test and post-test. Before employing the paired sample t-test, the Analysis prerequisite test is needed to confirm the data has a normal distribution using the Shapiro Wilk test. The assumption of a normal distribution is when the value of Sig. more than the specified alpha level of 5% [218].

3) Independent Sample t-test.

It analyses the differences of collaborative mindset between the experiment class use the blended online learning platform with project-based flipped classroom strategy and the control class use the regular learning model without using the blended learning platform. The independent sample t-test was executed at the pre-test of the experimental class and the control class to find out whether the conditions of the experimental class and control class were different or not. If the result shows no difference, then the experiment can be continued by implementing the blended online learning platform with a project-based flipped classroom strategy at the experiment class. After the experiment was carried out for the specified period, a post-test was carried out in the experimental and control classes. The post-test results of the experimental class and the control class were then tested

using an independent sample t-test to determine the difference in the collaborative mindset after the treatment.

The independent samples t-test was employed in two ways, firstly, by comparing the value of Sig. (2-tailed) with 0.05 probability. If the value of Sig. (2-tailed) less than 0.05 probability, it means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted, with an interpretation there is a significant difference of student collaborative mindset between experiment class and control class. On the other hand, if the value of Sig. (2-tailed) more than 0.05 probability, it means the Null Hypothesis is accepted, and the Alternative Hypothesis is rejected, with an interpretation there is no significant difference of student collaborative mindset between experiment and control classes. After that, the assumption of $t_{count} > t_{table}$ with 5% probability (2-tailed) is written in the critical value table of t distribution, which means the Null Hypothesis is rejected and the Alternative Hypothesis is accepted. The interpretation, there is a significant difference in student collaborative mindset between experiment and control classes. Before analyzing the data by the Independent Samples t-test, the normality and variance homogeneity of data should be first examined as analysis requirements. It is needed to confirm the data has a normal distribution using the Shapiro Wilk test. The assumption of a normal distribution is when the Sig. Value more than the specified alpha level of 5%. The homogeneity of variance test using Levene's test provided that the Sig. > 0.05, then the homogeneity of variance of the two groups is the same [218].

4) Normalized Gain Analysis

This analysis aims to determine the achievement of collaborative mindset improvement from the experiment conducted. The normalized gain analysis formula is employed with an interpretation of $g<0.3$ is low, $0.3 \leq g < 0.7$ is medium, and $g \geq 0.7$ is high. [219]. The formula is given at equation 7. (1).

$$g = \frac{S_f - S_i}{100 - S_i} \tag{7. (1)}$$

where g is gain score, S_f is the final score (post-test), and S_i is the initial score (pre-test).

7.3.2. Population and Sample

As a part of development research, the research subjects were all students in the fourth-semester of the Civil Engineering Education Study Program. It was conducted in the semester of February-July 2021. 36 students of class B as the experiment class and 39 students of class A as the control class. The instrument used in this study is a collaborative mindset rubric which has 10 indicators as described in Table 7.3 below. The collaborative mindset rubric was given to the students at the beginning of the class lesson to discover their entry behavior. After one month of the learning process, an assessment was conducted again to the students to know the collaborative mindset's improvement after one month experiment.

Table 7. 3 Collaborative Mindset Indicator

Number	Collaborative Mindset Indicators
1.	Willing to be an active problem solver, idea maker, and like discussion
2.	Willing to have a job preparation before working with high expectations
3.	Willing to work in a team with many risks and problems
4.	Prioritizing choices matching the expectations of the team
5.	Prioritizing collaboration between peers rather than individual competition
6.	Prioritizing group responsibilities and learning interdependence
7.	Looking at existing knowledge is not the only source of learning, but many others can be extracted from the community group
8.	Willing to give colleagues the opportunity to be active participants in the learning process
9.	Willing to build the spirit of lifelong learning
10.	Willing to foster relationships that support and respect each other among colleagues

The instrument was examined using the content validity test with the raters agreement index proposed by Aiken *V*. The seven raters consist of lecturers and industrial practitioners. With validity assumption of an index value of $V \geq 0.40$ is consider being valid [129][170]. The formula is defined as equation 7. (2).

$$V = \frac{\sum s}{n(c-1)}$$

$$V_{for\ 39\ items} = \frac{\overline{\sum s}_{for\ 10\ items}}{n(c-1)} = \frac{18.10}{7(4-1)} = 0.86$$

7. (2)

where *V* is raters agreement index, *s* is the score assigned by each rater minus the lowest score in the category used ($s = r - I_0$, with r = score assigned by each rater and I_0 the lowest

score in the scoring category), n = the number of raters, c = the number of score the rater can select. The result showed that the content validity is 0.86, which is higher than the value of the V index of 0.40, where it can be interpreted that the assessment instruments are maintained valid.

The instrument's reliability used the Interclass Correlation Coefficient (ICC) formula, with a reliable assumption of the ICC value more than 0.75 (ICC value ≥ 0.75 for a reliable decision [130]. The formula is given by equation 7. (3).

$$r = \frac{MS_{people} - MS_{residual}}{MS_{people} + (df_{people}\, x\, MS_{residual})}$$

$$r = \frac{1.633 - 0.037}{1.633 + (6\ x\ 0.037)} = 0.86$$

7. (3)

where r is ICC coefficients, MS_{people} refers to mean square between people, $MS_{residual}$ is the mean square within people residual, and df_{people} refers to degree of freedom within people. The collaborative mindset assessment instrument reliability test results using the IBM SPSS showed that the ICC reliability coefficient value of 0.860 meets the requirement of the ICC reliability coefficient value ≥ 0.75. Therefore, the collaborative mindset assessment instrument is reliable.

7.4. Result

7.4.1. Initial Behavior and Implementing the Online Learning Platform.

To discover the improvement of students' collaborative mindset while using the blended online learning platform and implementing the project-based flipped classroom strategy, the student's initial condition in both class A and B was observed using a collaborative mindset assessment instrument pre-test. The analysis result of descriptive statistics showed the collaborative mindset pre-test mean score of class A is 70.90 on a scale of 100. Simultaneously, the collaborative mindset pre-test of class B showed a mean value of 70.28 on a scale of 100. it is included in the good category with grade values in the range of 68.76-81.25 according to Azwar's assessment criteria [217] as presented at Table 7.2. The initial collaborative mindset from the pre-test showed the mean scores presented in Figure 7.4.

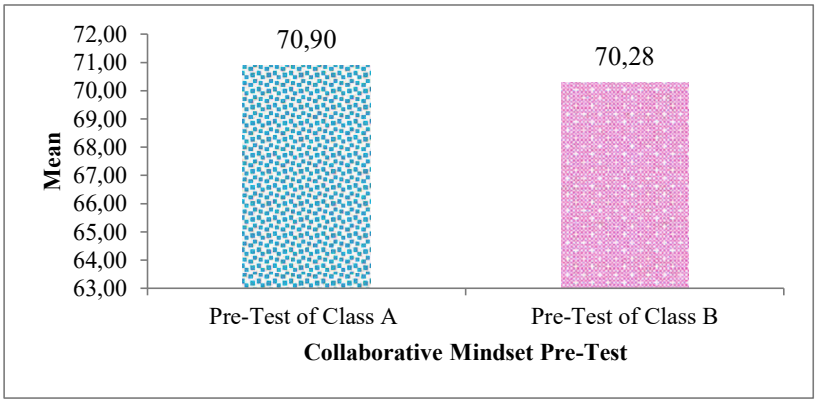


Figure 7. 4 Collaborative Mindset Pre-Test Mean Score

To ensure equality between the experiment class and the control class, testing the difference in the mean pre-test scores of the experimental and control classes with the independent sample t-test. The normality and variance homogeneity of data should be first examined as analysis requirements before analyzing the data by the Independent Samples t-test. It is needed to confirm the data has a normal distribution using the Shapiro Wilk test as presented at Table 7.4. The assumption of a normal distribution is when the Sig. value more than the specified alpha level of 5%. According to the Shapiro Wilk test, Sig. value for class A pre-test is 0.243 and Sig. value for the class B pre-test is 0.090. As these two Sig. values > 0.05, so it can be concluded that the pre-test in both classes have a normal distribution. Thus, the requirements and assumptions for normality in using the Independent Sample t-test have been fulfilled.

Table 7. 4 Summary of Normality Test of Experiment and Control Classes (Pre-Test)

	Group	**Shapiro-Wilk**	**Conclusion**
		Sig.	
Collaborative mindset	Class A Pre-test	0.243	Normal
	Class B Pre-test	0.090	Normal

The homogeneity of variance test using Levene's test provided that the Sig. > 0.05, then the homogeneity of variance of the two groups is the same. From the results of Levene's test, the Sig. value was obtained to 0.238 > 0.05, then the collaborative mindset data variant for the class A and class B pre-tests are the same or homogeneous. So, it can be concluded that the assumption of homogeneity of variance is fulfilled. Table 7. 5 shows the summary of homogeneity of variance test of class A and B pre-test.

Table 7. 5 The homogeneity of Variance Test of Experiment and Control Classes

	Levene's Test for Equality of Variances	**Conclusion**
	Sig.	
Collaborative mindset (Pre-test)	0.238	Homogeneous

After the pre-requisite test of the independent sample t-test analysis for normality and homogeneity had been fulfilled, an independent sample t-test was then analyzed to test the differences of collaborative mindset pre-test between the experiment class and the control class. The analysis result shows that the value of Sig. (2-tailed) of 0.782 more than 0.05 probability, it means the Null Hypothesis is accepted, and the Alternative Hypothesis is rejected, with an interpretation there is no significant difference of student collaborative mindset between experiment and control classes. After that, $t_{count} = 0.278 < t_{table} = 1.665$, which means the Null Hypothesis is accepted, and the Alternative Hypothesis is rejected. The interpretation, there is no significant difference in student collaborative mindset between experiment and control classes. Thus, it can be concluded that students' initial conditions of collaborative mindset between experiment and control class are equal. The independent samples t-test summary is presented in Table 7.6.

Table 7. 6 The Summary of Independent Samples t-test of Experiment and Control Classes (Pre-test)

	t-test for Equality of Means			**Conclusion**
	t	df	Sig. (2-tailed)	
Collaborative mindset (Pre-test)	-0.278	73	0.782	H_0 is accepted, and H_a is rejected

After the initial behavior between all classes was declared equal, the experiment was carried out in one of the classes where the other class can be used as a control class as a comparison to evaluate the success of learning in the experimental class. Further descriptive analysis is presented to explain the lowest mean score of the experiment class's collaborative mindset indicators. The lowest mean score of the collaborative mindset indicators from the pre-test are found in indicators number 1, 4, 6, 5, and 3 presented in Table 7.7 as follow:

Table 7. 7 The Five Lowest Initial Score of Collaborative Mindset Indicators

Indicator Number	**Collaborative Mindset Indicators**	**Mean Score of Experiment Class**	**Category**
1	Willing to be an active problem solver, idea maker, and like discussion	62.50	Fair
4	Prioritizing choices matching the expectations of the team	63.19	Fair
6	Prioritizing group responsibilities and learning interdependence	64.58	Fair
5	Prioritizing collaboration between peers rather than individual competition	66.67	Fair
3	Willing to work in a team with many risks and problems	68.06	Fair

The students' initial behavior is necessary to be observed before implementing the experiment. The students' weaknesses should be discovered and well concerned. Table 7.7 presents the lowest collaborative mindset indicator mean score for class B before the experiment started. The lowest mean score is in the first indicator, i.e., willing to be an active problem solver, idea maker, and like the discussion with a mean score of 62.50. Followed by the indicator number 4 prioritizing choices matching the team expectations with 63.19 mean score, number 6 prioritizing group responsibilities and learning interdependence with a mean score of 64.58, number 5 prioritizing peer collaboration rather than individual competition with 66.67 mean score, and the last fifth-lowest score is the indicator number 3 willing to work in a team with many risks and problems with a mean score of 68.06. The five collaborative mindset indicators with the lowest mean score are a concern for improvement during the experiment. Then, the pre-test frequency distribution in experiment and control class, presented in Figure 7.5.

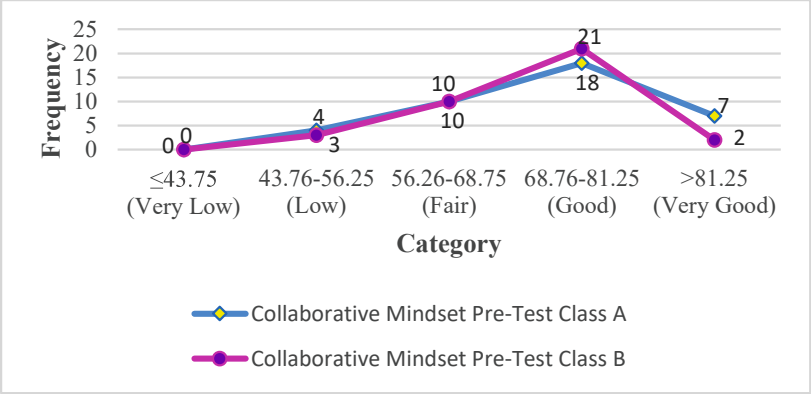


Figure 7. 5 Frequency Distribution of Collaborative Mindset (Pre-test)

The frequency distribution of collaborative mindset describes the student's initial behavior before having the treatment. Figure 7.5 shows the frequency distribution of collaborative mindset pre-test scores for class A and class B before being given treatment. The highest frequency was found in the value interval 68.76-81.25, including 18 students in class A and 21 students in class B. While the lowest frequency is in the interval of 43.76-56.25, consisting of four students in class A and three students in class B. Because the most frequent distribution of collaborative mindset pre-test scores is in the value interval 68.76-81.25 for both class A and class B, the pre-test collaborative mindset score is in a Good category. The frequency distribution and other descriptive analysis of the collaborative mindset are essential in defining the teamwork arrangement and synchronizing the project-

based flipped classroom learning model using blended online learning platform with student characteristics. Class B consisted of 36 students as an experimental class divided into seven teams, the orange and blue team, the pink team, the green team, the yellow team, the purple team, and the red team. Each of the seven teamwork consists of 5-6 students with a balanced composition based on the frequency distribution of the initial behavior obtained from the pre-test data. Each teamwork consists of three students who have a collaborative mindset score in the Good category, and the rest are students with a combination of Very Good, Fair, and Low categories as the frequency distribution shown in Figure 7.5. The application of the blended online learning platform with a project-based flipped classroom strategy is designed by applying the seven steps of project-based learning designed in previous research. Table 7.8 shows the ECD seven learning steps.

Table 7. 8 The Seven ECD's Learning Steps for Construction Drawing

Number	Learning Steps
1.	Teacher setting the challenging stage by giving examples of construction drawing project and essential sustained questions
2.	Student actively design the authentic construction drawing project by collecting information and negotiate the evaluating criteria sustainably
3.	Student actively create the schedule and work on the construction drawing project authentically
4.	Monitor the student activity and the progress of the drawing project
5.	Reviewing the construction drawing project to prepare for the presentation
6.	Present the project to collect critique and revision
7.	Doing reflection and evaluation as the criteria planned

Whereas in its implementation, these seven learning steps apply the flipped classroom strategy, which consists of three stages of activity, namely pre-class, regular-class, and after-class, as presented in Figure 7.6.

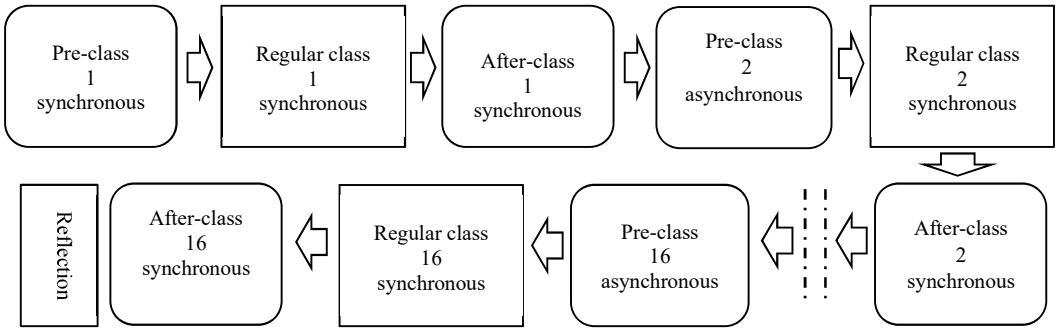


Figure 7. 6 Learning Steps Design Adopted from the 16 Regular Class Meeting

The implementation refers to Regulation Number 44, 2015, Article 17 of The Minister of Research, Technology and Higher Education of the Republic of Indonesia [31].

The learning model contains regular class meeting time is 16 times in one semester. This design using the Flipped classroom strategy with 16 meetings (face to face or synchronous), 16 pre-class meetings (independent assignment), and 16 after-class meetings (structured assignment). The learning experiment implements the blended online learning platform with a project-based flipped classroom learning model for one semester. As part of the research on designing vocational lesson and learning model development, this study evaluates the improvement of the collaborative mindset on learning for one month with four meetings, and wherein one meeting contains three learning activities, pre-class, regular-class, and after-class. The material discussed is the function and classification of building construction and building requirements, both administrative and technical, designed at meetings 1-2. The second material is buildings designed shop drawings and CAD basic-drawing operation at 3-4 meetings. Before the class start, students conduct socialization regarding implementing the blended online e-learning platform and the project-based flip classroom strategy model. The preparation activity is presented at Table 7.9.

Table 7. 9 The Preparation Steps of the ECD Learning Model

Number	Preparation Steps
1.	Socializing lecture mechanism through notice boards, website, study program admins and circulars to academic supervisors.
2.	Informing the students to register phone numbers, SNS WhatsApp account, and e-learning account through the e-vocational website or directly by contacting the lecturers.
3.	Forming a WhatsApp group.
4.	Creating e-learning account.
5.	Informing students to open the e-learning and study the material available through WhatsApp SNS.
6.	After students open e-learning, the e-learning inform the lecture mechanism and present the learning material for the first pre-class, Building construction function and classification, building administrative requirements, building reliability requirements.
7.	Conducting pre-assessment, construction drawing and collaborative skills.
8.	Guiding the course through SNS WhatsApp and e-learning.

SNS WhatsApp Group gives information about learning activities, including pre-class, regular-class, and after-class. In pre-class, students do self-learning activities supported by the online platform for preparing the students' readiness to join the regular-class. Students learn CAD construction drawing course materials through the LMS eFront platform, which is integrated with various complementary platforms to facilitate student learning activity and enhancing students' collaborative mindset, such as Google for Education, YouTube, and Imgbb. It contains lesson material and guidance for students to have contextual learning experiences and training to master CAD construction drawing

competency and enhance their collaborative mindset. Regular-class is a structured learning activity carried out synchronously through the e-learning platform with a Zoom meeting where lecturers and students conduct face-to-face online lectures in a single meeting room and breakout rooms for teamwork discussions. After finishing the regular class, the last learning activity in one class-package is the after-class. It is a follow-up of regular-class with synchronous design for advancing the students' skills and monitoring the student activity and the project's progress. Pre-class, regular-class, and after-class are scheduled for one-week activity. The pre-class is carried out before the regular class with no scheduled meeting, an asynchronous class form, except the course's first meeting. Regular-class is scheduled once a week, in the morning for 100 minutes (2x50 minutes), starting from 10.50 to 12.30, followed by after-class, held for 120 minutes (2x60 minutes) every Monday evening from 19.30 to 21.30. To describe the class model, Table 7.10 presents the learning activities and students experiences in the first class.

The lesson continues from the first pre-class, regular-class, after class to the next class, second first pre-class, and regular-class. Students access the e-vocational blended online learning platform to learn about building regulation, watch the tutorial video, be trained to do the assignment and also bonus stages assignment. The lecturer asks questions randomly for preliminary evaluation of pre-class completeness in the class, directing each team to refer to the City Regency Planning Information, in Indonesia *Keterangan Rencana Kota/Kabupaten* (KRK), which contains information about the city's building and environmental requirements. For the online teamwork working, the lecturer making Zoom meeting breakout rooms according to the number of teamwork. Students discuss in their respective rooms making project design concepts and applying KRK to make presentation materials. The lecturer encourages and motivates each team member to communicate with the client confidently to get the land area measurement and government regulations data for doing the project planning. This experience will influence their motivation to cooperate and help each other, leading to an improved collaborative mindset. Pre-class one was held on Monday, February 15, 2021, at 10.50-12.30 Western Indonesia Time or in Indonesia *Waktu Indonesia Barat* (WIB) Coordinated Universal Time (UTC)+07:00. As it is the first meeting, it is crucial to give better information and apperception to the student by synchronous and asynchronous online class to address students to be ready and motivated to join the whole class successfully.

Table 7. 10 Summary of Learning Activities and Experiences in Pre-Class 1, Regular-Class 1, and After-Class 1

Class Information	Activity and Learning Expereiences
Pre-class 1 **Schedule**: 1. Synchronous (Only for **pre-class 1**) Monday, Feb 15, 2021 **Time:** 10.50-12.50 Western Indonesia Time or in Indonesia *Waktu Indonesia Barat* (WIB) Coordinated Universal Time (UTC)+07:00 2. Asynchronous Monday-Sunday, Feb 15-28, 2021 **Time:** free (min learning time 2 x 60') **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 1 objective:** 1. Identify the building drawing projects 2. Plan the determined building construction project 3. Propose work schedule 4. Identify the collaborative mindset to socialize with the team 5. Recognize the collaboration between peers as the best strategy to finish the project optimally	**Synchronous** 1. Receiving the teacher greetings by WhatsApp SNS and prepare for learning 2. Access the e-vocational platform (1') 3. Enter the **Introduction Module,** Pre-test topic (basic drawing), and join zoom link. (1') 4. Hearing the lecture and understanding the collaborative mindset enthusiastically. (10') 5. Doing Pre-test (basic drawing). (20') 6. Enter the **Introduction Module,** Challenges, and examples topic **7. Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project. (1)** (15') 8. Learning the challenging stage and examples by e-vocational platform. (20') 9. Hearing the announcement enthusiastically and socialize with new teamwork. members. Open the determining teamwork group topic (1') 10. Hearing the teacher direction and identifying how to organized the teamwork. (5') 11. Preparing to join the teamwork discussion room for teamwork working. (7') 12. Enter the discuss room. Organize teamwork, **actively design the authentic Project**. **(2)** (30') 13. Moving to the Zoom mainroom. (10') 14. Concluding the lesson, understanding the assignment in asynchronous pre-class 1. 15. Mastering the lesson connect to the next meeting, (synchronous pre-class and regular class 1). **Asynchronous** 1. Receiving the teacher greetings, motivated and begin to prepare for learning, and identifying the informations about the learning activity by the WhatsApp SNS group. (at the beginning of the **Asynchronous** class) 2. Having apperception and motivation. (by asynchronous e-learning) 3. Enter the **Introduction Module,** Pre-test topic (**Doing the pre-test** of Student skill assessment for construction drawing) 4. Collecting information about the designing Project, including the project location, land area, and the building regulations set at the site. (based on each group discussion) 5. Determining the best building construction project to design in a teamwork discussion. (based each group appointment, by elearning forum and WhatsApp SNS Group) 6. Giving a chance to each team for finding and getting a client who needs to build the building project. (based on each group discussion) 7. Each teamwork member involves communicating with the client to get the land area measurement data and government regulations data for doing the project planning. (based on each group discussion) 8. Negotiating the evaluating criteria of the Project in teamwork and lecturers. (based each group appointment, by elearning forum and WhatsApp SNS Group) 9. Challenged to create the schedule and work on the Project Creating the schedule and work on the Project. (based each group appointment, by elearning forum and WhatsApp SNS Group)
Regular-Class 1 Time: Monday, Feb 22, 2021 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous Methods: Lecture, demonstration, discussion Media: e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	1. Receive the teacher greetings by WhatsApp SNS, prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the Modul 1 **Building Regulations** topic, and join the embedded zoom link. (1') 4. Apperception, prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to organize the teamwork, **create the schedule and work on the Project actively (3)** in Planing the determined building construction project. (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create the schedule and work on the Project authentically. (3)** Planing the determined building construction project (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment for after-class 1 b. Identifying the lesson connection for the next meeting, (after-class 1).
After-Class 1 Time: Wed, Feb 22, 2021 19.30-21.30 (120') (WIB) UTC+07:00 Synchronous Methods: Lecture, demonstration, discussion Media: e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	1. Receive the teacher greetings by WhatsApp SNS, prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the Modul 1 **Building Regulations** topic, and join the embedded zoom link. (1') 4. Hearing the apperception and motivation of prioritizing team choices for the best achievement. (10') 5. **Presenting the Project to collect critique and revision. (6)** (13'x7=91') Learning to socialize and interact with people in a presentation forum Collecting critique and revision 6. Doing **reflection and evaluation as the criteria planned. (7)** (10') 7. Identifying the connection between the present lesson with the next lesson in pre-class 2. (7')

Regular-class one was held on Monday morning, February 22, 2021, while after-class one was held in the evening on the same day. They were followed by the next pre-class, the regular-class, and the after-clas two, three, and four held on every Monday, March 1, 8, 15, 2021, where the pre-classes were held independently by self-learning before the students entering the regular-class. After four weeks, the learning process entering the fourth class meeting, Monday, March 15, 2021. The lecturer conducted a post-test to both the experimental and control classes to assess the collaborative mindset improvement.

7.4.2. Collaborative Mindset Enhancement

As a part of an ongoing study of designing a vocational course learning model and e-learning platform, this study presents an examination of the blended online learning platform with project-based flipped classroom model implementation into an experiment class of a civil engineering education study program. The study implemented two times assessment for this experiment. The first assessment was a pre-test arranged at the beginning of the course, and the second was a post-test conducted after one month assessment period in an ongoing learning period. The one-month assessment period contains a four-week meeting. There were four meeting packages in the four-week meeting, where each package consisted of a pre-class, a regular-class, and an after-class. At the end of the fourth week, on Monday, March 15, 2021, a post-test was carried out in both the experimental and control classes. The post-test assessment discovered the mean score of the experimental class's collaborative mindset is 79.93 (class B) and the control class of 73.91 (class A) on a scale of 100. According to the assessment criteria, it is included in the Good category with a grade range of 68.76-81.25. The collaborative mindset based on the post-test showed the mean scores presented in Figure 7.7.

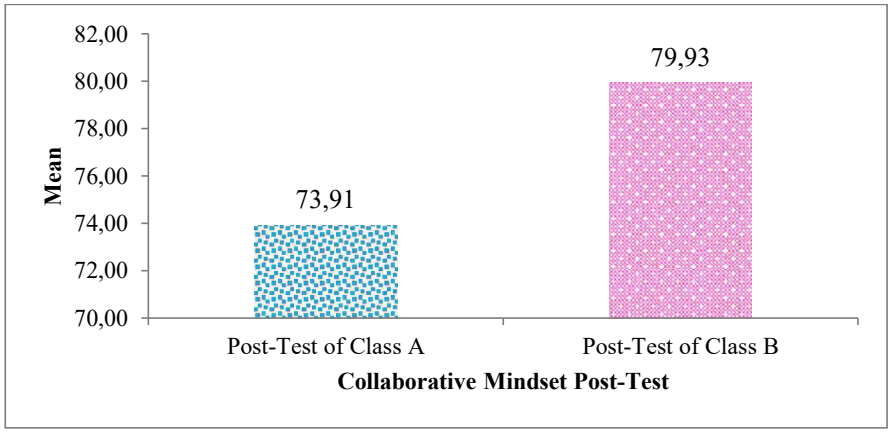


Figure 7. 7 Collaborative Mindset Mean Score (Post-Test)

Based on Figure 7.7, the collaborative mindset post-test score of class A as the experiment class is 73.91 and class B as the control class is 79.93 on a scale of 100. It implies the scores are improving. It rose 3.01 points from the mean value of pre-test 70.90 and post-test 73.91 on a scale of 100 for class A as a control class. Furthermore, as the experiment class, class B showed a more considerable increase in the mean score of collaborative mindsets with a score of 9.65 from a pre-test score of 70.28 and 79.93 in post-test on a scale of 100. The frequency distribution of the post-test from 75 students as the research subject is presented in Figure 7.8.

After seeing the equal initial behavior between the two classes, discovering the result of the experiment by post-tests is the most wanted goal. After experimenting, it was found that the level of collaborative mindset changed in each class with a different distribution from the initial conditions when the experiment had not been carried out. The achievement of scores and their frequency distribution can be seen in Figure 7.8 The frequency distribution of collaborative mindset post-test scores for class A and class B after being carried out by the experiment for one month shows changes that generally increase.

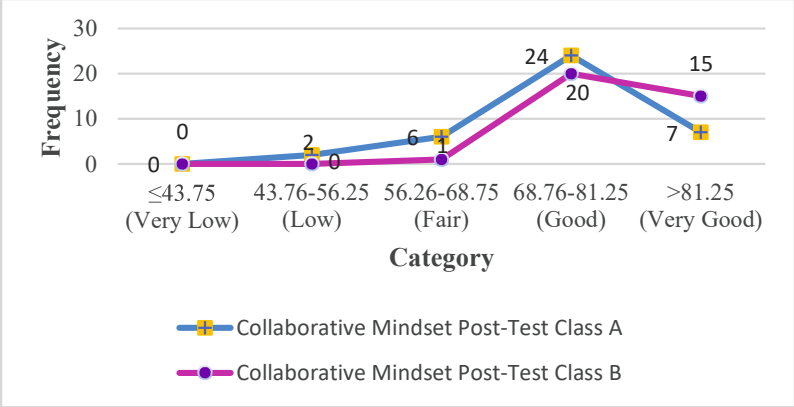


Figure 7. 8 Frequency Distribution of Collaborative Mindset (Post-Test)

In class A as the control class, the highest frequency is in the Good category (68.76-81.25), increasing from 18 to 24 students. Whereas in the Very Good category (above 81.25), there is no change with seven students. On the other hand, as the experimental class, class B shows a much better improvement in reducing students who get Fair scores from 10 to only one student, and no more students get Low scores where previously there were three students in the Low category. Besides, there is a significant improvement in the number of students in the higher category, in the Very Good category, which previously only two students, it becomes 15 students. Meanwhile, for the highest frequency, the

conditions were almost the same, the Good category, which previously numbered 21, became 20 students. The highest frequency distribution of collaborative mindset post-test scores was in the interval of 68.76-81.25, both class A and class B, so the collaborative mindset after one month experiment was in a Good category. A summary description of the pre-test and post-test collaborative mindset is presented in Table 7.11.

Table 7. 11 Summary of Collaborative Mindset Descriptive Statistics

Collaborative Mindset	Class A	Class B
Mean scores of Pre-test	70.90	70.28
Mean scores of Post-test	73.91	79.93
Increasing of the Mean scores	3.01	9.65

Furthermore, to determine whether the increase occurred significantly or not, the pre-test and post-test data of the experimental class and control class were tested using paired samples t-test. Paired sample t-test analysis was conducted to reveal differences in students' collaborative mindset before and after treatment. Before employing the paired sample t-test, the Analysis prerequisite test is needed to confirm the data has a normal distribution using the Shapiro Wilk test. The assumption of a normal distribution is shown when Sig.'s value is more than the specified alpha level of 5%. The data normality tests of class A and class B is presented in Table 7.12.

Table 7. 12 The Summary of Normality Test (Pre-test and Post-test)

	Group		Shapiro-Wilk		Conclusion
			df	Sig.	
Collaborative mindset	Class A	Pre-test	39	0.243	Normal
		Post-test	39	0.126	Normal
	Class B	Pre-test	36	0.090	Normal
		Post-test	36	0.526	Normal

According to the Shapiro Wilk test, Sig. value for class A pre-test is 0.243 and post-test 0.126. As these two Sig. values > 0.05, so it can be concluded that data collaborative mindset pre-test and post-test class A have a normal distribution. Furthermore, Sig. value for the class B pre-test is 0.090 and post-test 0.526. As these two Sig. values > 0.05, so it can be concluded that data collaborative mindset pre-test and post-test class B have a normal distribution. Thus, the requirements and assumptions for normality in using the paired sample t-test have been fulfilled.

After the prerequisite test of the paired-sample t-test analysis for normality had been fulfilled, the paired-sample t-test was then analyzed to examine student collaborative mindset improvement before (pre-test) and after the experiment (post-test) for both

experiment class and control class. The analysis result shows that the value of Sig. (2-tailed) pre-test and post-test for class A of 0.019 less than 0.05 probability mean the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted, with an interpretation there is a significant improvement of student collaborative mindset Class A between pre-test and post-test. After that, $t_{count} = 2.444 > t_{table} = 1.684$, which means the Null Hypothesis is rejected and the Alternative Hypothesis is accepted. The interpretation, there is a significant improvement of student collaborative mindset Class A between the pre-test and post-test. Thus, there is an increase in the mean score of class A collaborative mindset pre-test and post-test with an average value of 3.013 increasing from 70.90 to 73.91, with a correlation value (r) of 0.684 between collaborative mindset pre-test and post-test with Sig. 0.000 less than 0.05.

Table 7. 13 The Summary of Paired Samples T-Test Result (Pre-Test and Post-Test)

	Group	**Pair**	**Paired Samples Correlations**		**Paired Differences**	**Paired Samples Test**			**Conclusion**
			Correlation	Sig.	Mean	t	df	Sig. (2-tailed)	
Collaborative mindset	Class A	Pre-test - Post-test	0.684	0.000	-3.013	-2.444	38	0.019	H_0 rejected, and H_a accepted
	Class B	Pre-test - Post-test	0.935	0.000	-9.653	-14.927	35	0.000	H_0 rejected, and H_a accepted

Furthermore, the results of the analysis in the class B experiment showed that the value of Sig. (2-tailed) pre-test and post-test for class B of 0.000 less than 0.05 probability mean the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted, with an interpretation there is a significant improvement of student collaborative mindset Class B between pre-test and post-test. After that, $t_{count} = 14.927 > t_{table} = 1.691$, which means the Null Hypothesis is rejected and the Alternative Hypothesis is accepted. The interpretation, there is a significant improvement of student collaborative mindset Class B between the pre-test and post-test. Thus, there is an increase in the mean score of class B collaborative mindset pre-test and post-test with an increase in the mean value of 9.653 from 70.28 to 79.93, with a correlation value (r) 0.935 between collaborative mindset pre-test and post-test with Sig. 0.000 less than 0.05. the correlation value (r) = 0.935 more than 0.80 means that there is a high correlation mean score between the collaborative mindset pre-test and post-test [175]. Thus, the experimental class students' collaborative mindset has increased

significantly, and the correlation is high after the experiment was carried out on the application of the blended online learning platform with the project-based flipped classroom model. A summary of the paired sample t-test analysis is presented in Table 7.13.

Furthermore, to discover a significant difference in the collaborative mindset between the experimental class (class B) and the control class (class A) using the independent samples t-test, the normality and variance homogeneity of data should be first examined as analysis requirements before analyzing the data by the independent samples t-test. It is needed to confirm the data has a normal distribution using the Shapiro Wilk test. The assumption of a normal distribution is when the Sig. value more than the specified alpha level of 5%. According to the Shapiro Wilk test, post-test Sig. value for class A is 0.126, and post-test Sig. value for class B is 0.526. As these two Sig. values> 0.05, so it can be concluded that the post-test in both classes A and B have a normal distribution as presented in Table 7.14. Thus, the requirements and assumptions for normality in using the Independent Sample t-test have been fulfilled.

Table 7. 14 The Summary of Normality Test of Experiment and Control Classes

	Group	**Shapiro-Wilk**	**Conclusion**
		Sig.	
Collaborative mindset	Class A Post-test	0.126	Normal
	Class B Post-test	0.526	Normal

The homogeneity of variance test using Levene's test provided that the Sig. > 0.05, then the homogeneity of variance of the two groups is the same. From the results of Levene's test, the Sig. value was obtained to 0.098> 0.05, then the collaborative mindset data variant for the class A post-test and class B post-test are the same or homogeneous. So, it can be concluded that the assumption of homogeneity of variance is fulfilled. Table 7.15 presents the homogeneity of variance post-test of experiment and control classes.

Table 7. 15 Homogeneity of Variance Test Summary of Experiment and Control Classes

	Levene's Test for Equality of Variances	**Conclusion**
	Sig.	
Collaborative mindset (Post-test)	0.098	Homogeneous

After the prerequisite test of the independent sample t-test analysis for normality and homogeneity had been fulfilled, an independent sample t-test was then analyzed to test the differences of collaborative mindset post-test between the experiment class (class B)

and the control class (class A). The analysis result shows that the value of Sig. (2-tailed) 0.000 less than 0.05 probability means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. With an interpretation, there is a significant difference in collaborative mindset between experiment and control classes. It is strengthened by the t_{count} value greater than the t_{table} as follows, $t_{count} = 3.707 > t_{table} = 1.665$, which means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. The interpretation, there is a significant difference in student collaborative-mindset between experiment and control classes. Thus, it can be concluded that students' collaborative mindset between experiment and control classes is significantly different. Table 7.16 presents the summary of the independent samples t-test.

Table 7. 16 The Summary of Independent Samples t-test of Experiment and Control Classes (Post-test)

	t-test for Equality of Means			**Conclusion**
	t	df	Sig. (2-tailed)	
Collaborative mindset (Post-test)	-3.707	73	0.000	H_0 is rejected, and the H_a is accepted

Furthermore, to determine the increase in collaborative mindset pre-test and post-test for experiment and control classes, a normalized gain analysis was carried out, with the interpretation of $g < 0.3$ low, $0.3 \leq g < 0.7$ moderate, and $g \geq 0.7$ high. [219]. A summary of the normalized-gain analysis is presented in Table 7.17.

Table 7. 17 The Summary of Normalized Gain Collaborative Mindset Analysis Result (Pre-test and Post-test)

		N-Gain Score (g)			**Conclusion**
		Mean	Minimum	Maximum	
Collaborative mindset	Class A	0.0513	-1.20	0.45	Low
	Class B	0.3225	0.21	0.50	Medium

From Table 7.17, the average value of the g-score for class A collaborative mindset is 0.0513 <0.3, low category, which means that the collaborative mindset in class A has increased by 5.13%. The g Score of Class B collaborative mindset is $0.3 \leq 0.3225 \leq 0.7$ Medium category, which means that collaborative mindset in class B increased by 32.25% after being treated by applying the blended online learning platform with project-based flipped classroom strategy. Thus, the blended online learning platform with project-based flipped classroom strategy effectively increases students' collaborative mindset.

7.5. Discussion

7.5.1. Initial Findings

The study has implemented a series of analyses, including descriptive statistics and inferential statistics such as paired sample t-test and independent sample t-test. In addition, a normalized Gain Analysis was also employed to reveal the level of the collaborative mindset enhancement. Besides confirming the analysis requirements for paired sample t-test and independent sample t-test by conducting several analysis requirements tests, the study also ensures the instrument feasibility by validity and reliability test using Aiken *V* and Interclass Correlation Coefficient (ICC) for the instrument employed. The descriptive analysis results show the initial finding as valued information needed to enhance the collaborative mindset as the expected learning outcome.

The primary initial findings of the descriptive study are presented in Table 7.7. There are five lowest students' collaborative skills in five indicators. These indicators were the weakest among all achieved scores that need to be concerned more, such as: indicator number 1, willing to be an active problem solver, idea maker, and like discussions; indicator number 4, prioritizing choices matching the expectations of the team; indicator number 6, prioritizing group responsibilities and learning interdependence; indicator number 5, prioritizing collaboration between peers rather than individual competition; and indicator number 3, willing to work in a team with many risks and problems. The learners' initial performance is necessary to be observed before implementing the experiment. The information about students' weaknesses will give correct initial guidance to provide better learning experiences.

7.5.2. Experiment Result

As the COVID-19 pandemic effect globally to more than 91 percent of students worldwide, especially vocational education face a problematic situation in learning, while it is urgent to reduce obstacles for technical and vocational education and training (TVET) in developing skills, starting from the secondary education level and higher education, also providing lifelong learning opportunities for all as mandated by the UN SDG4.3 [220]. In achieving the research goals to solve the problems faced by vocational education by enhancing students' collaborative mindset using blended online learning platforms in CAD construction drawing course, each phase of development research is conducted to support one another. As a part of development study in developing vocational lessons and learning

model to improve student skills for meeting the industry requirement, this study aims to discover the students' collaborative mindset improvement by examining the student collaborative mindset indicator score by initial assessment in a pre-test and a post-test after a one-month ongoing learning process. The analysis result of descriptive statistics showed the collaborative mindset pre-test mean score is 70.90 on a scale of 100 for class A as the control class. Simultaneously, class B, as the experiment class, got 70.28 on a scale of 100. According to Azwar's assessment criteria [217], it is included in the Good category with grade values in the range of 68.76-81.25. By seeing the range, it is clear that the student mindset is good. Furthermore, to significantly and efficiently increase student achievement and solve the vocational education problem, the experiment needs to be reviewed in a more detailed analysis. Comparison between the initial behavior and after experiment behavior with a statistical measurement is needed to examine the exact contribution of the developed blended online platform with the lesson and learning model implemented. Besides, concerning the student's detailed weaknesses will help the researcher create a better strategy in solving the problem.

As an examination for discovering the developed online platform and the learning model contributes significantly, this study ensures equality between the experiment class and the control class before conducting the actual class learning experiment. Besides, the normality and variance homogeneity of data was examined using the Shapiro Wilk test. The Sig. value for class A pre-test is 0.243 and Sig. value for the class B pre-test is 0.090. As these two Sig. values > 0.05, so it can be concluded that the pre-test in both classes has a normal distribution. It means the requirements to use the Independent Sample t-test have been fulfilled. While the homogeneity of variance test using Levene's test also has been fulfilled by getting the Sig. of 0.238 > 0.05. An independent sample t-test was then analyzed to test the initial collaborative mindset differences between the experiment class and the control class. The analysis result shows that the value of Sig. (2-tailed) of 0.782 more than 0.05 probability, there is no significant difference in collaborative mindset between experiment and control classes before the class starts. It is also strengthened by seeing the $t_{count} = 0.278 < t_{table} = 1.665$, which means there is no significant difference in student collaborative-mindset between the experiment and control classes. Thus, both the two classes are equal. After all classes' initial behavior was declared equal, it is available for the online learning platform and the learning model to be implemented. In preparing to start

the learning process, reviewing the student's weaknesses is needed by seeing the descriptive analysis result, especially at the test's lowest score. The test's low scores will give the lecturer a recommendation to treat the students effectively.

The study discovered the lowest mean score of the collaborative mindset in several indicators, as seen in Table 7.7 Indicator number 1, "willing to be an active problem solver, idea maker, and like discussion," with a mean score of 62.50, followed by "prioritizing choices matching the team expectations," with 63.19 mean score, on the other hand, number 6 prioritizing group responsibilities and learning interdependence with a mean score of 64.58, while, number 5 prioritizing peer collaboration rather than individual competition with 66.67 mean score. The last is number 3, "willing to work in a team with many risks and problems," with a mean score of 68.06. Those five lowest collaborative mindset indicators are a concern for improvement during the experiment. It is necessary to manage a good teamwork members distribution. Therefore, it is concerned to analyze the frequency distribution presented in Figure 7.5 to map the teamwork member's balance. The highest frequency was a Good category, with 18 students in class A and 21 students in class B. Simultaneously, the lowest frequency is in the Low category, with four students in class A and three students in class B. The most frequent distribution of collaborative mindset for class A and class B are in the Good category. This result was then used to define the teamwork member distribution. The experiment class consisted of 36 students divided into seven groups, with 5-6 students for each teamwork. Each group consists of three students in the Good category score, and the rest member is a combination of Very Good, Fair, and Low categories. Besides defining the teamwork member distribution, the descriptive statistics data was used to synchronize the learning model, project-based flipped classroom learning model, using blended online learning platform with student characteristics.

The blended online learning platform with a project-based flipped classroom strategy applies the seven steps of project-based learning designed in previous research [12]. The implementation employs flipped classroom strategy, which was adapted for the Civil Engineering Education Study Program. This consists of three stages of activity, pre-class, regular-class, and after-class. The implementation of the blended online learning platform using a project-based flipped classroom model is generally going well. The platform supports the learning process without any severe problems. The lecturer states that the students appear to be happy in pursuing the class activity, their motivation is increasing

gradually. Several students said that they are motivated to join the class. The lecturer implies the majority of the students are interested in this model, some of the teamwork performed higher than the expectation. The learning experience of "finding and getting a client who needs to build the building project" is an additional competency because it is more closely with a business subject. Besides, it is concerned with economic major, especially marketing competency, it is considered a difficult assignment for the student. Nevertheless, some of them succeed in getting the client who needs to build the building project. This condition is significantly motivated them to do their best to satisfy the customer. Meanwhile, for the teamwork that cannot get an actual client who orders the project, they still have the client, with the client's position is changed by the lecturer. Thus, the students have a big responsibility to finish the project and continuously consult the project with the client or lecturer.

The blended online learning platform provides proper supports to the student. There are several positive testimonies from the students, and some practitioners imply the platform's benefits and help. The blended online platforms, which employ more than one online application, give students conveniences in accessing the learning materials, supporting the student collaborative work and discussion. It removes the bad feelings of low-skilled students who are usually getting anxious and getting left behind and unable to catch other friends' ability who are getting more skilled day after day. Those students are expected to have a better chance to learn collaboratively and also independently. The group formed by WhatsApp supplies information, including pre-class, regular-class, and after-class. The pre-class self-learning activities are supported by the platform for preparing to enter the regular class. The pre-classes were implemented asynchronously, except for the first pre-class, which was conducted synchronously to accommodate its urgency. Lesson materials are embedded through the LMS eFront platform, which integrates various complementary platforms to facilitate student learning activity and enhance students' collaborative mindset. Regular-classes were carried out synchronously through the e-learning platform using a zoom meeting accessed from the e-learning. The classes were implemented in a single meeting room and breakout rooms for teamwork discussions and finally back to the previous single room. The after-classes are advanced of regular-class with synchronous design to advance their skills and monitor the project's progress and student activity.

The collaborative mindset post-test assessment discovered the mean score of the experimental class is 79.93 (class B) and the control class of 73.91 (class A) on a scale of 100. It is included in the Good category with a grade range of 68.76-81.25. Class A's collaborative mindset score as the control class is 73.91, and class B as the experiment class is 79.93 on a scale of 100. They improve 3.01 points from the pre-test 70.90 and post-test 73.91 on a scale of 100 for class A as a control class. Furthermore, as the experiment class, class B showed a more considerable increase in the mean score of collaborative mindsets with a score of 9.65 from a pre-test score of 70.28 and 79.93 in post-test on a scale of 100. As the experiment class, class B shows a much better improvement compared to class A as the control class. Class B was reducing students who get Fair scores from 10 to only one student. There are no more students who get Low scores where there were three students in the Low category. Additionally, the condition shows a notable increase of students in the Very Good category, in the Very Good category, from only two students, it enhances 15 students. While the situations were identical concerning the highest frequency, the Good category, previously 21 students, shifted to 20 students. The collaborative mindset post-test highest frequency scores distribution is in the interval of 68.76-81.25 for the two-class, class A and B. So, after one month learning period of the experiment, the result was in a Good category.

From the Shapiro Wilk test result for class A pre-test and post-test, it can be concluded that collaborative mindset pre-test and post-test have a normal distribution. Moreover, Sig. value for the class B pre-test and post-test, Sig. values > 0.05, means that the pre-test and post-test class B of collaborative mindset have a normal distribution. Hence, the requirements for normality in using the statistical methods of paired sample *t*-test are fulfilled. Next, analyzing the results to investigate the student collaborative mindset enhancement for both classes. The result confirms that the class A's Sig. (2-tailed) pre-test and post-test is less than 0.05 probability. It indicates the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. It shows a significant enhancement of class A's student collaborative mindset. Which the H_0 is rejected, and the H_a is accepted. This means there is a significant improvement in students' collaborative mindset. Hence, there is an improvement in class A's collaborative mindset pre-test and post-test, with a mean score of 3.013 progressing from 70.90 to 73.91, with $r = 0.684$ between pre-test and post-test collaborative mindset, with Sig. 0.000 less than 0.05. Moreover, class B's analysis results

showed that the H_0 is rejected, and the H_a is accepted, which means there is a significant improvement of student collaborative mindset class B. From the t_{count} of 14.927 > t_{table} = 1.691, which means the H_0 is rejected, and the H_a is accepted. Consequently, there is a significant enhancement of the collaborative mindset in class B. Therefore, there is an improvement in the mean score of class B's collaborative mindset with an improvement of the mean value, 9.653, from 70.28 to 79.93, with an *r* of 0.935 between collaborative mindset pre and post-test with Sig. 0.000 less than 0.05. The *r* = 0.935 higher than 0.80 means there is a high correlation between pre-test and post-test. Consequently, the experimental study shows the collaborative mindset has increased significantly. The correlation is increased after the learning experiment was conducted using the e-vocational blended online learning platform with the project-based flipped classroom model for the CAD construction drawing course in the Civil Engineering Education Study Program.

To discover a significant difference between the experimental class and the control class using the independent samples t-test, the normality and variance homogeneity of data should be first examined. According to the Shapiro Wilk test, post-test Sig. value for class A is 0.126, and post-test Sig. value for class B is 0.526. As these two Sig. values> 0.05, so it can be concluded that the post-test in both classes A and B have a normal distribution. Thus, the requirements and assumptions for normality in using the Independent Sample t-test have been fulfilled. The homogeneity of variance test using Levene's test provided the Sig. value was obtained to 0.098> 0.05, then the collaborative mindset data variant for the class A post-test and class B post-test are the same or homogeneous. After the prerequisite test of the independent sample t-test analysis for normality and homogeneity had been fulfilled, an independent sample t-test was then analyzed to test the differences of collaborative mindset post-test between the experiment class (class B) and the control class (class A). The analysis result shows that the value of Sig. (2-tailed) 0.000 less than 0.05 probability means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. With an interpretation, there is a significant difference in collaborative mindset between experiment and control classes. It is strengthened by the t_{count} value greater than the t_{table} as follows, t_{count} = 3.707> t_{table} = 1.665, which means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. The interpretation, there is a significant difference in student collaborative-mindset between experiment and control classes. Thus, it can be concluded that students' collaborative mindset between experiment and control

classes is significantly different. Furthermore, a normalized gain analysis was carried out to determine the increase in collaborative mindset. The result shows the average value of the g score for class A collaborative mindset is 0.0513 <0.3, low category, which means that the collaborative mindset in class A has increased by 5.13%. The g Score of class B collaborative mindset is $0.3 \leq 0.3225 \leq 0.7$ Medium category, which means that collaborative mindset in class B increased by 32.25% after being treated by applying the blended online learning platform with project-based flipped classroom strategy. The conclusion is the blended online learning platform with project-based flipped classroom strategy effectively increases students' collaborative mindset.

7.6. Conclusion

From the result of this chapter, it is concluded that after implementing the ECD learning model, a learning model using blended online learning platform using project-based flipped classroom strategy in two classes of the Civil Engineering Education Study Program, there is a significant improvement of collaborative mindset with a highly significant correlation of 0.935 and sig. 0.000 between pre-test and post-test. On the other hand, the post-test result asserts a significant difference of collaborative mindset between the experiment class and the control class. Based on all the analysis tests, it can be concluded that the blended online learning platform with project-based flipped classroom strategy is significantly enhancing students' collaborative mindset. Furthermore, a normalized gain analysis shows the average value of the g score for the experiment class collaborative mindset is 0.3225, which means that collaborative mindset in the experiment class increased by 32.25% after being treated by implementing the ECD learning model. The conclusion is the ECD learning model effectively increases students' collaborative mindset. The next activity is conducting the summative evaluation and developing the learning model based on further evaluation.

CHAPTER 8 IMPLEMENTATION OF THE ECD LEARNING MODEL FOR ENHANCING STUDENT SKILLS

8.1. Summary

This chapter is an implementation of ECD learning model, as a part of a development study in developing the ECD to improve student skills for meeting the industry need. This chapter aims to discover the student skills enhancement in the CAD construction drawing course after implementing the ECD learning model. This study is experimental research that includes an experiment class (class B) and a control class (class A). The experiment class (class B) uses the ECD learning model consists of 36 students, and the control class (class A) uses the regular learning model consists of 39 students. It applied descriptive statistics analysis, paired sample t-tests, and independent-sample t-test for analyzing the data. The study also employed N-gain scores analysis for explaining the level of student skills enhancement. The descriptive statistics analysis showed construction drawing skills in the pre-test scores is 45.40 and in the post-test of 78.46. While collaborative skills scores' pre-test is 70.90, and post-test of 76.99 on a scale of 100 for the control class (class A).

In contrast, the experiment class (class B) construction drawing skills scores are 43.96 and 85.47 for the pre-test and post-test, with an N-gain score of 0.742, which means the construction drawing skills increased by 74.20% after implementing the ECD learning model for one semester. Besides, the collaborative skills scores are 70.28 for the pre-test and the post-test of 89.86, with 0.673 of N-gain score, which means the collaborative skills increased by 67.3% after implementing the ECD learning model for one semester. The paired samples t-test analysis of the experiment class (class B) discovers a significant skills improvement with a highly significant correlation of 0.927 and Sig. 0.000 between pre-test and post-test for construction drawing, and a highly significant correlation of 0.942 and Sig. 0.000 between pre-test and post-test for collaborative skills.

Furthermore, the independent samples t-test revealed that the two classes' initial behaviors (pre-test) are equal with the Sig. (2-tailed)=0.571>0.05 probability and t-count = 0.569<t-table = 1.996 for construction drawing. And the Sig. (2-tailed) of 0.782>0.05 probability, and t-count = 0.278<t-table = 1.996 for collaborative skills. Reversely, the post-test result asserts a significant difference of construction drawing skill between the experiment class and the control class with a t-count of 8.69 and the value of Sig. (2-tailed)

0.000. Moreover, it states a significant difference in collaborative skill between the experiment and control classes with a t-count of 10.351 and the Sig. (2-tailed) 0.000. So, the conclusion is that the ECD learning model has significantly enhanced students' skills. Furthermore, the next activity is widely implementing the ECD and developing the platform based on the new research findings and recommendations.

Keywords: ECD learning model, student skill, construction drawing skill, civil engineering drawing skill, collaborative skill, flipped classroom

8.2. Introduction

8.2.1. Background

Learning is a fundamental factor in knowledge-based societies and economies. Many nations promote to reflect this by ensuring the education system focus greatly on learning itself rather than simply changing the structures and the educational order [221]. Vocational learning develops the work capabilities to solve various problems in the workplace and society, develop careers professionally and sustainably. The learning activity requires social partnerships as a collegial collective process in social interaction between students-teachers, students-students, and industries. They must work together collaboratively. The linkage of the learning materials with the workplace is arranged in stages, starting from basic work-oriented learning, continuing and improving the training materials to be connected to the workplace. Learning materials are integrated between theoretical and practical materials. Theoretical concepts are realized in real practice activities as a process of proving and applying theory. The learning is carried out to provide various experiences in carrying out work tasks, including aspects of work knowledge, work skills, and work attitudes.

Work dynamic in the digital era changes rapidly. Everyone, including educational institutions, communities, and companies, faces unpreparedness and unreadiness of transferring technology. More new ways of working are introduced and defined as job requirements. As a result, vocational education is faced the real challenge of preparing educational and training programs following the job requirements. The new ways of working have developed randomly without structure and single standards pattern. Work structures and processes have recently led to increasingly complex forms. Cross-sector work collaboration, unlimited geographical locations, cross-ethnicity, cross-ethnicity cannot be avoided. New workers need a strong and compact team, higher technological

skills, socio-cultural-economic skills, capable of managing and solving problems, skilled in using information and data accurately.

Besides technical and collaborative skills such as negotiating ability, coordinating, directing, conflict handling, and creativity, are important determinants of personal success at work. The curriculum must be continuously updated according to the workplace changes, so it consistently links and matches the needs of the new workplace. Thus, there is no gap between the competence of graduates and the needs of the industry. Wherever possible, the learning model should reduce the transition period of graduates from school to the industry. The ECD learning model tries to present ideas for innovations in developing 21st Century vocational learning methodologies to face the knowledge-based industrial era.

8.3. Method

8.3.1. Research Method

This study evaluates the ECD learning model in improving the students' skills by experiment. The skills are including construction drawing skill and collaborative skill. It is quasi-experimental research using a quantitative approach to find the effect of ECD treatments on others variable under controlled conditions [199]. It measured the enhancement level of student skills using the ECD learning model in the experiment class (class B), and the control class (class A) used the regular learning model without using the blended learning platform. Data analysis was performed by:

1) Descriptive Analysis

The descriptive analysis in this chapter illustrates the student skills (construction drawing and collaborative skill) from the beginning until the end of the learning process in one semester. It presents a descriptive statistic of the student achievement of the experimental and the control class from the pre-test to post-test by displaying the mean, frequency distribution, and histogram. Then the student skills data is categorized by the criteria developed by Azwar [217] as presented at Table 7.2, Chapter 7.

2) Paired Sample t-test

The test analyzes the initial students' skills and the improvement by analyzing the pre-test and post-test for both experiment class and control class. The paired samples t-test was employed in two ways:

a) By comparing the value of Sig. (2-tailed) with 0,05 probability. If the value of Sig. (2-tailed) less than 0,05 probability, it means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted, with an interpretation there is a significant improvement of students' skill between pre-test and post-test. On the other hand, if the value of Sig. (2-tailed) more than 0.05 probability, it means the Null Hypothesis is accepted, and the Alternative Hypothesis is rejected, with an interpretation there is no significant improvement of students' skill between pre-test and post-test.
b) By seeing the $t_{count} > t_{table}$ with 5% probability (1-tailed) from the critical value table of t distribution [175] (H_0 is rejected and the H_a is accepted) means there is a significant improvement between the students' pre-test and post-test. An analysis prerequisite test is conducted to confirm the data normality by the Shapiro Wilk test, before employing the paired sample t-test. The assumption of a normal distribution is when the value of Sig. more than the specified alpha level of 5% [218].

3) Independent Sample t-test

The study analyzes the differences of students' skills between the experiment class (class B) and the control class (class A). The independent sample t-test was done at the beginning of the class to confirm the experimental class and control class were equal or not. If the result shows them equal, then the experiment can be continued by implementing the ECD learning model at the experiment class. After the experiment was carried out for one semester, a post-test was carried out in the experimental and control classes. The post-test results of the experimental class and the control class were then tested using an independent sample t-test to determine the difference. The independent samples t-test was employed in two ways:

a) By comparing the value of Sig. (2-tailed) with 0.05 probability. If the value of Sig. (2-tailed) less than 0.05 probability (the H_0 is rejected, and the H_a is accepted), means there is a significant difference of student skills between experiment class and control class. On the other hand, if the value of Sig. (2-tailed) more than 0.05 probability, it means the H_0 is accepted, and the H_a is rejected. With an interpretation, there is no significant difference in student skills between experiment and control classes.

b) By confirming the assumption of $t_{count} > t_{table}$ with 5% probability (2-tailed) from the critical value table of t distribution [175], which means the H_0 is rejected and the H_a is accepted. The interpretation, there is a significant difference between experiment and control classes. The normality and variance homogeneity of data should be first examined as analysis requirements before analyzing the data by the Independent Samples t-test. It is to confirm the data is normal by the Shapiro Wilk test. The normal distribution assumption is when the Sig. value more than the specified alpha level of 5%. The homogeneity of variance test using Levene's test provided that the Sig. > 0.05, then the homogeneity of variance of the two groups is the same [218]

4) Normalized Gain Analysis

It aims to determine the students' skills enhancement after experiment. The normalized gain analysis formula is apply with an assumption of g<0.3 is low, 0.3≤g<0.7 is medium, and g≥0.7 is high [219] which is presented in equation 8.(1).

$$g_{students'skill} = \frac{S_{f-students'skill} - S_{i-students'skill}}{100 - S_{i-students'skill}} \quad 8.\ (1)$$

where $g_{students'\ skill}$ is students' skill gain score, $S_{f-students'skill}$ is the students' skill final score (post-test), and $S_{i-students'\ skill}$ is the students' skill initial score (pre-test).

8.3.2. Population and Sample

The population is all students of the Civil Engineering Education Study Program in the fourth semester. The implementation of the ECD learning model was during the semester of February-July 2021 with 36 students of class B as the experiment class. While there are 39 students of class A as the control class. The instrument used in this study is a students' skills assessment sheet with rubric which has 50 indicators including 40 construction drawing skills indicators and 10 collaborative skills indicators. The pre-assessment was conducted at the beginning of the class lesson to discover their entry behavior. At the end of the semester, the construction drawing and collaborative skills assessment was conducted to discover the student skills enhancement for one semester experiment. Table 8.1 presents the students' skill assessment indicators in the CAD construction drawing course.

Table 8. 1 Student Skill Assessment Indicators for Civil Engineering Education Study Program

Students' Skills Aspects	Students' Skills Indicators
Construction drawing skill	1. Mastering general principles of building design 2. Planning the concept design 3. Preparing to draw and making work-time-schedule 4. Sharing the drawing tasks to the Team Member 5. Implementing the drawing process in the correct procedure 6. Communicate with the team regarding the drawing process 7. Complying with the rules of technical drawing 8. Mastering the drawing plan and construction detail drawing 9. Presenting the drawing project
Collaborative skill	1. Solving problem actively, giving ideas, and likes discussion 2. Preparing to work with high expectations 3. Working in a team with risks and problems 4. Prioritizing the team choices and expectations 5. Prioritizing collaboration over individual competition 6. Prioritizing team responsibilities and learning interdependence 7. Believing that peer discussion is also a source of learning 8. Giving the colleagues chance and opportunity 9. Building the spirit of lifelong learning 10. Fostering relationships and respect each other

The study examined the research instrument by content validity test with raters agreement index proposed by Aiken V. The raters consist of lecturers and industrial practitioners (seven raters). The validity assumption of an index value of V ≥ 0.40 will be considered valid [129][170]. The Aiken V formula is defined as equation 8. (2).

$$V = \frac{\sum s}{n(c-1)}$$

$$V_{for\ 50\ items} = \frac{\sum s_{for\ 50\ items}}{n(c-1)} = \frac{18.78}{7(4-1)} = 0.89$$

8. (2)

From the equation above, V = raters agreement index, and s is the score assigned by each rater minus the lowest score of the category used (s= r-I_0, with r = score assigned by each rater and I_0 the lowest score in the scoring category), n = the number of raters, c = the number of score the rater can select. The result showed that the content validity is 0.89, which is higher than the value of the V index of 0.40, where it can be interpreted that the assessment instruments are maintained valid.

The instrument's reliability used the Interclass Correlation Coefficient (ICC) formula, with a reliable assumption of the ICC value more than 0.75 (ICC value ≥ 0.75 for a reliable decision [130]. The formula is given by equation 8. (3).

$$r = \frac{MS_{people} - MS_{residual}}{MS_{people} + (df_{people}\, x\, MS_{residual})}$$

$$r = \frac{1.368 - 0.030}{1.368 + (6\, x\, 0.030)} = 0.864$$

8. (3)

where *r* is ICC coefficients, MS_{people} refers to mean square between people, $MS_{residual}$ is the mean square within people residual, and df_{people} refers to degree of freedom within people. The students' skill assessment instrument reliability test results using the IBM SPSS showed that the ICC reliability coefficient value of 0.864 meets the requirement of the ICC reliability coefficient value ≥ 0.75. Therefore, the students' skill assessment instrument is reliable.

8.4. Result

As an implementation part of development research, this chapter essentially aims to prove that the ECD learning model can enhance student skills. So that the discrepancy between the needs of the industrial world and the skills of students decreases. Moreover, creating harmony between industry and vocational schools that can meet each other's needs. This chapter describes a summary of the learning process from the first class until the last of the 16th class. First, it describes lessons 1 and 2, where lesson 1 shows different meeting methods from other lessons. It employes both synchronous and asynchronous modes to maximize student understanding about students' skill and the course role. The learning process description continues until lesson 2, where the ECD's seven steps are applied in each lesson from the pre-class, regular-class, and after-class. After entering the lesson 3 to 16, the description is focused only in the lesson objective assessment.

The ECD learning model that aims to align student skills with workplace needs, the ECD learning model applies project-based learning with e-vocational online learning platform support. In addition, to accommodate government regulations regarding credit fulfilment, the ECD learning model uses the flipped classroom as a meeting arrangement strategy. According to the investigation study that discovers the importance of collaborative skills toward construction drawing skills, the study implements the ECD by encouraging students to improve the spirit of collaboration in every stage of learning activity.

Implementing the ECD learning model using the e-vocational blended online learning platform with a project-based flipped classroom strategy is designed by applying

the seven steps of project-based learning designed in previous research. The ECD's seven learning steps are presented in Chapter 7 Table 7.8 summarized as follow:

1) Set the challenging stage of designing construction drawing project with essential sustained questions
2) Design the authentic construction drawing project and negotiate the evaluating criteria
3) Create the work schedule for the construction drawing project
4) Monitor the progress of the drawing project
5) Review the construction drawing project for presentation
6) Present the drawing project to collect critique and revision
7) Reflect and evaluate the project as the proposing criteria.

After the civil engineering industry synchronizing, the seven main stages of the ECD learning model also can be stated as follow: (1) project auction (construction drawing challenging stage); (2) proposing project; (3) proposing work schedule; (4) proposing progress report and monitoring; (5) reviewing and preparing for project presentation; (6) presenting the project; and (7) reflecting and evaluating.

The ECD's seven learning steps are designed to correspond to the closest condition of the civil engineering industry in focus on construction drawing projects. It adopts the actual working procedure of construction drawing production in the workplace. The drawing project is the vital work of the construction company for implementing the whole work on the building construction, as a complicated work to do from the beginning until the construction project built and finished.

The primary purpose of the construction drawings project is to afford a graphic representation of what is to be built. Therefore, the drawings should be concise and organized. Furthermore, it should avoid ambiguity and confusion. To minimize the drawing misunderstanding, properly coordinating the drawings in a collaborative team is proposed to be implemented.

Before the lesson start, there are preparation steps conducted to confirm that the lesson runs well as the lesson plan. Socialization regarding implementing the ECD e-learning model. The preparation activity is presented in Table 7.9 in Chapter 7. The preparation phase is vital for confirming the readiness of the course to be implemented following the lesson plan. The preparation activities are described as follow:

1) Socializing the course information and the ECD learning model systems through campus notice boards, SNS, website, and announcements to academic supervisors.
2) Informing about registering student SNS WhatsApp account and e-learning account through the e-vocational website (https://e-vocational.com/)
3) Creating SNS WhatsApp group. Figure 8.1 shows the SNS WhatsApp group for the lesson guidance

Figure 8. 1 SNS WhatsApp Group for Lesson Guidance

4) Confirming the e-learning account readiness
5) Through WhatsApp SNS, confirming to open the e-learning and study the material available
6) After students open e-learning, the e-learning informs the lecture mechanism
7) Conducting pre-assessment test, construction drawing and collaborative skills
8) Through SNS WhatsApp and e-learning, guiding the course.

Since the end of the previous semester, the initial preparation activities were conducted and confirmed to be implemented two weeks before the first lesson start. The preparatory activities include announcing to prospective students at the end of the previous semester's course that there will be an ECD learning model experiment in the coming semester by a brief explanation. In addition, the e-vocational feasibility test also involves

some students who will take the CAD construction drawing course. Figure 8. 2 speaks about the summary of limited sections lesson syntax from the preparation phase, lesson 1, until the end of the lesson (lesson 16).

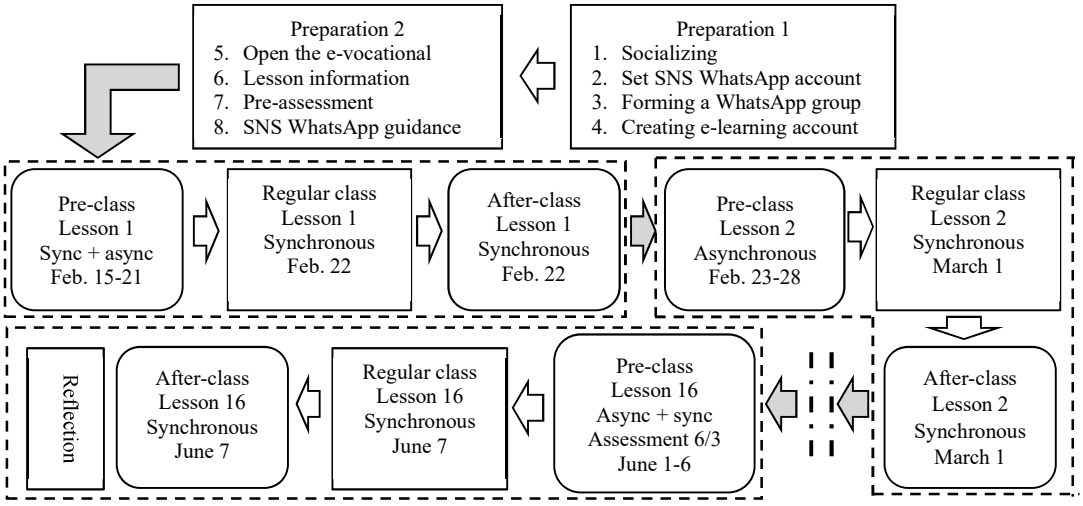


Figure 8. 2 Lesson Syntax in Sections (preparation, class 1, class 2, and class 16)

The one-semester implementation of the ECD learning model is designed for 16 lessons (class meetings). It applies the flipped classroom strategy with three learning activities in each class meeting, including pre-class, regular-class and after-class, by applying seven principal learning steps. Before the regular class, the first activity is conducting pre-class with no scheduled meeting using an asynchronous class form, except the first meeting. The regular class is a structured learning activity carried out face to face or synchronously through the e-learning platform. The regular class employs a Zoom meeting platform where students join a face-to-face online class in a single meeting room for general lecture and breakout rooms for teamwork discussions. After finishing the regular class, the last three learning activities is the after-class. It is a follow-up of regular-class with synchronous design for advancing the students' skills that have been learned in the previous class. Pre-class, regular-class, and after-class are scheduled to be implemented in a one-week activity period. The pre-class is carried out before the regular class with a minimum learning time of 120 minutes (2x60 minutes) on a free scheduled meeting with an asynchronous class form, except the first meeting. While the regular class is scheduled once a week, with 100 minutes (2x50 minutes) meeting duration, starting from 10.50 to 12.30 every Sunday morning. The regular class is followed by the after-class in the evening

(19.30 to 21.30) on the same day, held for 120 minutes (2x60 minutes) every Monday evening.

As each lesson contain 3 class activities, the ECD learning model determine the lesson objectives for at least one lesson (3 class activities). From the determined objectives, there are objectives related with collaborative skills. The skill indicators presented as the learning objectives refer to the Benjamin Bloom 1956 [70][222], which identified a hierarchy of six categories of cognitive skills: knowledge, comprehension, application, analysis, synthesis and evaluation. Beside, in 2001, Lorin Anderson and collaborators published a revised of the Bloom taxonomy [223]. Table 8.2 presents the implementation of bloom's taxonomy to the lesson objectives. Anderson revised the evaluation phase is no longer the highest level of the hierarchy. A new level added, creating, is at the top level. It describes learners' thinking processes rather than behaviors. While creating the shop drawing project is the main goal of the CAD construction drawing course, the revised Bloom taxonomy is considered a matching instructional method for the learning model.

Table 8. 2 Bloom Taxonomy Framework on the ECD Learning Model

		Bloom Taxonomy	Learning Activity	
Higher order thinking skills (Deep Learning)	Challenging qualitative assignments	Creation	Create original products. Design and create the construction drawing project, reflect the result and criteria planned. (pre-, regular, and after-class)	Collaborative e-learning trough peer-interaction (engaging, motivating experience) Synchronous/ asynchronous
		Evaluation	Judge the analysis, justify a stand or decision. Appraise the project determining result and the work schedule (after-class)	
		Analysis	Analyze, repurpose knowledge, Analyze the project determining result and comparing with the work schedule (regular-class)	
		Application	Use the knowledge. Employ the RTRW formula to determine the construction drawing project (regular-class)	
Basic skills	Content consumption (video, text, etc.)	Comprehension	Identify and understand the knowledge, identify and describe the best building construction project (pre-class)	Traditional e-learning Asynchronous
		Knowledge	Memorize basic facts and data, Collecting information about the designing construction drawing and National Territory Spatial Planning (RTRW) (pre-class)	

The ECD learning model implementation successfully finishes the 16 meetings from February 15 to June 7, 2021.

8.4.1. Descriptive Analysis of Initial Students' Skill

The study observes the student's initial condition in the experiment class (class B) and the control class (class A) using a students' skill assessment instrument pre-test. The descriptive statistics analysis result revealed that the construction drawing skill pre-test mean score of class A is 45.40 on a scale of 100. At the same time, the construction drawing skill pre-test of class B revealed a mean value of 43.96 on 100 scales. It is included in the low category with grade values in the range of 43.76-56.25, according to Azwar [217]. The initial construction drawing skill from the pre-test showed the mean scores displayed in Figure 8.3.

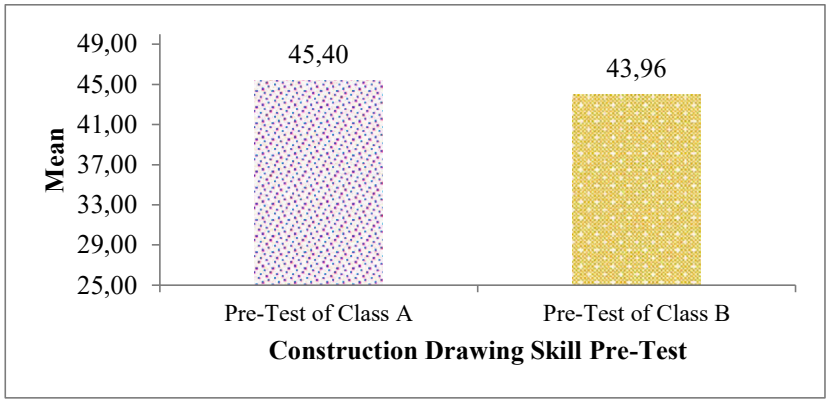


Figure 8. 3 Construction Drawing Skill Pre-Test Mean Score Result

The result of descriptive statistics analysis explained that the collaborative skill pre-test class A mean score is 70.90 on a 100 scale. Concurrently, the pre-test of collaborative skill class B conferred a mean value of 70.28 on a 100 scale. It is covered in the good category with grades in the range of 68.76-81.25 according to assessment criteria developed by Azwar [217]. The pre-test of collaborative skill gave the mean scores presented in Figure 8.4

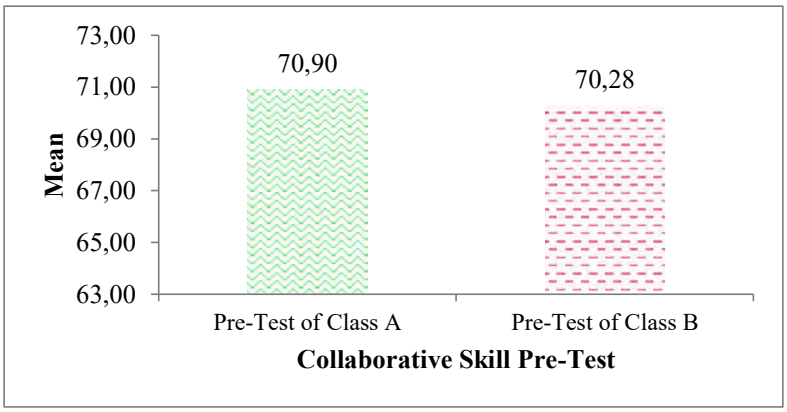


Figure 8. 4 Collaborative Skill Pre-test Mean Score Result

8.4.2. The Equality of Experiment and Control Class Initial Behavior

To assure equality among the experiment and the control class, examining the difference of their pre-test scores with the independent sample t-test. The normality and variance homogeneity of data should be first tested as analysis requirements before analyzing the Independent Samples t-test. It is required to verify that the data is distributed normally by the Shapiro Wilk test. The premise of a normal distribution is during the Sig. more than the specified alpha level of 5%. Refer to the Shapiro Wilk test, the class A pre-test Sig. value construction drawing skill is 0.579 and class B pre-test Sig. value construction drawing skill is 0.126. As these two Sig. values > 0.05, so it means that the pre-test in both classes are normal. Then collaborative skill Sig. value for class A pre-test is 0.259 and the collaborative skill Sig. value for class B pre-test is 0.161. As these two Sig. values > 0.05, so it means that the pre-test in both classes are normal. Hence, the terms and premises for normality in applying the Independent Sample t-test are fulfilled. The normality analysis of pre-test control and experiment classes displayed in Table 8.3.

Table 8. 3 The Summary of Pre-test Normality Test of Experiment and Control Classes

Student's Skill	**Group**	**Shapiro-Wilk**	**Conclusion**
		Sig.	
Construction drawing skill	Class A Pre-test	0.579	Normal
	Class B Pre-test	0.126	Normal
Collaborative skill	Class A Pre-test	0.259	Normal
	Class B Pre-test	0.161	Normal

The variance test homogeneity utilizing Levene's test presented that the Sig. > 0.05, next, the variance homogeneity of the two groups is equivalent. From the results of Levene's analysis, the Sig. value is reached to 0.437> 0.05, the construction drawing skill data variant for the class A and class B pre-test are homogeneous. Furthermore, the Sig. value was reached to 0.238> 0.05. Next, the collaborative skill data variant for the class A and B pre-test are homogeneous or the same. Thus, it can be inferred that the premise of variance homogeneity is achieved. Table 8.4 shows the summary of pre-test homogeneity of variance of experiment and control classes.

Table 8. 4 The Pre-test Homogeneity of Variance for Experiment and Control Classes

Student's Skill	**Levene's Test for Equality of Variances**	**Conclusion**
	Sig.	
Construction drawing skill (Pre-test)	0.437	Homogeneous
Collaborative skill (Pre-test)	0.238	Homogeneous

Following the requirement analysis of the independent sample t-test analysis for normality and homogeneity had been achieved, applying an independent sample t-test to

analyze the differences between students' skill pre-test of experiment class and the control class. The result explains that the Sig. (2-tailed) is 0.571 > 0.05 probability, it indicates the H_0 is accepted, and the H_a is rejected, with an assumption there is no significant difference of construction drawing skill between experiment and control classes. Furthermore, t_{count} = 0.569 <t_{table} = 1.996, which implies the H_0 is accepted, and the H_a is rejected. The assumption, there is no significant difference in construction drawing skills among experiment and control classes. Next, the examination result explains that the Sig. (2-tailed) is 0.782 > 0.05 probability, it indicates the H_0 is accepted, and the H_a is rejected, with a premise there is no significant difference of collaborative skill between control and experiment classes. Moreover, t_{count} = 0.278 <t_{table} = 1.996, which implies the H_0 is accepted, and the H_a is rejected. The premise, there is no significant difference in collaborative skill between experiment and control classes. Hence, it can be inferred that students' initial behavior of the control and experiment class are equal. Table 8. 5 is the summary of independent samples t-test of experiment and control classes (pre-test).

Table 8. 5 The Summary of Independent Samples t-test of Experiment and Control Classes Pre-Test

Students' Skill	t-test for Equality of Means			Conclusion
	t	df	Sig. (2-tailed)	
Construction drawing skill (Pre-test)	0.569	73	0.571	H_0 is accepted, and H_a is rejected
Collaborative skill (Pre-test)	0.278	73	0.782	H_0 is accepted, and H_a is rejected

As the pre-test between class B and A is maintained equal, the experiment was then conducted in one of them. The other class was used as a control. Further descriptive analysis is performed to explain the lowest mean score of the experiment class's construction drawing skill indicators. The lowest mean score of the construction drawing skill from the pre-test are found in sub-indicators number 28, 30, 34, 40, and 26 displayed in Table 8.6.

Table 8. 6 The Five Lowest Initial Score of Construction Drawing Skill Indicators

Indicators of Construction Drawing Skills Aspect	Sub-Indicator Number	Construction Drawing Skill Sub-Indicators	Mean Score of Experiment Class	Category
Drawing plan and construction detail drawing	28	Section drawing A-A, B-B, C-C, D-D	30.56	Very Low
	30	Drawing the detailed roof plan	33.33	Very Low
	34	Drawing the plumbing and ME plan	34.72	Very Low
Presenting the drawing	40	Explaining the arguments of the drawing concept	37.50	Very Low
Drawing plan and construction detail drawing	26	Drawing floor plans accurately, detailed and informative	40.28	Very Low

The initial performance is essential to be recognized before experimenting. The students' deficiencies should be identified and well concerned. Table 8.6 displays the lowest construction drawing skill indicator mean score for class B before the study began. The lowest mean score is in the first indicator, i.e., section drawing (A-A, B-B, C-C, D-D), with a mean score of 30.56. Followed by number 30, drawing the detailed roof plan with 33.33 mean score, number 34, drawing the plumbing and ME plan, with a mean score of 34.72, number 40, giving the arguments of the drawing concept with 37.50 mean score. The last fifth-lowest score is indicator number 26, drawing floor plans accurately, detailed and informative 40.28. The five lowest construction drawing skill indicators mean score are a concern for development throughout the experiment. Later, the pre-test frequency distribution of construction drawing skills in the experiment and control class pre-test, exhibited in Figure 8.5.

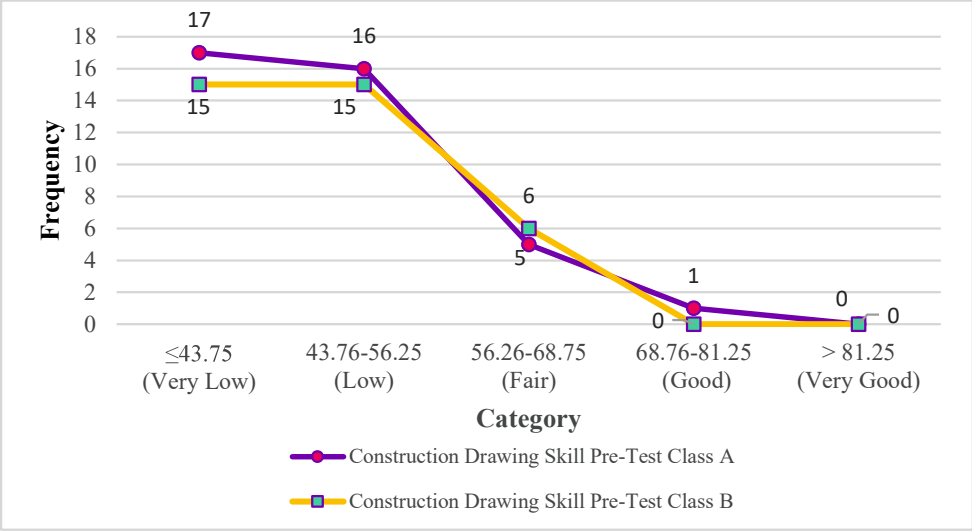


Figure 8. 5 Frequency Distribution of Construction Drawing Skill (Pre-Test)

The construction drawing skills' frequency distribution describes the student's initial performance before the experiment. Figure 8.5 exposes the frequency distribution of the pre-test construction drawing skill scores for class B and class A before the experiment. The highest frequency was discovered in the value interval ≤43.75, including 17 students in class A and 15 students in class B. On the other hand, the lowest frequency is in the interval of 68.76-81.25, consisting of one student in class A and no one in class B. However, the most frequent distribution of the pre-tests' scores of the construction drawing skill is in the interval ≤43.75 for both class B and class A. However, the mean score of pre-test construction drawing skill of class A is 45.40, and class B is 43.96 in the range of 43.76-

56.25, so it can be concluded that the pre-test construction drawing skill score is in a Low category. The frequency distribution pre-test and other descriptive analyses of the construction drawing skill are necessary to define the teamwork arrangement and synchronize the ECD learning model with student characteristics. Thirty-six students of class B consisted of an experimental class split into seven teams, the orange and blue teams, the pink team, the green team, the yellow team, the purple team, and the red team. Each of the seven teamwork consists of 5-6 students with a well-balanced composition based on the frequency distribution of the initial behavior obtained from the pre-test data. Each team consists of one student who has a Fair category construction drawing skill score. The rest are Low and Very Low categories students. The frequency distribution is shown in Figure 8.5. Moreover, the collaborative skill indicators' lowest mean score from the pre-test in the experimental class is found in indicators number 1, 4, 5, 6, and 3, which is displayed in Table 8.7.

Table 8. 7 The Five Lowest Initial Score of Collaborative Skill Indicators

Indicator Number	Collaborative Skill Indicators	Mean Score of Experiment Class (Class B)	Category
1	Solving problem actively, giving ideas, and likes discussion	62.50	Fair
4	Prioritizing the team choices and expectations	63.19	Fair
6	Prioritizing team responsibilities and learning interdependence	64.58	Fair
5	Prioritizing collaboration over individual competition	66.67	Fair
3	Working in a team with risks and problems	68.06	Fair

The initial performance is essential to be recognized before executing the experiment. The students' vulnerabilities should be identified and fully concerned. Table 8.7 shows the lowest collaborative skill indicator mean score for class B before the experiment commenced, i.e., number 1, solving problems actively, giving ideas, and likes discussion, with a mean score of 62.50. Then number 4, prioritizing the team choices and expectations with 63.19 mean scores. Number 6, prioritizing team responsibilities and learning interdependence with a mean score of 64.58. Number 5, prioritizing collaboration over the individual competition with 66.67 mean scores. And the last fifth-lowest score is indicator Number 3, willing to work in a team with risks and problems with a mean score of 68.06. The five lowest mean scores of collaborative skill indicators are a concern for improvement during the experiment. Then, the pre-test frequency distribution of collaborative skills in the experiment and control class is displayed in Figure 8.6.

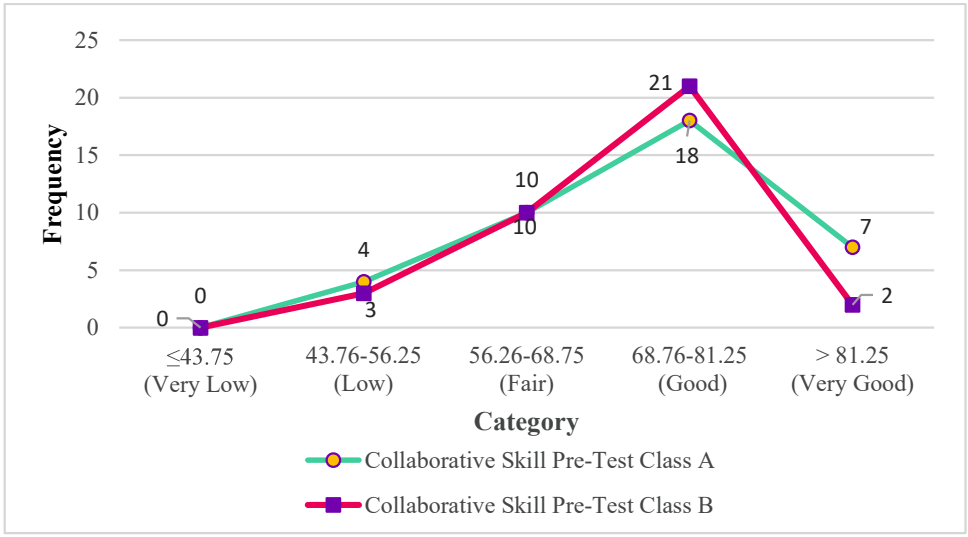


Figure 8. 6 Frequency Distribution of Collaborative Skill (Pre-Test)

The collaborative skill frequency distribution explains the student's initial performance before the experiment. Figure 8.6 exposes the collaborative skills pre-tests' scores frequency distribution of classes A and B before the experiment. The maximum frequency was discovered in 68.76-81.25, including 18 students in class A and 21 students in class B. While the lowest frequency is in the range of 43.76-56.25, consisting of four students in class A and three in class B. Because the most frequent distribution of collaborative skill pre-test scores is in the interval of 68.76-81.25 for both classes A and B, the collaborative skill score pre-test is in a Good category. The pre-test frequency distribution and other descriptive analyses of the collaborative skill are necessary to determine the teamwork arrangement and synchronize the ECD learning model with student characteristics. The 36 students of class B as an experimental class were split into seven teams, the orange, blue, pink, green, yellow, purple, and red teams. Each of the seven teamwork consists of 5-6 students with a harmonious composition based on the frequency distribution of the initial performance achieved from the pre-test. Each team consisted of three students with good category collaborative skill. The rest are students with a compound of Very Good, Fair, and Low categories as the frequency distribution in Figure 8.6.

The statistical analyses show that the primary initial findings of the descriptive statistics study are presented in Table 8.6 and 8.7 about the five lowest indicators of the construction drawing skills and collaborative skills. These ten indicators (five construction drawing and five collaborative skills) were the lowest among all the achieved indicators scores from all the students' skills indicators.

Table 8. 8 The Proposing Solutions for the Five Lowest Initial Drawing Skill

Num	Construction Drawing Skill Indicators	Mean Score	Proposing Solutions
28	Section drawing A-A, B-B, C-C, D-D	30.56	1. Give more demonstration video in section drawing lesson material 2. Enhance team responsibility spirit and learning interdependence by giving motivation via WhatsApp every morning
30	Drawing the detailed roof plan	33.33	1. Give more demonstration video in drawing the detailed roof plan lesson material 2. Enhance prioritizing collaboration by giving motivation via WhatsApp every morning
34	Drawing the plumbing and ME plan	34.72	1. Give more demonstration video in drawing the plumbing and ME plan lesson material 2. Enhance working in a team with risks and problems via WhatsApp every morning
40	Explaining the arguments of the drawing concept	37.50	1. Everyone should explain argument in each discussion 2. Enhance solving problem actively, giving ideas, and likes discussion by give a drawing problem, and everyone must give idea in the discussion
26	Drawing floor plans accurately, detailed and informative	40.28	1. Give more demonstration video in Drawing floor plans accurately, detailed and informative lesson material 2. Enhance prioritizing the team choices and expectations via WhatsApp every morning

The lowest construction drawing skills that need to be concerned and enhanced are (1) section drawing; (2) drawing the detailed roof plan; (3) drawing the plumbing and ME plan, (4) explaining the arguments of the drawing concept; and (5) drawing floor plans accurately.

Table 8. 9 The Proposing Solutions for the Five Lowest Initial Collaborative Skill

Num	Collaborative Skill Indicators	Mean Score	Proposing Solutions
1	Solving problems actively, giving ideas, and likes discussion	62.50	1. Enhance solving problem actively, giving ideas, and likes discussion by give a drawing problem, and everyone must give idea in the discussions 2. Motivate to be an active problem solver, giving ideas, and likes discussion via WhatsApp
4	Prioritizing the team choices and expectations	63.19	1. Giving success stories of prioritizing the team choices and expectations in meetings 2. Enhance prioritizing the team choices and expectations via WhatsApp every morning
6	Prioritizing team responsibilities and learning interdependence	64.58	1. Giving success stories of team responsibility spirit and learning interdependence in meetings 2. Enhance team responsibility spirit and learning interdependence by giving motivation via WhatsApp every morning
5	Prioritizing collaboration over individual competition	66.67	1. Giving success stories of prioritizing collaboration in meetings 2. Enhance prioritizing collaboration by giving motivation via WhatsApp every morning
3	Working in a team with risks and problems	68.06	1. Giving success stories of working in a team with risks and problems in meetings 2. Enhance working in a team with risks and problems via WhatsApp every morning

The ECD learning model as a collaborative learning model designed to improve students' skills must significantly solve learning problems. For increasing the score of the

lowest student skills, several efforts are made to overcome problems that arise in the learning process and learning outcomes. The ECD learning model as a collaborative learning model designed to improve students' skills must significantly solve learning problems. For increasing the score of the lowest student skills, several efforts are made to overcome problems that arise in the learning process and learning outcomes. The proposing solution is presented in Table 8.8 for construction drawing and 8.9 collaborative skills. The proposing solutions include conveying wise quotes from successful public figures [224], for example as follows:

1) “Faith Believers are to each other as a brick of a wall, supporting and reinforcing each other”, Prophet Muhammad SAW
2) "Alone we can do so little, and together we can do so much", Helen Keller
3) "Teamwork begins by building trust. And the only way to do that is to overcome our need for invulnerability”, Patrick Lencioni
4) "Talent wins games, but teamwork and intelligence win championships”, Michael Jordan
5) "It is literally true that you can succeed best and quickest by helping others to succeed", Napoleon Hill
6) "If you want to lift yourself up, lift up someone else”, Booker T. Washington
7) "None of us, including me, ever do great things. But we can all do small things, with great love, and together we can do something wonderful", Mother Teresa
8) "No one can whistle a symphony. It takes a whole orchestra to play it”, H.E. Luccock
9) "Teamwork is the ability to work together toward a common vision. The ability to direct individual accomplishments toward organizational objectives. It is the fuel that allows common people to attain uncommon results”, Andrew Carnegie
10) "Effectively, change is almost impossible without industry-wide collaboration, cooperation, and consensus”, Simon Mainwaring
11) "No matter how brilliant your mind or strategy, if you’re playing a solo game, you’ll always lose out to a team”, Reid Hoffman
12) "Great things in business are never done by one person, they are done by a team of people”, Steve Jobs

13) "The greater the loyalty of a group toward the group, the greater is the motivation among the members to achieve the goals of the group, and the greater the probability that the group will achieve its goals", Rensis Likert.

When every student in the teams share and respect each member's thoughts and differences, they stand a greater chance of being more cohesive and thriving together. Teachers encourage the collaborative mindset in each class meeting to instill a collaborative spirit in all students. Besides that, collaborative encouragement is also delivered to students every morning via SNS WhatsApp by wise words and collaborative quotes from successful world leaders inspire students' enthusiasm.

8.4.3. Lesson 1 Building Regulations

The lesson begins with level and progresses through the hierarchy of observable knowledge, skills, attitudes, behaviors, and abilities as the learning activity process. Hence, the last lesson should include higher-level skills than the basic skills taught at the introductory lessons. The objectives for lesson 1 of 16 are as follow: (1) identify the building drawing projects; (2) plan the determined building construction project; (3) propose work time schedule; (4) identify the collaborative mindset to socialize with the team; and (5) define the collaboration between peers is the best strategy to finish the project optimally.

1) Pre-Class 1, Lesson 1 Identify Building Regulations

The pre-class 1 is the first meeting of the CAD construction drawing course. As the important of the first meeting for giving foundation for the next meetings until the last one, it is conducted in a special condition. The course started earlier on Monday, February 15, 2021. The ordinary schedule is Monday, February 22, 2021, where all courses in the Civil Engineering Education Study Program is start from this date. Beside it is a new learning model, the flipped classroom steps need to start the pre-class a week earlier. The ordinary pre-class implementation is a week before the regular class, the schedule is free, before the regular class with minimum learning time of 120 minutes (2x60 minutes). As the important of the pre-class 1 to the whole experiment, it is conducted in two learning methods including both synchronous and asynchronous start form February 15, 2021.

a) Synchronous, Pre-Class 1 Demonstrate and Practice the Building Regulations

This class activity was held on Monday, February 15, 2021, at 10.50-12.50 Western Indonesia Time in Indonesia *Waktu Indonesia Barat* (*WIB*) with lecture, demonstration,

and discussion methods through e-vocational blended online learning platform (WordPress, eFront, Google for education, Zoom Meeting).

The students' learning steps implementations are as follow:

(1) The first activity starts from teachers' greetings and announcement by the SNS WhatsApp before the class start. Greet students using words of wisdom of collaborative encouragement from Prophet Muhammad SAW, "Faith believers are to each other as a brick of a wall, supporting and reinforcing each other",

This activity aims to develop the students learning spirit and grow their learning motivation. Besides, ask them to begin preparing to learn by the ECD learning model. The teachers' greetings, encouragement, and motivation delivered by the SNS WhatsApp give a positive result. Most of the students are motivated and enthusiastic about learning. It is indicated from the student responses in the SNS group conversation that most students give positive responses.

(2) The teachers begin to conduct the lesson by accessing the e-vocational platform. Then the students also begin accessing the e-vocational platform. Approximately one minute to open the e-learning platform to access the learning module.

(3) The teachers enter the introduction module and pre-test topic of basic drawing while guiding the students to learn the topic and join the embedded Zoom link. Figure 8.7 shows the pre-class 1 meeting by embedded Zoom link, the teachers introduce the ECD learning model and e-vocational platform to the students while started giving motivation.

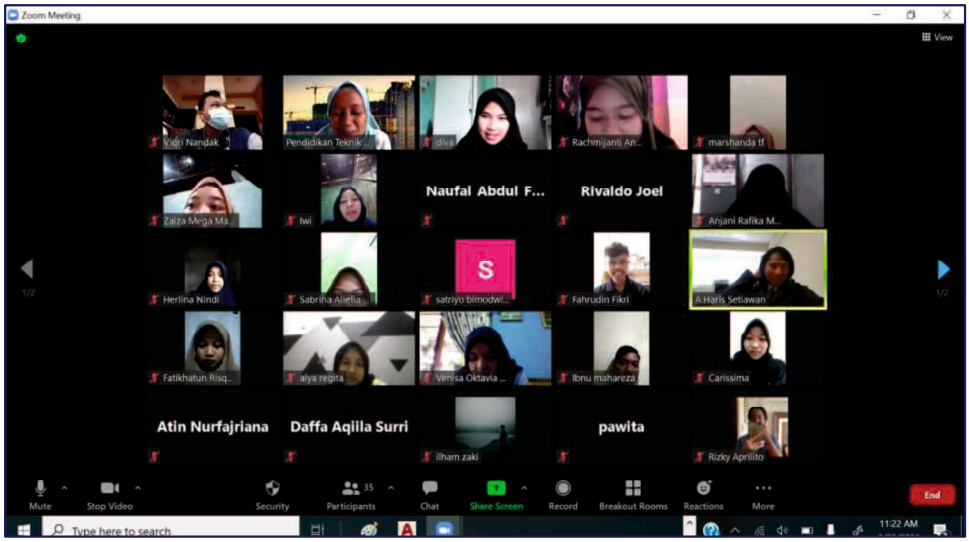


Figure 8. 7 The Teachers and the Students Join the Embedded Zoom Link

(4) The teachers give apperception and motivation. The teachers encourage to do the best in every project for the best future, give collaborative mindset motivation, the collaboration between peers is the best strategy to finish the project optimally. Deliver a collaborative quote from Andrew Carnegie, "Teamwork is the ability to work together toward a common vision. The ability to direct individual accomplishments toward organizational objectives. It is the fuel that allows common people to attain uncommon results." Figure 8.8 presents the apperception, collaborative motivation, and course information.

Figure 8. 8 Apperception, Collaborative Motivation, and Course Information

(5) The teachers enter the pre-test topic (basic drawing). The test aims to confirm the initial student skills in construction drawing. The result was combined with the pre-assessment student skills result from the pre-class. The pre-test was conducted for 20 minutes. After that, guide the student to join the zoom link.

(6) The students enter the introduction module**,** challenges, and examples topic with the teachers' guidance.

(7) The teachers begin to open the project auction, set the challenging stage of designing construction drawing projects with essential sustained questions. Challenging to design a building construction drawing with various difficulty levels and determine the project. There are 15 minutes available time. (Step 1 of the 7 ECD's steps, project auction). Figure 8.9 shows the project auction of the e-vocational challenge stage module. There are many beautiful buildings with different functions and complexity for the project auction's challenging example.

The student is expected to be interested and challenged to choose and design the more complex and creative construction drawing projects. Interested in the construction drawing challenging example, then the collecting information about the designing of the project. Before having the group formed, each student searched and collected the project references individually and discussed with other friends freely.

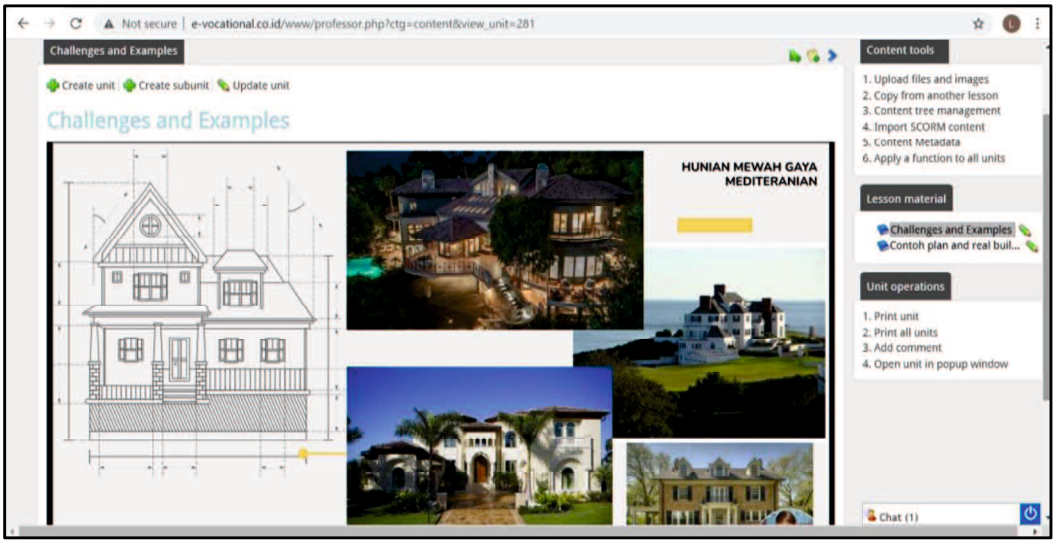


Figure 8. 9 Setting the Challenge Stage of the E-vocational Platform

(8) The teachers evaluate the pre-test, the result aims to confirm the initial student skills in construction drawing by combining with the pre-assessment student skills result from the pre-class, then determining the student teamwork group by considering the result. Learning the challenging stage and examples by e-vocational platform. There are 20 minutes available time.

(9) Announcing the teamwork members list and the students hearing the announcement enthusiastically and learning to socialize with new teamwork members. In preparing the announcement, teachers motivate students to be happy with collaborative teamwork. The teachers' play an important role in encouraging students to be enthusiastic about working together in learning together. Success will be easier to achieve with good teamwork. Strengthening the spirit of cooperation is very important in addition to maintaining a collaborative mindset to remain enthusiastic in collaborative learning. Teachers should ensure that there is no mismatch between individuals within the team members. All team members should be united, excited, spirited, and motivated to learn and work together to achieve the mutual

goal. Moreover, deliver Christine Caine's quote for supporting the new teams, "To build a strong team, you must see someone else's strength as a complement to your weakness and not a threat to your position or authority."

Figure 8. 10 Announcing the Teamwork Members

(10) The teachers give directions to organize the teamwork. At the same time, the student hearing the teacher's direction and identifying how to organize the teamwork in five minutes.

(11) After confirming the students' readiness, the teachers then creating Zoom discussion rooms for teamwork working with 7 minutes duration. While the students were preparing to join the teamwork discussion room for teamwork working.

(12) The teachers open all the Zoom discussion rooms, monitor the authentic Project by collecting information and negotiating the evaluating criteria for 30 minutes. Then followed by the students to enter the discussion room, organize the teamwork to actively design the authentic construction drawing project by collecting information and negotiate the evaluating criteria. (Step 2 of the 7 ECD's steps, proposing project)

(13) Moving to the Zoom main room for 10 minutes. Concluding the lesson with the students and following up by giving assignments for the asynchronous pre-class 1. Next, give lesson connection and guiding for the next meeting, asynchronous pre-class, and regular class 1. The students followed the lesson together and understood the assignment given for the activity in the asynchronous pre-class 1

and mastered the lesson connection for the asynchronous pre-class and regular class 1. Furthermore, the last, deliver Max McKeown quote, “Strategy is not a solo sport, even if you’re the CEO.”

b) Asynchronous, Pre-Class 1 Summarize the Building Regulations

The asynchronous meeting was implemented to follow up on the previous synchronous class. This class activity was held on Monday-Sunday, February 15-28, 2021. The schedule is free with a minimum learning time of 2 x 60 minutes through an e-vocational blended online learning platform of the ECD learning model. The students’ learning steps implementations are as follow:

(1) Before the class begins, the teachers greet and give announcements about the lesson plan by the SNS WhatsApp. Giving word of wisdom from George Herman, “The way a team plays determines its success. You may have the greatest bunch of individual stars in the world, but if they don’t play together, the club will not be worth a dime.” Then ask the student to begin learning with the e-vocational online platform. Greetings, encouragement, and motivation are essential for building trust. Most of the students are motivated and enthusiastic. Student responses in the SNS group discover that most students give positive responses in the forum.

(2) By asynchronous e-learning, giving apperception and motivation to the students. Encourage the students to do the best in every project for the best future and motivate all the students to be the best for the community. Promote the collaborative mindset power. Appraise the collaboration between peers is the best strategy to finish the project optimally.

(3) By SNS WhatsApp and the e-vocational content, guide the students to enter the introduction module and pre-test topic, encourage the student to do the pre-test again and motivate the student to learn and collect information to solve the problem or difficulty doing the pre-test. Monitor the student pre-test and be involved at the discussion forum for supervising assignment problems and difficulties.

(4) Conduct and monitor the teamwork working in collecting information about the designing Project, including the project location, land area, and the building regulations set at the area by WhatsApp SNS group and information at the e-learning.

(5) Monitor the determining of the best building construction project to design in a teamwork discussion by WhatsApp SNS group and e-learning.
(6) Monitor Teamwork in giving each team a chance to find and get a client who needs to build the building project by WhatsApp SNS group and e-learning.
(7) Monitor each teamwork member involves communicating with the client to get the land area measurement data and government regulations data for doing the project planning by WhatsApp SNS group and e-learning.
(8) Negotiating the evaluating criteria of the project in teamwork and lecturers by WhatsApp SNS group and e-learning forum.
(9) Challenging to create the schedule and work on the project by WhatsApp SNS group and e-learning forum.
(10) Encouraging to creating the schedule and work on the project by WhatsApp SNS group and e-learning.

2) Regular-Class 1, Lesson 1 Application of the Building Regulations for Proposing the Construction Drawing Projects

On Monday, February 22, 2021, the regular class was held at 10.50-12.50 Western Indonesia Time (WIB) using the synchronous method through the e-vocational blended online learning platform with Zoom embedded support.

a) Before the class start, greets, motivate, and asking the student to prepare for learning by the SNS WhatsApp group. Give a good collaborative quote from John Carmack, "A strong team can take any crazy vision and turn it into reality". The essential part of the lesson package in the flipped classroom strategy is in the regular class. The application of prior knowledge and theory would be employed in this stage. Teachers should make sure that the student capable of applying the knowledge to the contextual working project
b) Access the e-vocational platform
c) Enter the Module 1 Building Regulations topic and join the embedded zoom link to prepare for synchronous lesson
d) Giving apperception and motivation to prioritizing group responsibilities and learning interdependence

e) Giving direction to organize the teamwork in creating the work schedule for the construction drawing project actively. (Step 3 of the 7 ECD's steps, proposing work schedule)
f) Planning the determined building construction project
g) Creating Zoom Discussion Rooms for teamwork working
h) Open all the Zoom discussion room, monitoring the student to create the schedule and work on the Project actively. (Step 3 of the 7 ECD's steps, proposing work schedule)
i) Planning the determined building construction project
j) Monitoring the student activity and the progress of the drawing project. (Step 4 of the 7 ECD's steps, proposing progress report and monitoring)
k) Monitor the students in reviewing the construction drawing project for presentation. (Step 5 of the 7 ECD's steps, reviewing and preparing for project presentation)
l) Enter each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation. Moving to the Zoom main room and concluding the lesson together with the students and following up by giving assignment for the activity in after-class 1. Finally, make the lesson connections and guide the students for the next meeting for the after-class 1 and give Ryunosuke Satoro quote, "Individually, we are one drop. But, together, we are an ocean."

3) After-Class 1, Lesson 1 Arrange the Construction Drawing Project Preliminary Proposal

The after-class meeting aims to follow up and enhance the previous regular class learning outcome. It is expected to be the advanced skill of the regular class result. Therefore, the after-class was designed to maximize the students' skills studied in a normal condition before. This class activity was held on Monday, February 22, 2021, at 19.30-21.30 Western Indonesia Time (WIB). The meeting method of this class is synchronous, with 2x60' = 120 minutes duration. The students' learning steps are as follow:

a) After the regular class was held successfully, the next objective is to improve the student skills after achieving the regular class learning outcome. Before the class started, a greeting message, motivation, and notification to join a class were sent by the SNS WhatsApp. Give a good quote from Joe Paterno, "When a team outgrows individual performance and learns team confidence, excellence becomes a reality".

The advanced applications of common knowledge and theory would be applied in this class. The teachers should ensure that the student can apply the knowledge to the contextual job with advanced skills.

b) Access the e-vocational platform (1')

c) Enter the e-vocational online learning platform at modul 1 building regulations topic and join the embedded zoom link. (1')

d) Giving apperception and motivation of prioritizing team choices for the best achievement. (10')

e) Guiding the students in presenting the drawing project to collect critique and revision. (13'x7=91'). (Step 6 of the 7 ECD's steps, presenting the project)

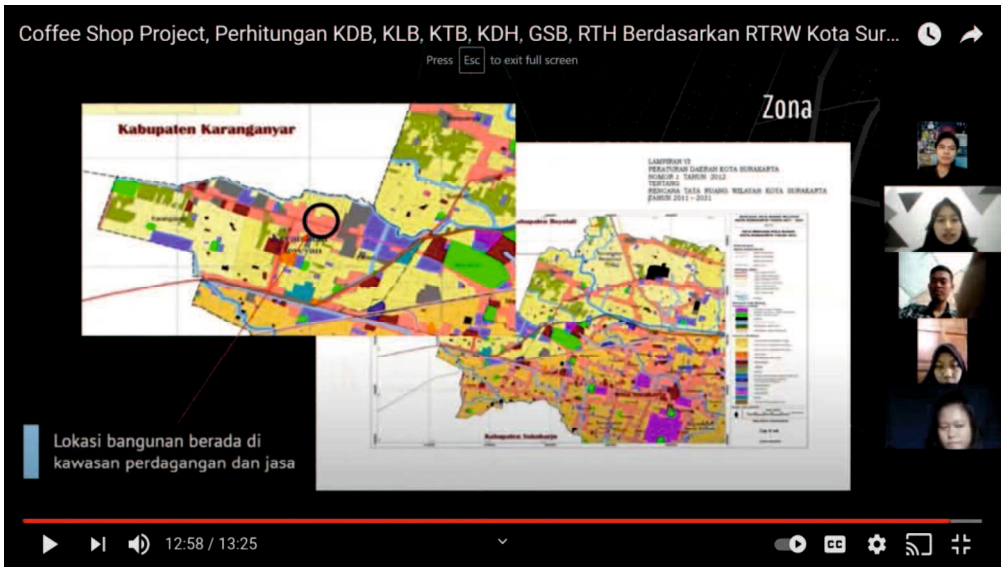


Figure 8. 11 Students' Presentation of Applying Building Regulation

f) Monitor the student in learning to socialize and interact with people in a presentation forum

g) Monitor the student in collecting critique and revision

h) Conducting the student in doing reflection and evaluate the project as the proposing criteria. (10') (Step 7 of the 7 ECD's Steps, reflecting and evaluating)

i) Giving connection and guiding for the next pre-class 2 and deliver Moira Alexander's quote, "Success can't truly be felt if you are alone on the journey or the victory."

Table 8. 10 Lesson 1 Objectives Achievement

Num	Lesson 1 Objectives	Teacher's Evaluation	Mean score	Result
1	Identify the building drawing projects	No significant problem	88.25	Passed
2	Plan the determined building construction project	No significant problem	87.22	Passed
3	Propose work time schedule	Some students had difficulty in identifying drawing work regarding the building function and the floors number	85.11	Passed
4	Identify the collaborative mindset to socialize with the team	A student had a difficulty in socialize with the team	92.36	Passed
5	Define the collaboration between peers is the best strategy to finish the project optimally	No significant problem	91.90	Passed

From the implementation of the ECD learning model in lesson 1, the lesson objectives achievement in the experimental class (class B) can be seen in Table 8.10. It shows the teachers' evaluation and class final result of students' skills in CAD construction drawing course of class B in lesson 1. The teachers evaluate the implementation of the ECD learning model by actual action as the teacher with observing the learning process and the possibility of learning problems happen in the class.

8.4.4. Lesson 2 Planning the Building Space Utilization Intensity

Lesson 2 continues the lesson 1 learning objectives, identifying the building drawing projects, Planning the determined building construction project, proposing a work schedule, and identifying the collaborative mindset to socialize with the team. This lesson will enhance the skills through the hierarchy of observable knowledge, skills, attitudes, behaviors, and abilities as the learning activity process. The objectives for lesson 2 are as follow: (1) planning the space utilization intensity; (2) drawing site plan space utilization intensity; (3) practice the collaborative mindset to socialize with the team; and (4) illustrate the collaboration between peers is the best strategy to finish the project optimally.

1) Pre-Class 2, Lesson 2 Demonstrate and Practice the Building Space Utilization Intensity

The pre-class implementation is one week before the regular class with an asynchronous method and conducted before the regular class with no fixed schedule. The time is free. The minimum learning duration is 120 minutes (2x60 minutes). The students should enter the e-learning platform on Thursday-Sunday, February 25-28, 2021. The learning methods are self-directed learning, demonstration video, free e-learning forum, and WhatsApp discussion. The implementations are as follow:

a) Greet, motivate, ask the student to prepare for learning, and announce the activity by WhatsApp SNS group. And deliver Margaret Mead's quote, "Never doubt that a small group of thoughtful, committed people can change the world. Indeed. It is the only thing that ever has."
b) Accessing the e-vocational platform
c) Enter the Module 1 building regulations topic
d) Giving apperception and motivation by asynchronous e-learning to do the best in every project for the best future. Giving collaborative mindset motivation, collaboration between peers is the best strategy to finish the project optimally.
e) By e-learning material, setting the challenging stage of designing construction drawing project by giving examples and essential sustained questions. (Step 1 of the 7 ECD's steps, project auction/update)
f) By asynchronous e-learning, monitor the student in entering the available topic, building regulations
g) Monitoring and assessing the student by asynchronous e-learning. Monitoring the individual assignment and group assignment.
h) The Individual assignment: bonus stage assignment, group project, answer the open-ended and multiple-choice quiz questions
i) The contextual team assignment: drawing site plan space utilization intensity
j) By e-learning and WhatsApp group, encouraging teamwork in designing the authentic construction drawing project by collecting information and negotiating the evaluating criteria. (Step 2 of the 7 ECD's Steps, Proposing project)
k) Creating/updating Zoom Meeting for the upcoming regular and after-class by embed to the e-learning platform
l) Correcting the individual student assignments from the e-learning
m) Supervising student teamwork project assignments by forum discussions on the e-learning.

2) Regular-Class 2, Lesson 2 Compute and Apply the Building Space Utilization Intensity

The regular class 2 was conducted on Monday, March 1, 2021, at 10.50-12.30 Western Indonesia Time (WIB) with the synchronous method. The media is using the e-vocational blended learning platform WordPress-eFront-Zoom-Meeting. The learning

methods are lecture, demonstration, teamwork working, discussion. The implementations are as follow:

a) Before the class start, by the WhatsApp SNS group, the teachers greet, motivate, and ask the student to prepare for learning. And deliver Victoria Osteen's quote, "We talk a lot about hope, helping, and teamwork. Our whole message is that we are more powerful together."
b) Access the e-vocational platform. (1')
c) Enter the Modul 1 building regulations topic and join the embedded zoom link. (1')
d) Giving apperception and motivation to prioritizing group responsibilities and learning interdependence. (10')
e) Giving direction to organize the teamwork and directing the student to actively create/update the schedule and work on the construction drawing project (Lesson) in applying the building regulation to the determined building construction project, calculating the Space Utilization Intensity, and drawing the Project Site Plan with intensity of space utilization. (20') (Step 3 of the 7 ECD's Steps, proposing work schedule/update) (teachers' guidance)
f) Creating Zoom Discussion Rooms for teamwork working. (5')
g) Open all the Zoom discussion room, monitoring the student to actively create the schedule and work on the construction drawing project authentically (Application) in applying the building regulation to the determined building construction project, calculating the Space Utilization Intensity, and drawing the Project Site Plan with Intensity of Space Utilization (30') (Step 3 of the 7 ECD's steps, proposing work schedule/update) (Application as a learning experience)
h) The students continuously work on the progress of the construction drawing project authentically. While the teachers monitoring the student activity and the progress of the project. (10') (Step 4 of the 7 ECD's steps, proposing progress report and monitoring)
i) The students review the construction drawing project to prepare for the presentation. The teachers monitor the students understanding the project to prepare for the presentation. (8') (Step 5 of the 7 ECD's steps, reviewing and preparing for project presentation)

j) Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (advancing the first presentation at after-class 2). (5')

k) Moving to the Zoom main room. (10')

(1) Concluding the lesson together with the students and following up by giving assignment for the activity in after-class 2.

(2) Giving lesson connection and guiding for the next meeting (after-class 2) and giving quote from Pat Riley, "Great teamwork is the only way we create the breakthroughs that define our careers".

3) After-Class 2, Lesson 2 Arrange the Building Space Utilization Intensity

The after-class 2 was implemented, and the lesson 2 objectives were achieved successfully. Table 8. 11 shows the lesson 2 objectives achievement. Consequently, the after-class 2 should maximize the students' skills in implementing the Government Regulation of the Republic of Indonesia Number 36 of 2005 concerning the Implementation Regulations of Law Number 28 of 2002 concerning Buildings. Moreover, it will enhance the student skills in applying the National Territory Spatial Planning regulation, in Indonesia namely *Rencana Tata Ruang Wilayah Nasional* (RTRW). The after-class 2 was held on Monday, March 1, 202, at 19.30-21.30 Western Indonesia Time (WIB) with the synchronous method. The implementations are as follow:

a) Before entering the class, the teachers greet, motivate, and ask the student to prepare for learning by the WhatsApp SNS group. Give quotes from Bang Gae "Teamwork makes the dream work."

b) Access the e-vocational platform (1')

c) Enter the module 1 building regulations topic and join the zoom link. (1')

d) Giving apperception and motivation of prioritizing team choices for the best achievement. Give quote from Stephen Covey, "Interdependent people combine their own efforts with the efforts of others to achieve their greatest success". (10')

e) Guiding the students in presenting the construction drawing project to collect critique and revision in applying the building regulation, calculating the Space Utilization Intensity. (13'x7=91'). Monitor the student in learning to socialize and interact with people in a presentation forum. Monitor the student in collecting critique and revision. (Step 6 of the 7 ECD's steps, presenting the project)

f) Conducting the student in doing reflection and evaluate the construction drawing project as the criteria planned. (10') (Step 7 of the 7 ECD's steps, reflecting and evaluating)

g) Giving connection and guiding for the next pre-class 3. Give quote from Ifeanyi Onuoha, "Teamwork is the secret that makes common people achieve uncommon results". (7')

Table 8. 11 Lesson 2 Objectives Achievement

Num	Objectives Indicator of Lesson 2	Teacher's Evaluation	Mean score	Result
1	Planning the space utilization intensity	No significant problem	85.06	Passed
2	Drawing site plan space utilization intensity	No significant problem	86.11	Passed
3	Practice the collaborative mindset to socialize with the team	No significant problem	91.67	Passed
4	Illustrate the collaboration between peers is the best strategy to finish the project optimally	No significant problem	90.97	Passed

As an implementation part of development research, this chapter essentially aims to prove that the ECD learning model can enhance student skills. So that the discrepancy between the needs of the industrial world and the skills of students decreases. Moreover, creating harmony between industry and vocational schools that can meet each other's needs. This chapter describes a summary of the learning process from the first class until the last of the 16th class. First, it describes lessons 1 and 2, where lesson 1 shows different meeting methods from other lessons. It employs both synchronous and asynchronous modes to maximize student understanding about collaborative mindset and the course role. The learning process description continues until lesson 2, where the ECD's seven steps are applied in each lesson from the pre-class, regular-class, and after-class. After entering the lesson 3 to 16, the description is focused only on the lesson objective assessment.

8.4.5. Lesson 3-16 Designing and Drawing the Building Construction

1) Lesson 3-6 Identify and Practice the Concept of Building Shop Drawing and CAD Drawing Command

As project-based collaborative learning, the ECD learning model implements 16 lessons in one-semester implementation. By applying the flipped classroom strategy, the implementation of 16 lessons was divided into three learning activities for each lesson, including pre-class, regular-class, and after-class (16x3). There are 48 classes implemented

from February 15 to June 7, 2021. From the student achievement on the lesson objective, the implementation of the ECD in CAD construction drawing course learning process for one semester has given the result of lessons 3-6 presented in Table 8. 12.

Table 8. 12 Lesson 3-6 Objectives Achievement

Num	Objectives Indicator of Lesson 3-4	Teacher's Evaluation	Mean score	Result
1	Identify the concept of drawing the building shop drawing	No significant problem	87.03	Passed
2	Practice the concept of building shop drawing to design the floor plan (including doors and windows)	Several students had difficulty in designing floor plan	86.06	Passed
3	Illustrate the coordinate system	No significant problem	85.97	Passed
4	Practice the CAD drawing commands	No significant problem	85.97	Passed
5	Drawing the floor plan	No significant problem	85.03	Passed
6	Drawing doors and windows plan	No significant problem	86.33	Passed
7	Apply the collaborative mindset to socialize with the team on designing the floor plan	No significant problem	90.74	Passed
Num	Objectives Indicator of Lesson 5-6	Mean Score	Mean Score	Result
1	Practice the concept of building shop drawing to design doors and windows details	No significant problem	86.08	Passed
2	Practice the concept of building shop drawing to design foundation plan	No significant problem	86.06	Passed
3	Drawing doors and windows details	No significant problem	86.03	Passed
4	Drawing the foundation plan	No significant problem	85.61	Passed
5	Apply the collaborative mindset to socialize with the team on drawing the doors and windows details (including foundation plan)	No significant problem	90.51	Passed

Lesson 3 was conducted by three classes, including pre-class 3 on March 2-7, 2021, the regular class 3 was conducted on Monday, March 8, 2021, at 10.50-12.30 WIB, and after class was held in the evening at 19.30-21.30. The student learns module 2, the concept of drawing the building shop drawing topic in the pre-class. They are excited about learning. While lesson 4 pre-class was held on March 9-14, 2021, the regular class was conducted on Monday, July 15, 2021. The student learns module 2, the concept of building shop drawing, and module 3 managing CAD drawing commands for construction drawing, including the coordinate system for construction drawing, drawing operations, CAD basic drawing commands. There is a finding on learning objective number two, practice the concept of building shop drawing to design the floor plan (including doors and windows). However, several students had difficulty planning floor plans, identifying space requirements, and arranging space organization according to building requirements. Thus,

even the result of lesson objectives is finally passed, but the teachers need to explain again instead of the student self-learning from the e-vocational learning platform. While in many other topics, the student has already understood and skilled only by self-learning at the pre-class using the e-vocational learning platform's lesson materials. The students' learning achievement of lessons 3-4 can be seen in Table 8.12, it is including the lesson 5-6. The highest score is in the indicator number seven, apply the collaborative mindset to socialize with the team on designing the floor plan. And the lowest score is in the indicator number three, drawing the floor plan.

Lesson 5 was held by pre-class 5 on March 16-21, 2021. The regular class 5 was conveyed on Monday, March 22, 2021, at 10.50-12.30 WIB, and after class was held in the evening at 19.30-21.30. The student learns module 3 managing CAD drawing command for construction drawing and module 4, drawing applied object on buildings, the building shop drawing topic in the pre-class. They are excited about learning. The wise quote embedded into the platform and flow regularly on the SNS WhatsApp every day make them feel at home. While lesson 6 pre-class was conducted on Tuesday to Sunday, March 23-28, 2021, the lesson materials are module 3 managing CAD drawing commands for construction drawing and module 4, drawing applied objects on building part 2, advance. The regular class was conducted on Monday, March 29, 2021, from 10.50-12.30. And the after class was held in the evening on the same day at 19.30-21.30.

The learning result of lessons 5 and 6, lesson objective number 1, practice the concept of building shop drawing to design doors and windows details, obtains a mean score of 86.08. While number 2, practice the concept of building shop drawing to design foundation plan obtains a mean score of 86.06, number 3 drawing doors and windows details, 86.03, number 4 drawing the foundation plan, 85.61. Objective number 5, apply the collaborative mindset to socialize with the team to draw the doors and windows details (including the foundation plan) obtains 90.51. Furthermore, all the results of the lesson objectives are passed with no significant problem.

2) Lesson 7 – 10 Drawing the Detail Foundation, Roof Construction Plan, Building View, and Building Sections

The implementation of lesson 7 started with pre-class 7 from March 30 to April 4, 2021. The regular class was held on April 5, 2021, on Monday from 10.50-12.30. In comparison, the after-class was held on the evening, April 5, 2021, from 19.30-21.30. The

lesson objectives include lesson 8, as stated in Table 8.13, including the teachers' evaluation and the achievement result. From the lesson 7 to lesson 8, there are 6 lessons' objectives: number 1 applies the concept of building shop drawing to design foundation details with an 85.89 score. Number 2 apply the concept of building shop drawing to design a roof construction plan with an 84.92 score. Number 3 manage the CAD drawing commands with 86.11. Number 4 drawing foundation details with 85.72. Number 5 drawing the roof construction plan with 85.03. Number 6 apply the collaborative mindset to organize the team on the foundation details and the roof construction plan with 90.28. In lessons 7-8, the lowest achievement of the lesson objectives found in indicator number 5, drawing the roof construction plan with a mean score of 85.03.

Table 8. 13 Lesson 7-10 Objectives Achievement

Num	Objectives Indicator of Lesson 7-8	Teacher's Evaluation	Mean score	Result
1	Apply the concept of building shop drawing to design foundation details	No significant problem	85.89	Passed
2	Apply the concept of building shop drawing to design roof construction plan	No significant problem	84.92	Passed
3	Manage the CAD drawing commands	No significant problem	86.11	Passed
4	Drawing foundation details	No significant problem	85.72	Passed
5	Drawing the roof construction plan	No significant problem	85.03	Passed
6	Apply the collaborative mindset to organize the team on the foundation details and the roof construction plan	No significant problem	90.28	Passed
Num	Objectives Indicator of Lesson 9-10	Teacher's Evaluation	Mean score	Result
1	Apply the concept of building shop drawing to design building view drawing	No significant problem	85.00	Passed
2	Apply the concept of building shop drawing to design building sections.	No significant problem	84.92	Passed
3	Drawing building view	No significant problem	84.78	Passed
4	Drawing the building sections	Several students had difficulty to draw building sections according to the cutting lines in the floor plan.	84.58	Passed
5	Apply the collaborative mindset to organize the team on drawing the building views and building sections	No significant problem	89.81	Passed

Lesson 9 begins with pre-class 9, which held on April 13-18, 2021. The regular class 9 was conducted on Monday, April 19, 2021, at 10.50-12.30 WIB, and after class was held in the evening at 19.30- 21.30. While lesson 10 pre-class 10 was held on April 20-25, 2021, the regular-class 10 was conducted on Monday, April 26, 2021, at 10.50-12.30 WIB, and after-class 10 was held in the evening at 19.30 -21.30. The student learns module 4 drawing applied objects on buildings, module 5 drawing a floor plan and building view, module 6. sections drawing, and module 7. advanced sections drawing. To design and draw

the building construction project on building view and building sections drawing There is a finding on learning objective number four, drawing the building sections. Drawing building sections is one of the lesson objective CAD construction indicators with the highest difficulty level, with a grade score of 84.58, which is the lowest score compared to the overall lesson objective indicators in lessons 1-16. From the students' activity of the learning process, it was found that four groups had difficulty drawing the sections, especially in projecting detailed sections on the foundation structure such as stairs, plate, and roof truss, according to the cutting lines' location on the floor plan. However, in the end, all students passed. The lecturer provided additional material on concepts, principles, and steps in drawing the sections, adding examples of section drawings and giving more demonstrations video in drawing building sections that students can access independently during the pre-class. Furthermore, enhance team responsibility spirit and learning interdependence by giving motivation. Lesson 7-10 objectives achievement are presented in Table 8.13.

3) Lesson 11 – 13 Manage the concept and Draw the Building Structural Elements

Lesson 11 was held initially by conducting pre-class 11 from April 27 to May 2, 2021. The regular-class 11 was conveyed on Monday, May 3, 2021, at 10.50-12.30 WIB, and after-class 11 was held in the evening at 19.30-21.30. While lesson 12 pre-class 12 was held on May 4-9, 2021, the regular-class 12 was conducted on Monday morning, May 10, 2021. The after-class 12 was held on Monday evening from 19.30-21.30. While lesson 13 pre-class 13 was held on May 11-16, 2021, the regular-class 13 was conducted on Monday, May 17, 2021. and after-class 13 was held in the evening at 19.30-21.30. Lesson 11-13 has 6 lesson objectives which are summarized in Table 8.14. In lessons 11-13, the student learns module 4 drawing applied objects on buildings, module 5 drawing a floor plan and building view, module 6 sections drawing, and module 7 advanced sections drawing to design building roof construction details drawing and design building structural elements (columns, concrete slope, concrete floor plate, and beams). Students are very enthusiastic about learning. However, in the learning process, some students had difficulties with the indicator lesson objective number 3, i.e., draw the building roof construction and truss construction details. However, all students finally passed. In addition, some of the students had difficulty connecting the partial part of the construction drawing objects to a single drawing unit.

Table 8. 14 Lesson 11-13 Objectives Achievement

Num	Objectives Indicator of Lesson 11-13	Teacher's Evaluation	Mean score	Result
1	Manage the concept of building shop drawing to design building roof construction details drawing	No significant problem	85.11	Passed
2	Manage the concept of building shop drawing to design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams)	No significant problem	85.08	Passed
3	Drawing building roof construction details drawing	Several students had difficulty in drawing the truss details	84.86	Passed
4	Drawing the stairs plans	No significant problem	84.78	Passed
5	Drawing columns, concrete slope, concrete floor plate, and beams plans and details drawing	No significant problem	84.58	Passed
6	Apply the collaborative mindset to organize the team on drawing the roof construction details and building structural elements	No significant problem	89.81	Passed

The teachers provided additional material on the concepts and the proper steps in drawing the truss details, adding examples of truss drawings, and demonstrating videos in roof detail drawing lesson material that students can learn independently at pre-class. Furthermore, enhance team responsibility spirit and learning interdependence by giving motivation. Lesson 11-13 objectives achievement are presented in table 8.14.

4) Lesson 14 – 16 Organize the Final Construction Drawing Project

After finishing the drawing of the building structural elements in the previous lessons, lesson 14 begins to learn and practice to draw building utility, i.e., plumbing and mechanical electrical. The first activity of lesson 14 is pre-class 14 implementation, it held on May 18-23, 2021. The regular class 14 was conducted on Monday, May 24, 2021, at 10.50-12.30 WIB, and after class was held in the evening at 19.30- 21.30. While lesson 15 pre-class 15 was held on May 25-25, 2021. The regular-class 15 was conducted on Monday, May 31, 2021, at 10.50-12.30 WIB, and after-class 15 was held on Monday evening at 19.30 -21.30. The student learns module 8 utility building drawing, module 9 plot the drawing, module 10 project building shop drawing. The student also learns the design and drawing utility building drawing, organize the project building shop drawing, and plot the drawing. There were findings on learning objective number 3 drawing the plumbing system and number 6 drawing the Mechanical and Electrical (ME) drawing. However, several students had trouble drawing the plumbing installation plan and ME. Thus, even the result of lesson objectives is finally passed, but the teachers need to give more explanation instead of the student self-learning from the e-vocational learning platform. While in many other topics, the student has already understood and skilled only by self-learning at the pre-class

using the e-vocational learning platform's lesson materials. Besides, the teachers provide more demonstration videos in drawing the plumbing and ME plan lesson material. Moreover, the teacher encourages each student to enhance team responsibility and learning interdependence.

Table 8. 15 Lesson 14 - 16 Objectives Achievement

Num	Objectives Indicator of Lesson 14-15	Teacher's Evaluation	Mean score	Result
1	Manage the concept of building shop drawing to design building utility drawing	No significant problem	85.06	Passed
2	Manage the concept of building shop drawing to organize the result of construction drawing	No significant problem	84.94	Passed
3	Drawing the plumbing system	Several students had trouble in drawing the plumbing installation plan	84.94	Passed
4	Drawing clean water installation	No significant problem	84.92	Passed
5	Drawing of dirty water (used) and sewage installations	No significant problem	84.89	Passed
6	Drawing the Mechanical and Electrical Drawing	Some students had difficulties in drawing mechanical and electrical installations.	84.89	Passed
7	Organize the whole construction drawing result	No significant problem	84.97	Passed
8	Manage the collaborative mindset to finish the building shop drawing project with the team	No significant problem	86.11	Passed
Num	Objectives Indicator of Lesson 16	Teacher's Evaluation	Mean score	Result
1	Arrange the building shop drawing project	No significant problem	84.92	Passed
2	Propose the building shop drawing project result in a presentation	No significant problem	84.22	Passed
3	Organize the teamwork for proposing the building shop drawing project result	No significant problem	85.19	Passed

Lesson 16 was held by pre-class 16 on June 1-6, 2021. The regular class 16 was conveyed on Monday, Juni 7, 2021, at 10.50-12.30 WIB, and after class was held in the evening at 19.30-21.30. The student learns module 10. project building shop drawing and evaluation module to organize the project building shop drawing and propose the building shop drawing project result in a presentation and evaluate the learning result in the pre-class. They are excited about learning. From the lesson 16 there are 3 lessons' objectives as follow: number 1 is arranging the building shop drawing project with 84.92 score; number 2 propose the building shop drawing project result in a presentation with 84.22 score; and number 3 organize the teamwork for proposing the building shop drawing project result with 85.19. From Table 8.15, in the objectives indicator of lesson 16, it is identified that the lowest grade score is in indicator number 2, proposes the building shop drawing project result in a presentation with an 84.22 score.

The implementation of the ECD learning model for one semester, which ended on June 7, 2021, all 16 lessons have been carried out well. The 48 classes were all performed entirely. As a result, the students' lesson objectives achievements are obtained successfully. Tables 8.10-8.15 show the lesson objectives' achievements.

8.4.6. Enhancing Students' Skills by Implementing the ECD Learning Model: Statistical Hypothesis Testing of Paired Sample t-test, Independent Sample t-test, and N-gain Score Analyses

1) Paired Sample t-test

As a part of developing research designing the ECD learning model for enhancing students' skills, this study examines the ECD learning model implementation in an experimental class of a civil engineering education study program. The study implemented two major assessments. The first assessment was a pre-test arranged at the beginning of the course, and the second was a post-test conducted at the end of the semester. The one-semester learning period contains 16 lessons/class meeting times, one meeting in a week. While the ECD learning model employs the flipped classroom strategy, each lesson contains three class meetings, including pre-class, regular-class, and after-class. There were four meeting packages in the four-week meeting, where each package consisted of a pre-class, a regular-class, and an after-class. The total number of class meetings is 48, which comes from 3x16. The first-class meeting was pre-class 1 lesson 1 held on February 15, 2021, and the last meeting is after class 16, lesson 16 held on June 7, 2021. On Thursday, June 3, 2021, a post-test was carried out in both the experimental and control classes. The post-test assessment discovered that the mean score of the experimental class's construction drawing skill is 85.47 (class B) and the control class of 78.46 (class A) on a 100 scale. According to the assessment criteria, it is included in the Very Good category with a grade range of more than 81.25 (Class B) and Good category with a grade range of 68.76-81.25 (Class A). Furthermore, the post-test assessment identified the mean score of the experimental class's collaborative skill of 89.86 for class B and the control class of 76.99 for class A on a 100 scale. According to the assessment criteria, it is included in the Very Good category with a grade range of more than 81.25 (Class B) and Good category with a grade range of 68.76-81.25 (Class A). The construction drawing skill and collaborative skill based on the post-test showed the mean scores presented in Figure 8.12 and Figure 8.14.

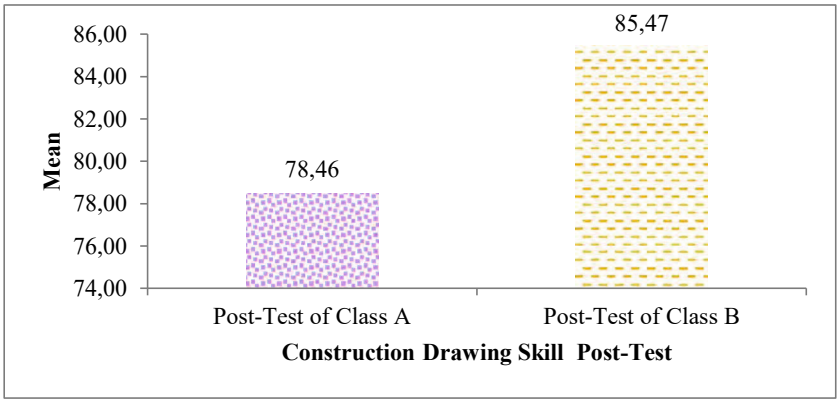


Figure 8. 12 Construction Drawing Skill Mean Score (Post-Test)

According to Figure 8.12, the post-test score of construction drawing skill for class B as the experiment class is 85.47, and class A as the control class is 78.46 on a 100 scale. It implies the scores are developing. It climbed 33.06 points from the mean value of pre-test 45.40 and post-test of 78.46 on a 100 scale for class A as a control class. Moreover, as the experiment class, class B conferred a more considerable improvement in the mean score of construction drawing skill with 41.51 from a pre-test score of 43.96 and 85.47 in post-test on a 100 scale. The frequency distribution of the post-test from 75 students as the research subject is presented in Figure 8.13.

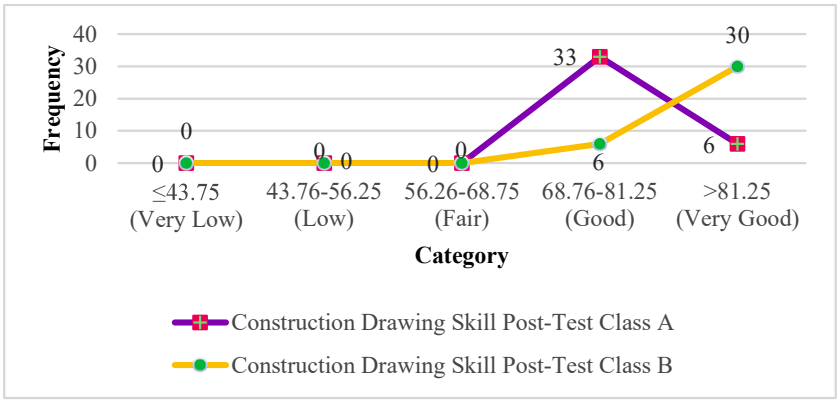


Figure 8. 13 Frequency Distribution of Construction Drawing Skill (Post-Test)

After examining the equal initial performance between the two classes, finding the result of the experiment by post-tests is the most requested aim. Subsequent experimenting, it was seen that the level of construction drawing skill developed in each class with a different distribution from the initial positions when the research had not been taken out. The completion of scores and their frequency distribution can be viewed in Figure 8.13. The post-test scores frequency distribution of construction drawing skills for classes A and B after the experiment for one semester exposes changes that ordinarily arise. In the control

class (class A), the highest frequency is in the Good category (68.76-81.25), rising from 1 to 33. Whereas in the Very Good category (above 81.25), rising from 0 to 6 students. In a different circumstance, as the experimental class, class B exposes an enormous growth in decreasing students who previously get Very Low 15, Low 15, and Fair 6 scores, in the post-test becomes no one. The highest frequency is above 81.25, it is including the Very Good category, rising from 0 to 30. Moreover, the Good category (68.76-81.25) is increasing from 0 to 6 students.

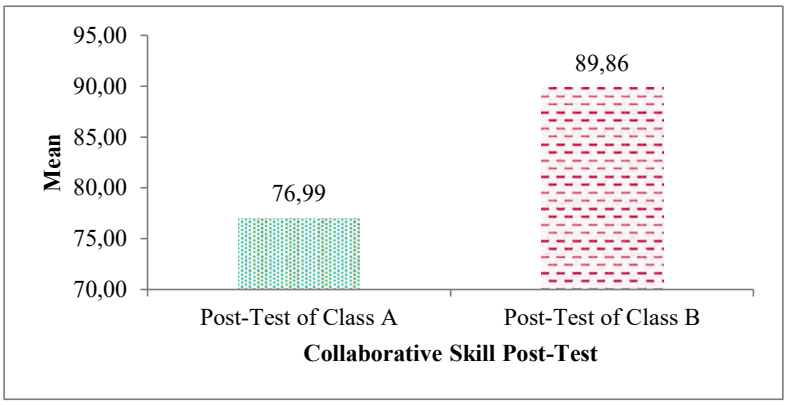


Figure 8. 14 Collaborative Skill Mean Score (Post-Test)

According to Figure 8.14, class B's post-test collaborative skill score as the experiment class is 89.86, and class A as the control class is 76.99 on a 100 scale. It indicates that the scores are increasing. It increased 6.09 points from the mean score of pre-tests 70.90 and post-test 76.99 on a 100 scale for class A as a control class. Moreover, class B's experiment class exposes a more substantial increase in the mean score of collaborative skill with a score of 19.58 from a pre-test score of 70.28 and 89.86 in post-test on a 100 scale. A post-test frequency distribution from 75 students as the research subject is presented in Figure 8.15.

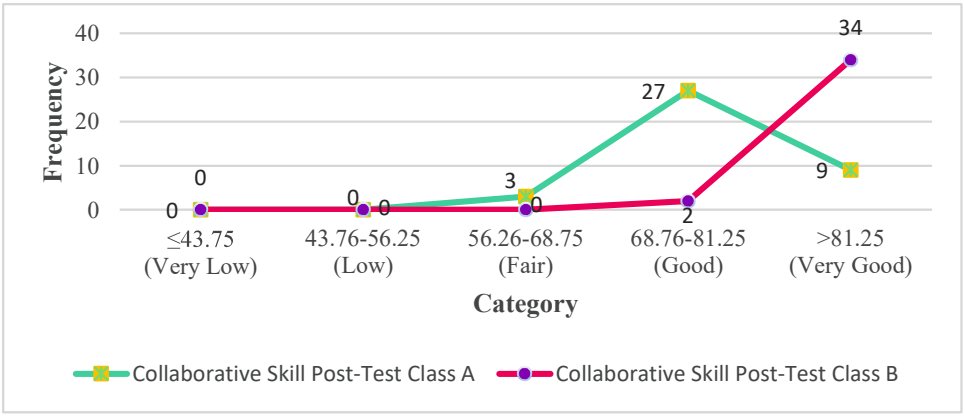


Figure 8. 15 Frequency Distribution of Collaborative Skill (Post-Test)

After observing the equal initial performance among those two classes, learning the result of the research by post-tests is the most desired purpose. After researching, it was found that the level of collaborative skill evolved in each class with a distinct appearance from the initial circumstances when the experiment had not been taken out. The completion of scores and their frequency distribution can be seen in Figure 8.15. The frequency distribution of collaborative skill post-test scores for classes A and B after being taken out by the experiment for one semester displays variations that generally grow. In class A as the control class, decreasing students who get Low scores from 10 to 3 and no more students get Low scores. Moreover, the highest frequency is in the Good category of 68.76-81.25, rising from 18 to 27 students. Whereas in the Very Good category, above 81.25, progressing from 7 to 9 students. On the other hand, as the experimental class, class B exhibits a much better development. No more students get Low and Fair scores from 3 and 10 to 0 student, the highest frequency is in the Very Good category (above 81.25), growing from 2 to 34. The Good category (68.76-81.25), which previously calculated 21, became 2 students. Summary information of the pre-test and post-test students' skills is presented in Table 8.16.

Table 8. 16 Summary of Students' Skill Descriptive Statistics

Student's Skill Aspect	Descriptive Statistics	Class A	Class B
Construction drawing skill	Mean scores of Pre-test	45.40	43.96
	Mean scores of Post-test	78.46	85.47
	Increasing of the Mean scores	33.06	41.51
Collaborative skill	Mean scores of Pre-test	70.90	70.28
	Mean scores of Post-test	76.99	89.86
	Increasing of the Mean scores	6.09	19.58

Moreover, to decide whether the improvement happened significantly or not, the pre-test and post-test of the experimental and control class were examined utilizing paired samples t-test. Paired sample t-test examination was conducted to reveal differences in students' collaborative mindset before and after treatment. Before applying the paired sample t-test, the Analysis requirement test is obliged to verify the data has a normal distribution employing the Shapiro Wilk test. The premise of a normal distribution is conferred when Sig.'s value is higher than the designated alpha level of 5%. A summary of data normality tests for classes A and B are manifested in Table 8.17.

Based on the Shapiro Wilk examination, Sig. value for class A construction drawing skill pre-test is 0.579 and post-test 0.259. As these two Sig. values > 0.05, so it can be

assumed that class A construction drawing skill pre-test and post-test have a normal distribution. Moreover, the class B Sig. value for pre-test is 0.126 and post-test of 0.161. As these two Sig. values > 0.05, so it can be presumed that the class B construction drawing skill pre-test and post-test have a normal distribution. Moreover, the collaborative skill Sig. value for class A pre-test is 0.243 and post-test 0.136. As these two Sig. values > 0.05 means that data collaborative skill pre-test and post-test class A have a normal distribution. Moreover, class B Sig. value for the pre-test is 0.090 and post-test of 0.133. As these two Sig. values > 0.05, so it can be inferred that class B collaborative skill pre-test and post-test have a normal distribution. Hence, the requirements and premises for normality in using the paired sample t-test have been achieved.

Table 8. 17 The Summary of Normality Test (Pre-Test and Post-Test)

Student's Skill Aspect	**Group**		**Shapiro-Wilk**		**Conclusion**
			Df	Sig.	
Construction drawing skill	Class A	Pre-test	39	0.579	Normal
		Post-test	39	0.259	Normal
	Class B	Pre-test	36	0.126	Normal
		Post-test	36	0.161	Normal
Collaborative skill	Class A	Pre-test	39	0.243	Normal
		Post-test	39	0.136	Normal
	Class B	Pre-test	36	0.090	Normal
		Post-test	36	0.133	Normal

After fulfilling the paired-sample t-test prerequisite analysis, the paired-sample t-test was then analyzed to examine student construction drawing skill enhancement before and after the experiment. The analysis result explains that the value of Sig. (2-tailed) construction drawing skill between pre-test and post-test for class A is 0.000, less than 0.05 probability. It means the H_0 is rejected, and the H_a is accepted. With an interpretation that there is a significant development of student construction drawing skill class A between pre-test and post-test. Moreover, $t_{count} = 22.053 > t_{table} = 1.687$, which implies the H_0 is rejected, and the H_a is accepted. The assumption, there is a significant rise in the pre-test and post-test student construction drawing skill class A. Hence, there is an improvement in the mean score of class A pre-test and post-test of construction drawing skill with an average value of 33.06, progressing from 45.40 to 78.46, with a correlation value (r) of 0.745 between pre-test and post-test of the construction drawing skill with Sig. 0.000 less than 0.05.

Moreover, the outcomes of the examination in class B pointed to the value of Sig. (2-tailed) class B pre-test and post-test is 0.000, less than 0.05 probability, it means that the

H_0 is rejected, and the H_a is accepted, with a premise there is a student construction drawing skills' significant increase between the pre-test and post-test of class B. After that, t_{count} = 35.072>t_{table} = 1.691, which indicates the H_0 is rejected, and the H_a is accepted. With the assumption, there is a significant increase between the pre-test and post-test of students' construction drawing skills class B. Therefore, there is an increase in the mean score of class B construction drawing skill between pre-test and post-test, the mean value raising of 41.51 from 43.96 to 85.47, with a high correlation (r) of 0.927 (more than 0.80) between construction drawing skill pre-test and post-test with Sig. 0.000, less than 0.05 probability. The correlation (r) = 0.927, more than 0.80, shows a high correlation mean score between the construction drawing skill pre-test and post-test [175]. Consequently, the students' construction drawing skills in the experimental class have increased significantly. The correlation is high after the experiment was carried out by implementing the ECD learning model.

Furthermore, for the analysis result of paired-sample t-test student skill in collaborative skill, the examination result explains that the value of Sig. (2-tailed) pre-test and post-test in collaborative skill for class A of 0.000 < 0.05 probability means the H_0 is rejected, and the H_a is accepted, assuming a significant increase of student collaborative skill class A between pre-test and post-test. Moreover, t_{count} = 6.084>t_{table} = 1.687, which implies the H_0 is rejected, and the H_a is accepted. The premise, there is a significant rise of student collaborative skill class A between the pre-test and post-test. Therefore, an increase in the mean score of class A collaborative skill pre-test and post-test, with an average value of 6.09 increasing from 70.90 to 76.99, with r = 0.745 between collaborative skill pre-test and post-test with Sig. 0.000, less than 0.05 probability.

Besides, the consequences of the investigation in the class B analysis explained that the value of Sig. (2-tailed) pre-test and post-test for class B of 0.000 less than 0.05 probability mean the H_0 is rejected, and the H_a is accepted, with a premise there is a significant development of student collaborative skill class B between pre-test and post-test. Subsequent that, t_{count} = 25.489>t_{table} = 1.691, which means the H_0 is rejected, and the H_a is accepted. The interpretation, there is a significant development of student collaborative skill class B between the pre-test and post-test. Hence, there is an increase in the mean score of class B collaborative skill pre-test and post-test with an improvement in the mean value of 19.583 from 70.28 to 89.86, with r= 0.942 between collaborative skill

pre-test and post-test Sig. 0.000 less than 0.05 probability. The $r = 0.942$ more than 0.80 means a high correlation mean score between the collaborative skill pre-test and post-test [175]. Hence, the students' collaborative skill in the experimental class has increased significantly, and the correlation is high after implementing the ECD learning model. A summary of the Paired Sample t-test analysis is presented in Table 8.18.

Table 8. 18 The Summary of Paired Samples T-Test Result (Pre-Test and Post-Test)

Students' Skill	**Group**	**Pair**	**Paired Samples Correlations**		**Paired Differences**	**Paired Samples Test**			**Conclusion**
			Correlation	Sig.	Mean	t	df	Sig. (2-tailed)	
Construction drawing skill	Class A	Pre-test - Post-test	0.745	0.000	-33.058	-22.053	38	0.000	H_0 rejected, and H_a accepted
	Class B	Pre-test - Post-test	0.927	0.000	-41.513	-35.072	35	0.000	H_0 rejected, and H_a accepted
Collaborative skill	Class A	Pre-test - Post-test	0.848	0.000	-6.090	-6.084	38	0.000	H_0 rejected, and H_a accepted
	Class B	Pre-test - Post-test	0.942	0.000	-19.583	-25.489	35	0.000	H_0 rejected, and H_a accepted

2) Independent Sample t-test and N-Gain Score

To uncover a significant variance of the students' skill between the experimental class (class B) and the control class (class A) utilizing the independent samples t-test, the normality and variance homogeneity of data should be primarily tested as analysis requirements before analyzing the data by the independent samples t-test. It is obliged to verify that the data has a normal distribution employing the Shapiro Wilk test. The premise of a normal distribution is when the Sig. value more than the designated alpha level of 5%. According to the Shapiro Wilk test, construction drawing skill post-test Sig. value for class A is 0.259, and construction drawing skill post-test Sig. value for class B is 0.161. As these two Sig. values> 0.05, so it can be assumed that the collaborative skill post-test in both classes A and B have a normal distribution. Moreover, collaborative skill post-test Sig. value for class A is 0.136, and collaborative skill post-test Sig. value for class B is 0.133. As these two Sig. values> 0.05, so it can be inferred that the collaborative skill post-test in both classes A and B have a normal distribution. Consequently, the requirements and

assumptions for normality in using the Independent Sample t-test have been fulfilled. Table 8.19 shows the summary of normality test on experiment and control classes.

Table 8. 19 The Normality Test Summary of Experiment and Control Classes (Post-test)

Students' Skill	Group	Shapiro-Wilk	Conclusion
		Sig.	
Construction drawing skill	Class A Post-test	0.259	Normal
	Class B Post-test	0.161	Normal
Collaborative skill	Class A Post-test	0.136	Normal
	Class B Post-test	0.133	Normal

The homogeneity test aims to determine whether a variant (diversity) of data from two or more groups is homogeneous (same). If the data variance between groups is homogeneous, it will produce an accurate data of independent sample t-test. The homogeneity of variance test applying Levene's test provided that the Sig. > 0.05, then the homogeneity of variance of the two groups is the same or homogeneous. From the results of Levene's test, the Sig. value was reached to 0.629> 0.05, the construction drawing skill data variant for the class A post-test and class B post-test are homogeneous. The Sig. value was reached to 0.058 > 0.05, the collaborative skill data variant for the class A post-test and class B post-test are the same or homogeneous. So, it can be concluded that the assumption of homogeneity of variance is fulfilled. Table 8.20 shows the homogeneity of variance test summary (post-test).

Table 8. 20 Homogeneity of Variance Test of Experiment and Control Classes (Post-Test)

Students' Skill	Levene's Test for Equality of Variances	Conclusion
	Sig.	
Construction drawing skill	0.629	Homogeneous
Collaborative skill	0.058	Homogeneous

Before applying the independent sample t-test analysis, the prerequisite tests of analysis must be passed. Normality and homogeneity of variance should be conducted first. After the prerequisite test of the independent sample t-test analysis had been fulfilled, an independent sample t-test then can be employed to analyze the differences between the experimental group and the control group.

This analysis also applies to the students' skill post-test between the experimental class (class B) and the control class (class A). The analysis result confirms that the value of Sig. (2-tailed) 0.000 less than 0.05 probability means the H_0 is rejected, and the H_a is accepted. With an interpretation, there is a significant difference in construction drawing skills between experiment and control classes. It is strengthened by the t-count value greater

than the t_{table} as follows, $t_{count} = 8.69 > t_{table} = 1.996$, which implies the H_0 is rejected, and the H_a is accepted. The interpretation, there is a significant difference in student construction drawing skills between experiment and control classes. Thus, it can be presumed that students' construction drawing skill between experiment and control classes is significantly different. Furthermore, the analysis result shows that the value of Sig. (2-tailed) 0.000 less than 0.05 probability means the H_0 is rejected, and the H_a is accepted. With an interpretation, there is a significant difference in collaborative skill between experiment and control classes. It is strengthened by the t-count value greater than the t-table as follows, $t_{count} = 10.351 > t_{table} = 1.996$, which means the H_0 is rejected, and the H_a is accepted. The interpretation, there is a significant difference in the collaborative skills between experiment and control classes. Thus, it can be concluded that the collaborative skills between experiment and control classes are significantly different. Table 8.21 speaks about the independent samples t-test of experiment and control classes (post-test).

Table 8. 21 The Independent Samples t-test of Experiment and Control Classes (Post-Test)

Students' Skill	**t-test for Equality of Means**			**Conclusion**
	t	df	Sig. (2-tailed)	
Construction drawing skill (Post-test)	-8.690	73	0.000	H_0 is rejected, and H_a is accepted
Collaborative skill (Post-test)	-10.351	73	0.000	H_0 is rejected, and H_a is accepted

Moreover, a normalized gain analysis was conducted to define the improvement in collaborative skill pre-test and post-test for experiment and control classes. The premise = $g < 0.3$ low, $0.3 \leq g < 0.7$ medium, and $g \geq 0.7$ high [219]. A summary of the normalized-gain analysis is presented in Table 8.22.

Table 8. 22 The Normalized Gain Collaborative Skill Analysis (Pre-test and Post-test)

Students' Skill		**N-Gain Score (g)**			**Conclusion**
		Mean	Minimum	Maximum	
Construction drawing skill	Class A	0.595	0.26	0.71	Medium
	Class B	0.742	0.68	0.79	High
Collaborative skill	Class A	0.176	0.00	0.45	Low
	Class B	0.673	0.44	0.86	Medium

According to Table 8.22, the average value of the g score for construction drawing skill class A is $0.3 \leq 0.595 \leq 0.7$ Medium category, which means that the class A construction drawing skill has increased by 59.5%. The g Score of Class B construction drawing skill is $0.742 \geq 0.7$ High category, which means that class B construction drawing skill increased by 74.2% after being treated by applying the ECD learning model. Therefore,

the ECD learning model effectively increases students' construction drawing skills. Furthermore, the average value of the g score for collaborative skill class A is 0.176<0.3, low category, which means that the Collaborative skill in class A has increased by 17.6%. The g Score of collaborative skill Class B is 0.3≤0.673≤ 0.7 Medium category, which means that collaborative skill in class B increased by 67.3% after being treated by applying the ECD learning model. Consequently, the ECD learning model effectively increases students' collaborative skills.

8.5. Discussion

8.5.1. Initial Findings of the Student Skills and Final Result

In this chapter, the study of designing an ECD learning model has implemented a series of analyses, including descriptive statistics analyses and inferential statistics analyses such as paired sample t-test and independent sample t-test. Moreover, the construction drawing, and collaborative skills' enhancement level is also achieved by a normalized Gain Analysis. The validity and reliability test using Aiken *V* and Interclass Correlation Coefficient (ICC) assures the assessment instrument's feasibility. The study verifies the analysis requirements for paired sample t-test and independent sample t-test by conducting several analysis requirements tests. At the same time, the descriptive statistics analysis results show the initial finding as valuable information needed to enhance the student skills, including construction drawing and collaborative skills.

Table 8. 23 The Five Lowest Student Skills in Construction Drawing with Proposing Solutions, Before and After the Implementation of the ECD Learning Model

Num.	Construction Drawing Skill Indicators	Pre-test Mean Score	Proposing Solutions (implemented)	Post-test Mean Score
28	Section drawing A-A, B-B, C-C, D-D	30.56	1. Give more demonstration video in section drawing 2. Enhance team responsibility spirit and learning interdependence by giving motivation via WhatsApp	84.03
30	Drawing the detailed roof plan	33.33	1. Give more demonstration video in drawing the detailed roof plan lesson material 2. Enhance collaboration by motivating via WhatsApp	89.58
34	Drawing the plumbing and ME plan	34.72	1. Give more demonstration video in drawing the plumbing and ME plan lesson material 2. Enhance working in a team with risks and problems via WhatsApp	83.33
40	Explaining the arguments of the drawing concept	37.50	1. Everyone should explain argument in each discussion 2. Enhance solving problem actively, giving ideas, and likes discussion by give a drawing problem, and everyone must give idea in the discussion	81.25
26	Drawing floor plans accurately, detailed and informative	40.28	1. Give more demonstration video in Drawing floor plans accurately, detailed and informative lesson material 2. Enhance prioritizing the team choices and expectations via WhatsApp	89.58

The statistical analyses show that the primary initial findings of the descriptive statistics study are presented in Table 8.6 and Table 8.7 about the five lowest indicators of the construction drawing skills and collaborative skills. These ten indicators (five construction drawing and five collaborative skills) were the lowest among all the achieved indicators scores from all the students' skills indicators.

Table 8. 24 The Five Lowest Collaborative Skills with Proposing Solutions, Before and After the Implementation of the ECD

Num	**Collaborative Skill Indicators**	**Pre-test Mean Score**	**Proposing Solutions** (implemented)	**Post-test Mean Score**
1	Solving problems actively, giving ideas, and likes discussion	62.50	1. Enhance solving problem actively, giving ideas, and likes discussion by give a drawing problem, and everyone must give idea in the discussions 2. Motivate to be an active problem solver, giving ideas, and likes discussion via WhatsApp	89.58
4	Prioritizing the team choices and expectations	63.19	1. Giving real success stories of prioritizing the team choices and expectations in meetings 2. Enhance prioritizing the team choices and expectations via WhatsApp	88.19
6	Prioritizing team responsibilities and learning interdependence	64.58	1. Giving real success stories of team responsibility spirit and learning interdependence in meetings 2. Enhance team responsibility spirit and learning interdependence by giving motivation via WhatsApp	88.19
5	Prioritizing collaboration over individual competition	66.67	1. Giving real success stories of prioritizing collaboration in meetings 2. Enhance prioritizing collaboration by giving motivation via WhatsApp	89.58
3	Working in a team with risks and problems	68.06	1. Giving real success stories of working in a team with risks and problems in meetings 2. Enhance working in a team with risks and problems via WhatsApp	88.89

The lowest construction drawing skills that need to be concerned and enhanced are: (1) section drawing, (2) drawing the detailed roof plan, (3) drawing the plumbing and ME plan, (4) explaining the arguments of the drawing concept, and (5) drawing floor plans accurately. While the collaborative skills are: (1) solving problems actively, giving ideas, and likes discussion, (2) prioritizing the team choices and expectations, (3) prioritizing team responsibilities and learning interdependence, (4) prioritizing collaboration over individual competition, and (5) working in a team with risks and problems. This finding is typically the same as the previous study in Chapters 4 and 5 about investigating vocational students' skills and contribution of collaborative skill toward construction drawing skill for developing the ECD learning model [22][225].

The ECD as a collaborative learning model designed to improve students' skills must significantly solve learning problems. For increasing the score of the lowest student skills, several efforts are made to overcome problems that arise in the learning process and learning outcomes. The ECD learning model as a collaborative learning model designed to improve students' skills must significantly solve learning problems. For increasing the score of the lowest student skills, several efforts are made to overcome problems that arise in the learning process and learning outcomes. The proposing solutions, pre-test, and post-test of the five lowest student skills is presented in Tables 8.23 dan 8.24.

8.5.2. Learning Process

The ECD learning model's implementation for one semester has been carried out well, and the students' lesson objectives achievements are obtained successfully. The learning model implements 16 lessons divided into three learning activities for each lesson, including pre-class, regular-class, and after-class (16x3). As a result, there are 48 classes implementations held from February 15 to June 7, 2021. From the student achievement on the lesson objective, the implementation of the ECD in the CAD construction drawing course learning process for one semester has given the result that six of 16 lessons performed well in all indicators of learning objectives in 6 lessons. The six lessons include lesson 2, arrange the building space utilization intensity with four learning objectives. Lesson 5-6 drawing the door, window, and foundation plan with three learning objectives, lesson 7-8 drawing foundation details and the roof construction plan with six learning objectives, and lesson 16 propose the building shop drawing project result in a presentation with five learning objectives. Thus, there are a total of 18 indicators in 6 lessons. Besides the six lessons above, the remaining 10 of the 16 lessons also managed well, and all the lesson objectives are achieved. However, some learning difficulties happened in the learning process, but they could be solved at the time of learning. Table 8. 25 speaks about the summary of evaluation result.

Furthermore, the ten lessons have a total of 31 lesson objectives indicators. The 31 lesson objective indicators found that 7 lesson objective indicators were difficult for students. Seven lesson objectives indicators, one of which is found in lesson 1 building regulation with 2 lesson objective indicators that are difficult for students, the first number 3 is proposing work time schedule. Some students had difficulty identifying drawing work regarding the building function and the number of the floors and cannot identify the

drawing to make a work schedule. However, finally, all students passed the lesson objectives test. The teacher adding more information about the list of types of drawings according to the function of the building and the number of floors of the building in the lesson material, so that students can access and learn independently during pre-class.

Table 8. 25 Summary of Evaluation Result

Num	Lesson 1 Objectives	Teacher's Evaluation	Mean score	Result
3	Propose work time schedule	Some students had difficulty in identifying drawing work regarding the building function and the floors number	85.11	Passed
4	Identify the collaborative mindset to socialize with the team	A student had a difficulty in socialize with the team	92.36	Passed
Num	Objectives Indicator of Lesson 3-4	Teacher's Evaluation	Mean score	Result
2	Practice the concept of building shop drawing to design the floor plan (including doors and windows)	Several students had difficulty in designing floor plan	86.06	Passed
Num	Objectives Indicator of Lesson 9-10	Teacher's Evaluation	Mean score	Result
4	Drawing the building sections	Several students had difficulty to draw building sections according to the cutting lines in the floor plan.	84.58	Passed
Num	Objectives Indicator of Lesson 11-13	Teacher's Evaluation	Mean score	Result
3	Drawing building roof construction details drawing	Several students had difficulty in drawing the truss details	84.86	Passed
Num	Objectives Indicator of Lesson 14-15	Teacher's Evaluation	Mean score	Result
3	Drawing the plumbing system	Several students had trouble in drawing the plumbing installation plan	84.94	Passed
6	Drawing the Mechanical and Electrical Drawing	Some students had difficulties in drawing mechanical and electrical installations.	84.89	Passed

Then guide students to identify, select and apply information appropriate to the type of project for each team to create and finalize a work schedule. Furthermore, enhance team responsibility spirit and learning interdependence by giving motivation. The second lesson objective indicator in lesson 1 is at number 4, namely, identify the collaborative mindset to socialize with the team. A student had difficulty socializing with the team. Some students did not participate in the socialization and were late in registering their cell phone numbers, so they were too late to join the WhatApps Group. As a result, they did not receive some of the information shared in the WhatsApps Group. Besides, it causes the students concerned about having difficulty interacting and socializing with team members. As a result, the student feels inadequate to be part of a team.

Furthermore, 5 of the 7 learning objective indicators that are difficult for students are found in lessons 3-4, lessons 9-10, lessons 11-13, and lessons 14-15. In lessons 3-4, there are number 2 lesson objective indicators, namely, identify and practice the concept of building shop drawing and CAD drawing command. Several students had difficulty designing floor plans, identifying space requirements, and arranging space organization according to building requirements. 3 groups are redesigning the layout of the bathroom facilities that are not yet symmetrical between the lower floor and the floor above it, complicating the planning of the plumbing system and user comfort. Besides that, it is related to planning natural lighting and ventilation, namely planning the design of openings in the floor plan.

From the 16 Lessons, there are 49 lesson objectives indicators. Where seven of them, or 14.29%, several students face difficulty. The seven learning objectives are spread over several lessons contained in the summary table of evaluation results. However, difficulties during the learning process can be overcome by adding lesson material to the e-vocational platform module, increasing motivation via e-learning and WhatsApp, and supervising teachers.

8.5.3. Hypothesis Testing of the Main Research Objective, Enhancing Student Skills by Implementing the ECD

It has been almost one and a half years since the COVID 19 pandemic influence globally to higher than 90 percent of students worldwide, uniquely vocational education meet a problematical condition in education, while it is essential to decrease barriers for technological and vocational education and training (TVET) in promoting talents, starting from the secondary education level and university, also providing lifelong learning opportunities for all as mandated by the UN SDG4.3 [220]. In completing the study intentions to resolve the dilemmas confronted by vocational training by raising learners' ability utilizing the ECD training model in CAD construction drawing course, each stage of development research is directed to encourage one another. Being a portion of developing research in forming e-vocational construction drawing (ECD) learning model to increase student skills for coinciding the enterprise demand, this research intends to explore the students' skill development by analyzing the student construction drawing skill indicator score by primary evaluation in a pre-test and a post-test later a one-semester continuous education process. The investigation outcome of descriptive statistics revealed

the plan moving skill pre-test mean score is 45.40 on a scale of 100 for class A as the control class. Concurrently, class B, as the experiment class, got 43.96 on a scale of 100. Applying to Azwar's evaluation criteria [217], it is incorporated in the Low category with a mean score in the area of 43.76-56-25. By comprehending the area, it is clear that the students' construction drawing skill is Low. Additionally, the analysis result of descriptive statistics explicated the construction drawing skill pre-test mean score of 70.90 on a scale of 100 for class A as the control class. Concurrently, class B, as the experimental class, gets 70.28 on a scale of 100. Referring to Azwar's evaluation rules [217], it is incorporated in the Good category with a mean score in the area of 68.76-81.25. By recognizing the area, it is explicit that the students' collaborative skill is Good. Moreover, the analysis needs to be studied more detailedly to significantly and efficiently boost student performance and solve the vocational education obstacle. Correspondence between the first behavior and after practice behavior with statistical analysis is necessitated to judge the exact contribution of the improved ECD learning model. Additionally, concerning the student's detailed shortcomings will assist the researcher in creating a more beneficial tactic in resolving the obstacle.

As an experiment for determining the advanced learning model contributes significantly, this study assures equality between the experiment and control classes before managing the actual class learning experiment. Furthermore, the normality and variance homogeneity of data was investigated using the Shapiro Wilk analysis. The assumption of a normal distribution is through the Sig. more than the specified alpha level of 5%. Refer to the Shapiro Wilk analysis, the class A pre-test Sig. value construction drawing skill is 0.579 and class B pre-test Sig. value construction drawing skill is 0.126. As these two Sig. values > 0.05, so it indicates that the pre-test in both classes are normal. Then collaborative skill Sig. value for class A pre-test is 0.259 and the collaborative skill Sig. value for class B pre-test is 0.161. As these two Sig. values > 0.05, so it implies that the pre-test in both classes are normal. Consequently, the terms and assumptions for normality in implementing the Independent Sample t-test are accomplished. While the homogeneity of variance test using Levene's test also has been achieved by receiving the Sig. of 0.437> 0.05, the construction drawing skill data variant for the class A and class B pre-test are homogeneous. Moreover, the Sig. value was given to 0.238> 0.05. Besides, the collaborative skill data variants for the class A and class B pre-test are homogeneous or equal.

The independent sample t-test examines the differentiation between students' skill pre-test of the experiment and control classes. The result emphasizes that the Sig. (2-tailed) is 0.571>0.05 probability, it shows the Null Hypothesis (H_0) is accepted, and the Alternative Hypothesis (H_a) is rejected, with a premise there is no significant difference of construction drawing skill between experiment and control classes. Moreover, $t_{count} = 0.569 < t_{table} = 1.996$, which indicates the H_0 is accepted, and the H_a is rejected. The premise, there is no significant heterogeneity in construction drawing skills between experiment and control classes. Next, the analysis result explains that the Sig. (2-tailed) is 0.782>0.05 probability, it indicates the Null Hypothesis is accepted, and the Alternative Hypothesis is rejected, with a proposition that there is no significant differentiation of collaborative skill between control and experiment classes. Furthermore, $t_{count} = 0.278 < t_{table} = 1.996$, which implies the Null Hypothesis is accepted, and the Alternative Hypothesis is rejected. The proposition, there is no significant difference in collaborative skill between experiment and control classes. Consequently, it can be inferred that students' initial behavior of the control and experiment class are equal. After all classes' initial behavior was maintained equal, the ECD learning model can be implemented. Reviewing the student's deficiencies is needed to start the learning process by seeing the descriptive analysis result, especially at the test's lowest score. The test's low scores will give the teacher a recommendation to treat the students efficiently.

The research uncovered the lowest mean score of the construction drawing skill in some sub-indicators, as seen in Table 8.6. Sub-indicator number 28, "section drawing A-A, B-B, C-C, D-D" with a mean score of 30.56, followed by number 30, "drawing the detailed roof plan," with 33.33 mean score, while number 34 drawing the plumbing and ME plan with a mean score of 34.72. In contrast, number 40 explaining the arguments of the drawing concept with a 37.50 mean score. The last is the number 26 with "drawing floor plans accurately, detailed and informative," the mean score is 40.28. The five lowest construction drawing skill indicators mean score is attention for improvement throughout the research. It is necessary to maintain a good teamwork member spread. Therefore, it is concerned to analyze the frequency distribution manifested in Figure. 8.5 to map the teamwork member's balance. The highest frequency was found in the value interval ≤43.75, including 17 students in class A and 15 students in class B. Additionally, the lowest frequency is in the interval of 68.76-81.25, consisting of one student in class A and no one in class B.

Nevertheless, the most frequent distribution of the pre-tests' scores of the construction drawing skill is ≤43.75 for class B and class A. However, the mean score of pre-test construction drawing skill of class A is 45.40, and class B is 43.96 in the range of 43.76-56.25, so it can be assumed that the pre-test construction drawing skill score is in a Low category. The frequency distribution pre-test and other descriptive analyses of the construction drawing skill are necessary to define the teamwork arrangement and synchronize the ECD learning model with student characteristics. The 36 students of experimental class B consisted of seven teams, the orange team, the blue team, the pink team, the green team, the yellow team, the purple team, and the red team. Each teamwork consists of 5-6 students with a balanced combination based on the frequency distribution of the initial behavior skills collected from the pre-test result data. Each teamwork consists of one student who has a Fair category of construction drawing skills. The rest are students with Low and Very Low categories in construction drawing skills. Besides determining the teamwork member distribution, the descriptive statistics data is utilized to synchronize the student characteristics, the ECD learning model, project-based flipped classroom and e-vocational blended online learning platform.

Furthermore, the study identified the lowest mean score of the collaborative skill in numerous indicators, as seen in Table 8.7. For example, indicator number 1, "solving problem actively, giving ideas, and likes discussion," with a mean score of 62.50, accompanied by number 4, "prioritizing the team choices and expectations," with 63.19 mean score, while number 6 prioritizing team responsibilities and learning interdependence with a mean score of 64.58. In contrast, number 5 prioritizing collaboration over the individual competition with a 66.67 mean score. The last is number 3, "working in a team with risks and problems," with a mean score of 68.06. Thus, those five lowest collaborative skill indicators are attention for development during the research. It is important to maintain a good teamwork members distribution. Consequently, it is required to analyze the frequency distribution displayed in Figure. 8.6 to map the teamwork member's balance. The highest frequency was a Good category, with 18 students in class A and 21 students in class B. Concurrently, the lowest frequency is in a Low category, with four students in class A and three in class B. Thus, the most frequent distribution of collaborative skills for class A and class B are in a Good category. This result was then used to define the teamwork member configuration. The experiment class consisted of 36 students divided into seven

groups, with 5-6 students for each teamwork. Each group consists of three students in the Good category score, and the rest member is a composite of Very Good, Fair, and Low categories. Besides determining the teamwork member configuration, the descriptive statistics data is utilized to synchronize the ECD learning model with student characteristics.

The construction drawing skill post-test evaluation determined the mean score of the experimental class of 85.47 (class B) and the control class of 78.46 (class A) on a 100 scale. According to the evaluation criteria, it is included in the Very Good category with a range of more than 81.25 (Class B) and Good category with 68.76-81.25 (Class A). Therefore, the post-test score of construction drawing skills for class B as the experiment class is 85.47, and class A as the control class is 78.46 on a scale of 100. It indicates that the scores are increasing. It rose 33.06 points from the mean value of pre-test 45.40 and post-test of 78.46 on a 100 scale for class A as a control class. Furthermore, as the experiment class, class B presented a more substantial growth in the mean score of construction drawing skill with 41.51 from a pre-test score of 43.96 and 85.47 in post-test on a scale of 100. Thus, class B's experiment class exposes a much better improvement than class A as the control class. The post-test scores frequency distribution of construction drawing skills for classes A and B after the experiment for one semester presents changes that generally climb. In the control class (class A), the highest frequency is in the Good category (68.76-81.25), increasing from 1 student to 33 students. Whereas in the Very Good category (above 81.25), growing from 0 to 6 students. In a different situation, as the experimental class, class B exhibits an immense increase in reducing students who previously get Very Low 15 students, Low 15 students, and Fair 6 students, in the post-test becomes no one. The highest frequency is above 81.25, it is including the Very Good category, rising from 0 to 30 students. Moreover, the Good category (68.76-81.25) is increasing from 0 to 6 students.

The collaborative skill post-test assessment identified the mean score of the experimental class as 89.86 (class B) and the control class of 76.99 (class A) on a 100 scale. It is incorporated in the Very Good category with a grade range of more than 81.25 (Class B) and Good category with a grade range of 68.76-81.25 (Class A). Class B's post-test collaborative skill score as the experiment class is 89.86, and class A as the control class is 76.99 on a 100 scale. It intimates that the scores are increasing. It progressed 6.09 points from the mean score of pre-tests 70.90 and post-test 76.99 on a 100 scale for class A as a

control class. Furthermore, class B's experiment class exhibits a more valuable improvement in the mean score of collaborative skill with a score of 19.58 from a pre-test score of 70.28 and 89.86 in post-test on a 100 scale. The frequency distribution of collaborative skill post-test scores for classes A and B after being taken out by the experiment for one semester presents variations that commonly improve. In class A as the control class, declining students get Low scores from 10 to 3, and no more students get Low scores. Furthermore, the highest frequency is in the Good category of 68.76-81.25, increasing from 18 to 27 students. Whereas in the Very Good category, above 81.25, improving from 7 to 9 students. On the other hand, as in the experimental class, class B displays a much better improvement. No more students get Low and Fair scores from 3 and 10 to 0 student, the highest frequency is in the Very Good category (above 81.25), arising from 2 to 34. Thus, the Good category (68.76-81.25), which previously counted 21, became only two students.

Regarding the Shapiro Wilk test result for class A pre-test and post-test, it can be inferred that construction drawing skill pre-test and post-test have a normal distribution. Furthermore, Sig. value for the class B pre-test and post-test, Sig. values > 0.05, indicates that the pre-test and post-test class B of construction drawing skill have a normal distribution. Consequently, the requirements for normality in using the statistical methods of paired sample *t*-test are accomplished. Following, analyzing the results to examine the student construction drawing skill improvement for both classes. The result approves that the class A's Sig. (2-tailed) pre-test and post-test is less than 0.05 probability. It intimates the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. It presents a significant improvement of class A's student construction drawing skills. Which the H_0 is rejected, and the H_a is accepted. It indicates there is a significant enhancement in students' construction drawing skills. Furthermore, $t_{count} = 22.053 > t_{table} = 1.687$, which implies the H_0 is rejected, and the H_a is accepted. The premise, there is a significant growth in the pre-test and post-test student construction drawing skill class A. Consequently, there is an enhancement in the mean score of class A pre-test and post-test of construction drawing skill with an average value of 33.06, improving from 45.40 to 78.46, with a correlation value (r) of 0.745 between pre-test and post-test of the construction drawing skill with Sig. 0.000 less than 0.05. Furthermore, class B's analysis results showed that the H_0 is rejected. However, the H_a is accepted, assuming that students' construction drawing skills

significantly increase between the pre-test and post-test of class B. Following, t_{count} = 35.072>t_{table} = 1.691, which intimates the H_0 is rejected, and the H_a is accepted. With the assumption, there is a significant increase between the pre-test and post-test of students' construction drawing skills class B. Hence, there is an improvement in the mean score of class B construction drawing skill between pre-test and post-test, the mean value raising of 41.51 from 43.96 to 85.47, with a high correlation (r) of 0.927 (more than 0.80) between construction drawing skill pre-test and post-test with Sig. 0.000, less than 0.05 probability. The correlation (r) = 0.927, more than 0.80, shows a high correlation mean score between the construction drawing skill pre-test and post-test [175]. Consequently, the students' construction drawing skills in the experimental class have increased significantly. Furthermore, the correlation is high after the experiment was carried out by implementing the ECD learning model.

From the Shapiro Wilk test result for class A pre-test and post-test, it can be assumed that collaborative skill pre-test and post-test have a normal distribution. Moreover, Sig. value for the class B pre-test and post-test, Sig. values > 0.05, means that the pre-test and post-test class B of collaborative skill have a normal distribution. Consequently, the requirements for normality in using the statistical methods of paired sample *t*-test are fulfilled. Next, analyzing the results to examine the student collaborative skill improvement for both classes. The result confirms that the class A's Sig. (2-tailed) pre-test and post-test is less than 0.05 probability. It indicates the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. It exposes a significant improvement of class A's student collaborative skills. Which the H_0 is rejected, and the H_a is accepted. It indicates there is a significant enhancement in students' collaborative skill. Furthermore, t_{count} = 6.084>t_{table} = 1.687, which implies the H_0 is rejected, and the H_a is accepted. Thus, there is a significant growth of student collaborative skill class A between the pre-test and post-test. Therefore, there is an increase in class A's collaborative skill pre-test and post-test, with a mean score of 6.09 improving from 70.90 to 76.99, with r = 0.745 between pre-test and post-test collaborative skill, with Sig. 0.000 less than 0.05. Furthermore, class B's analysis results revealed that the H_0 is rejected, and the H_a is accepted, indicating a significant enhancement of student collaborative skill class B. From the t_{count} of 25.489>t_{table} = 1.691, which means the H_0 is rejected, and the H_a is accepted. The interpretation, there is a significant development of student collaborative skill class B between the pre-test and post-test.

Consequently, there is an improvement in the mean score of class B collaborative skill pre-test and post-test, increasing the mean value of 19.583 from 70.28 to 89.86, with r= 0.942 between collaborative skill pre-test and post-test Sig. 0.000 less than 0.05 probability. The r = 0.942 more than 0.80 means a high correlation mean score between the collaborative skill pre-test and post-test [175]. Therefore, the students' collaborative skill in the experimental class has progressed significantly, and the correlation is high after implementing the ECD learning model.

For uncovering a significant variance of the students' skill between the experimental class (class B) and the control class (class A) utilizing the independent samples t-test, the normality and variance homogeneity of data should be first examined. Referring to the Shapiro Wilk test, post-test Sig. value for class A is 0.259, and post-test Sig. value for class B is 0.161. As these two Sig. values> 0.05, so it can be concluded that the post-test in both classes A and B have a normal distribution. Furthermore, collaborative skill post-test Sig. value for class A is 0.136, and collaborative skill post-test Sig. value for class B is 0.133. As these two Sig. values> 0.05, so it can be concluded that the collaborative skill post-test in both classes A and B have a normal distribution. Thus, the requirements and assumptions for normality in using the Independent Sample t-test have been fulfilled. The homogeneity of variance test using Levene's test provided the Sig. value was obtained to 0.629> 0.05, the construction drawing skill data variant for the class A post-test and class B post-test are homogeneous. The Sig. value was reached to 0.058 > 0.05, then the collaborative skill data variant for the class A post-test and class B post-test are the same or homogeneous So, it can be concluded that the assumption of homogeneity of variance is fulfilled. After the requirement test of the independent sample t-test analysis for normality and homogeneity had been accomplished, an independent sample t-test was then analyzed to test the differences of students' skill post-test between the experiment class (class B) and the control class (class A). The examination result shows that the value of Sig. (2-tailed) 0.000 less than 0.05 probability means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. With an interpretation, there is a significant difference in construction drawing skills between experiment and control classes. It is strengthened by the t_{count} value greater than the t_{table} as follows, t_{count} = 8.69> t_{table} = 1.996, which means the Null Hypothesis is rejected, and the Alternative Hypothesis is accepted. The interpretation, there is a significant difference in student construction drawing skills

between experiment and control classes. Hence, it can be assumed that students' construction drawing skill between experiment and control classes is significantly different. Furthermore, the analysis result shows that the value of Sig. (2-tailed) 0.000 less than 0.05 probability means the H_0 is rejected, and the H_a is accepted. With an interpretation, there is a significant difference in collaborative skill between experiment and control classes. It is strengthened by the t-count value greater than the t-table as follows, $t_{count} = 10.351 > t_{table} = 1.996$, which means the H_0 is rejected, and the H_a is accepted. Hence, the interpretation, there is a significant difference in student collaborative skills between experiment and control classes. Thus, it can be inferred that students' collaborative skill between experiment and control classes is significantly different.

Moreover, normalized gain analysis was conducted to define the advancement in students' skills pre-test and post-test for experiment and control classes. The average value of the g score for construction drawing skill class A is $0.3 \leq 0.595 \leq 0.7$ Medium category, which means that the class A construction drawing skill has progressed by 59.5%. The g Score of class B construction drawing skill is $0.742 \geq 0.7$ High category, which means that class B construction drawing skill enhanced by 74.2% after being treated by implementing the ECD learning model. Consequently, the ECD learning model effectively enhances students' construction drawing skills. Moreover, the average value of the g score for collaborative skill class A is $0.176 < 0.3$, Low category, which implies that the collaborative skill in class A has increased by 17.6%. The g Score of collaborative skill class B is $0.3 \leq 0.673 \leq 0.7$ Medium category, which means that collaborative skill in class B progressed by 67.3% after being treated by implementing the ECD learning model. Consequently, the ECD learning model effectively enhances students' collaborative skills.

8.6. Conclusion and Recommendations

8.6.1. Conclusion

From the results and discussion of the study in chapter 8, there are several findings, research objective achievements, and recommendations that can be concluded as follow:

1) The implementation of the ECD learning model for one semester is completed with the final average students' skill assessment of 87.67, on a 100 scale, including in a very good category. Separately the construction drawing skills average achievement is 85.47, on a scale of 100, it includes in a very good category. While the

collaborative skills' average achievement is 89.86, on a scale of 100, it includes a very good category.

2) The one-semester assessment of the implementation of the ECD learning model revealed that the learning process is running well, without any significant barriers.
3) According to the statistical hypothesis testing, it is concluded that after implementing the ECD learning model in the Civil Engineering Education Study Program, the result shows that there is a significant enhancement of construction drawing skill with a highly significant correlation of 0.927 and sig. 0.000 between the initial construction drawing skill (pre-test) and the construction drawing skill after learning with the ECD learning model for one semester (post-test). Besides, there is a significant enhancement of collaborative skill with a highly significant correlation of 0.942 and sig. 0.000 between the initial collaborative performance (pre-test) and the collaborative performance after learning with the ECD learning model for one semester (post-test). Moreover, the independent samples t-test exposed that both experimental and control classes' initial behaviors (pre-test) are equal. In contrast, the two classes' final performance assessment (post-test) result declares a significant difference of construction drawing skill between the experiment class (class B) and the control class (class A) with a t-count of 8.69 and the value of Sig. (2-tailed) 0.000. The post-test result asserts a significant difference of collaborative skill between the experiment class (class B) and the control class (class A) with a t-count of 10.351 and the value of Sig. (2-tailed) 0.000. According to the series of statistical hypothesis analysis tests, it can be concluded that the ECD learning model is significantly enhancing students' skills. Furthermore, a normalized gain analysis reveals the average g score of the construction drawing skills' experimental class is $0.742 \geq 0.7$, including in the High category, which means the construction drawing skill in the experiment class raised by 74.2% after implementing the ECD learning model. Moreover, the average g score of the collaborative skill is 0.673, including the Medium category ($0.3 \leq g \leq 0.7$), which means that collaborative skill in the experimental class progressed by 67.3% after implementing the ECD learning model for one semester. The conclusion is that the ECD learning model effectively enhances students' skills.

8.6.2. Recommendations

1) Review the research findings and the ECD learning model implementation results.
2) Follow up the review result to develop the ECD learning model.
3) Continue implementing the ECD learning model to other vocational education institutions to share the advantages of the collaborative project-based flipped classroom learning model with the E-vocational education blended learning platform.
4) Invite the vocational teachers and industries to review and develop the ECD learning model for Vocational High School.
5) Implement the ECD learning model in Vocational High School.

CHAPTER 9 FINAL CONCLUSIONS AND FUTURE DEVELOPMENT

9.1. Final Conclusions

Finally, this study has been conducted with a series of partial research presented several findings as follow:

The main objective is to enhance students' skills by promoting a collaborative mindset using a project-based approach and flipped classroom strategy supported by e-vocational blended online platform that assists the students in learning effectively inside and outside the class has achieved, presented in chapter 6. The development procedure adopts Borg and Gall begins from survey and identification, planning, designing, and developing phases was conducted and presented in chapter 2-6.

The surveys and identification were held and determine the CAD construction drawing course to be developed. Students are confirmed ready to use their personal computers in a minimum lab facility by a survey with descriptive statistics analysis. Investigations of student performance were conducted to evaluate students' initial skills for determining the correct method and learning strategy in enhancing the specific skills based on student performance evaluation. The recommendation of the survey and identification phase were used to develop the instructional model.

Several studies with other methods were employed, including surveys with simple descriptive statistics analysis, *ex-post-facto* with regression, experiment with t-test, evaluation using discrepancy evaluation and Kirkpatrick model. The investigation studies were conducted in Central Java and DIY explicated the construction drawing skills are in a Good category of 68.26 with a Low discrepancy of 31.74% and the collaborative skills are in a Fair category of 61.69 with a Low discrepancy of 38.31%. With a high collaborative skills gap, prioritizing collaboration between peers of 57.50 with 42.50% discrepancy.

Another study involving the vocational school in Papua, DIY, and Central java discovered a significant and positive influence of collaborative skill (X) toward construction drawing skill (Y). Besides, the analysis has presented a linear regression model $\hat{Y} = 31.443 + 1.952X$. It also exhibited a correlation coefficient of 0.644, a coefficient of determination (R-squared) of 0.415, and an Adjusted R-squared of 0.410, which means the collaborative skill (X) as a predictor in the regression model gives a 41% contribution to explain the variants of the construction drawing skill (Y) as the dependent variable in a moderate category. The research found two groups: (1) Linear score group (the

collaborative group) 25.38% and 36.92% = 62.31%; (1) non-linear score group (the non-collaborative group) 31.54% and 6.15% = 37.69%. It is indicated that most of the student accepts the collaborative approach. Furthermore, regarding the research finding of students' skill achievement characteristics, the designing lesson and learning model will consider observing the students' perception and satisfaction of the proposed collaborative lesson and learning model to accommodate the non-collaborative students and prioritizing collaboration between peers and learning interdependence.

While the developing phase involves raters, revising, examining the design by preliminary field testing, and second field testing. The evaluation uses the Kirkpatrick model's reaction stage during the learning, behavior, and result stage. The first is the alpha test to get expert's validation, and the second is the beta test by the individual, small group, and field testing. The e-vocational used blended online platforms including WordPress, SNS Whatsapp, the Efront LMS, YouTube, Zoom, Imgbb, and Google for Education integrated into a learning package for better advantages. The platform provides a project showroom with comment tools for discussion, collaborative learning material, and sustainably developed tutorial videos. Students appreciate the use of blended online platforms, which provide project showroom and collaborative learning material. They believe the showroom contributes to enhancing their motivation to do the best. They proud of their job exhibited on the website. Moreover, the collaborative learning material makes the student feel confident with the learning material, and group collaboration supports. The evaluation result by raters and field testings states the e-vocational online learning platform is feasible for use and can be continued for further development. An experiment study concluded that after implementing the blended online learning platform using project-based flipped classroom strategy in two classes of the Civil Engineering Education Study Program, there is a significant improvement of collaborative mindset with a highly significant correlation of 0.935 and sig. 0.000 between pre-test and post-test. It got a g-score of 0.3225, which means that the collaborative mindset in the experiment class increased by 32.25% after one month of being treated by implementing the blended online learning platform with a project-based flipped classroom strategy. The conclusion stated that the e-vocational online learning platform is declared feasible for use and recommended for further development.

The implementation of the ECD learning model for one semester is completed with the final average students' skill assessment of 87.67, on a 100 scale, including in a very good category. Separately the construction drawing skills average achievement is 85.47, on a scale of 100, it includes in a very good category. While the collaborative skills' average achievement is 89.86, on a scale of 100, it includes a very good category.

The one-semester assessment of the implementation of the ECD learning model revealed that the learning process is running well, without any significant barriers.

According to the statistical hypothesis testing, it is concluded that after implementing the ECD learning model in the Civil Engineering Education Study Program, the result shows that there is a significant enhancement of construction drawing skill with a highly significant correlation of 0.927 and sig. 0.000 between the initial construction drawing skill (pre-test) and the construction drawing skill after learning with the ECD learning model for one semester (post-test). Besides, there is a significant enhancement of collaborative skill with a highly significant correlation of 0.942 and sig. 0.000 between the initial collaborative performance (pre-test) and the collaborative performance after learning with the ECD learning model for one semester (post-test). Moreover, the independent samples t-test exposed that both experimental and control classes' initial behaviors (pre-test) are equal. In contrast, the two classes' final performance assessment (post-test) result declares a significant difference of construction drawing skill between the experiment class (class B) and the control class (class A) with a t-count of 8.69 and the value of Sig. (2-tailed) 0.000. The post-test result asserts a significant difference of collaborative skill between the experiment class (class B) and the control class (class A) with a t-count of 10.351 and the value of Sig. (2-tailed) 0.000. According to the series of statistical hypothesis analysis tests, it can be concluded that the ECD learning model is significantly enhancing students' skills. Furthermore, a normalized gain analysis reveals the average g score of the construction drawing skills' experimental class is $0.742 \geq 0.7$, including in the High category, which means the construction drawing skill in the experiment class raised by 74.2% after implementing the ECD learning model. Moreover, the average g score of the collaborative skill is 0.673, including the Medium category ($0.3 \leq g \leq 0.7$), which means that collaborative skill in the experimental class progressed by 67.3% after implementing the ECD learning model for one semester. The conclusion is that the ECD learning model effectively enhances students' skills.

9.2. Future Development

The future development will begin by:

1) Review the research findings and the ECD learning model implementation results.
2) Follow up the review result to develop the ECD learning model.
3) Continue to implement the ECD learning model to other vocational education institutions to share the advantages of the collaborative project-based flipped classroom learning model with the E-vocational education blended learning platform.
4) Developing the ECD learning model for Vocational High School.
5) Implementing the ECD learning model for Vocational High School.
6) Proposing mass implementation and experiments to many education institutions in many places of Indonesia.
7) Developing the learning model based on local culture in Indonesia.
8) Developing the learning model for other vocational courses, proposing collaboration research with other researchers in other major subjects.
9) Proposing a study to solve research problem number 3, the uneven balance between teachers with academic and practitioner background in TVET institutions. Developing the e-vocational learning platform to improve the teacher and lecturer skills.
10) Design a learning model for teacher and lecturer training
11) Designing online learning platform for teacher and lecturer training
12) Implementing the teacher and lecturer training model
13) Implementing the teacher training model to several city and provinces in Indonesia
14) Developing the e-vocational learning platform for more complete features.
15) Developing the e-vocational learning platform for massive users
16) Implementing the e-vocational learning platform for massive users
17) Planning to do investigation research on other relevant student skills that need to be enhanced
18) Resolving the problem as the result of the investigation of other relevant student skills.
19) Planning to do investigation research on other relevant student skills that need to be enhanced
20) Proposing patent for the research outcomes (learning models)
21) Developing the learning model and e-learning platform for sustainable development.

REFERENCE

[1] UN SDG-Education 2030 Steering Committee, "Sustainable Develpment Goals 4," *2020*, 2020. [Online]. Available: https://www.un.org/sustainabledevelopment/education/. [Accessed: 11-Mar-2021].

[2] M. Gigliotti, G. Schmidt-Traub, and S. Bastianoni, "The sustainable development goals," in *Encyclopedia of Ecology*, 2nd ed., Amsterdam, The Netherlands: Elsevier Inc, 2018, pp. 426–431.

[3] United Nation, "Transforming our world: The 2030 agenda for sustainable development," in *A New Era in Global Health*, 1st ed., W. Rosa, Ed. New York: Springer Publishing Company, 2018, pp. 529–567.

[4] United Nation, "Staying on-track to realize the Sustainable Development Goals," *News*, 2019. [Online]. Available: https://www.un.org/development/desa/en/news/sustainable/sustainable-development-goals.html. [Accessed: 01-Jan-2021].

[5] Government of the Republic of Indonesia, *Presidential Regulation Number 18 of 2020 concerning the 2020-2024 National Medium-Term Development Plan of Indonesia*. Indonesia, 2020, pp. 1–7.

[6] Ministry of National Development Planning, "Medium-Term National Development Plan 2020-2024," *Minist. Natl. Dev. Plan. Repub. Indones.*, vol. 1, no. 1, pp. 1–313, 2019.

[7] UNESCO-UNEVOC, "World TVET database Indonesia," Bonn Germany, 2013.

[8] S. Zahro, "Applying entrepreneurship as a learning design for engineering education," *World Trans. Eng. Technol. Educ.*, vol. 14, no. 3, pp. 410–415, 2016.

[9] D. Nurhadi and S. Zahro, "Becoming Vocational Teachers for 21st Century in Indonesia," in *2nd International Conference on Vocational Education and Training (ICOVET 2018). Advances in Social Science, Education and Humanities Research*, 2019.

[10] M. Pavlova, "TVET as an important factor in country's economic development," *Springerplus*, vol. 3, no. Supplement 1, pp. 1–2, 2014.

[11] R. Bates, "Improving human resources for health planning in developing economies," *Hum. Resour. Dev. Int.*, vol. 17, no. 1, pp. 88–97, 2014.

[12] A. H. Setiawan and R. Takaoka, "Designing PBL steps in vocational course based on students' readiness and teachers' discussion," in *Journal of Physics: Conference Series*, 2020, pp. 1–9.

[13] A. H. Setiawan, "The contribution of the vocational teachers professional competence toward vocational high schools performance," in *The 3rd UPI International Conference on TVET*, 2015, pp. 1–6.

[14] E. Unterhalter, "The Many Meanings of Quality Education: Politics of Targets and Indicators in SDG4," *Glob. Policy*, vol. 10, no. 1, pp. 39–51, 2019.

[15] UNESCO (GC), "Recommendation Concerning Technical and Vocational Education and Training (TVET)," *General Conference 2015*, no. November. pp. 1–9, 2015.

[16] M. Preckler Galguera, "TVET at UNESCO," in *Technical and Vocational Education and Training*, vol. 31, 2018.

[17] C. W. Sandroto, B. P. D. Riyanti, and M. Tri Warmiyati, "Entrepreneurial intention and competencies of vocational and high school graduates in Indonesia," *Pertanika J. Soc. Sci. Humanit.*, vol. 26, no. T, 2018.

[18] M. B. Triyono, L. Trianingsih, and D. Nurhadi, "Students' employability skills for construction drawing engineering in Indonesia," *World Trans. Eng. Technol. Educ.*, vol. 16, no. 1, pp. 29–35, 2018.

[19] BPS, "February 2020: The Open Unemployment Rate (TPT) is 4.99 percent, Februari 2020: Tingkat Pengangguran Terbuka (TPT) sebesar 4,99 persen," Jakarta, Indonesia, 2020.

[20] B. P. Statistik, "Tingkat Pengangguran Terbuka," *badan Pus. Stat. Indones.*, 2019.

[21] A. G. Watts, "Strategic directions for careers services in higher education," Cambridge, 1998.

[22] A. H. Setiawan, R. Takaoka, and L. Trianingsih, "Investigation of vocational students' skills for determining learning experiences on CAD construction drawing course," in *IEEE International Conference on Engineering, Technology and Education, TALE*, 2020, pp. 637–642.

[23] N. Gu and K. London, "Understanding and facilitating BIM adoption in the AEC industry," *Autom. Constr.*, vol. 19, no. 8, 2010.

[24] M. Syaifullah, "The government closes 2,000 vocational schools," *Tempo*, Jakarta, Indonesia, pp. 1–2, 10-Jul-2019.

[25] T. Munte and R. Ansori, "Get ready, 2,000 vocational schools in Indonesia will be closed," *Tagar.id*, Yogyakarta Indonesia, pp. 1–2, 10-Jul-2019.

[26] Y. Miarso, *Menyemai Benih Teknologi Pendidikan*. 2007.

[27] M. J. Koehler, P. Mishra, and W. Cain, "What is Technological Pedagogical Content Knowledge (TPACK)?," *J. Educ.*, vol. 193, no. 3, pp. 13–19, 2013.

[28] N. Friesen and S. Lowe, "The questionable promise of social media for education: Connective learning and the commercial imperative," *J. Comput. Assist. Learn.*, vol. 28, no. 3, pp. 183–194, 2012.

[29] S. López-Querol, S. Sánchez-Cambronero, A. Rivas, and M. Garmendia, "Improving civil engineering education: Transportation geotechnics taught through project-based learning methodologies," *J. Prof. Issues Eng. Educ. Pract.*, vol. 141, no. 1, pp. 1–7, Jan. 2015.

[30] L. Smith and J. T. Macgregor, "What is collaborative learning ?," *Assessment*, vol. 117, no. 5, pp. 10–30, 1992.

[31] Kemenristekdikti, *Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi Republik Indonesia Nomor 44 Tahun 2015 tentang Standar Nasional Perguruan Tinggi*. Indonesia, 2015, pp. 1–58.

[32] The World Bank, "Indonesia Skills Development Project," 2019.

[33] C. Dougherty, "The Cost-Effectiveness of National Training Systems in Developing Countries," Washington, D.C., 171, 1989.

[34] M. Yahya, "Strategi Pemenuhan Kebutuhan Guru Produktif SMK," in *Arah Kebijakan Pendidikan Guru di Indonesia*, 2016.

[35] B. T. Strom, "At Issue - the role of philosophy in education-for-work," *J. Ind. Teach. Educ.*, vol. 33(2), no. Winter, pp. 77–82, 1996.

[36] P. Sudira, *Philosophy and Theory of Vocational Education*. Yogyakarta Indonesia: UNY Press, 2012.

[37] P. Godayol, "The Francoist censorship and the Catalan translations of Jean-Paul Sartre," *Perspect. Stud. Transl.*, vol. 24, no. 1, pp. 59–75, 2016.

[38] M. Siregar, "Filsafat Eksistensialisme Jean-Paul Sartre," *Yurisprudentia*, vol. 1, no. 2, pp. 30–46, 2015.

[39] J. Cockayne, "Søren Kierkegaard: subjectivity, irony, and the crisis of modernity," *Br. J. Hist. Philos.*, vol. 25, no. 4, pp. 844–847, Jul. 2017.

[40] C. Barroso, "The ideas and ideals that define a life: Simone de beauvoir and carmen da silva," *Cad. Pagu*, vol. 2019, no. 56, pp. 1–16, 2019.

[41] D. A. Kolb, R. E. Boyatzis, and C. Mainemelis, "Experiential learning theory: Previous research and new directions," in *Perspectives on Thinking, Learning, and Cognitive Styles*, 2nd ed., R. J. Sternberg and L. Zhang, Eds. Oxfordshire, United Kingdom: Taylor and Francis, 2014, pp. 227–247.

[42] D. Pavlis and J. Gkiosos, "John Dewey, From Philosophy of Pragmatism to Progressive Education," *J. Arts Humanit.*, vol. 6, no. 9, pp. 23–30, Sep. 2017.

[43] D. Sidorsky, "Pragmatism and new directions for American philosophy: A turn to the future via commitment to scientific method," *Philos. J.*, vol. 12, no. 4, pp. 100–111, 2019.

[44] J. W. Rojewski, "Preparing the workforce of tomorrow: A conceptual framework for career and technical education," *J. Vocat. Educ. Res.*, 2010.

[45] R. Huisinga, *Approaches to Designing TVET Curricula*. Springer Netherlands, 2009.

[46] A. Brown, J. Bimrose, and S.-A. Barnes, "Collaborative Work-Related Learning and Technology-Enhanced Learning," in *International Handbook of Education for the Changing World of Work*, Springer Netherlands, 2009, pp. 1687–1698.

[47] K. Evans, "Reconciling the system world with the life worlds of young adults: Where next for youth transition policies?," in *Experience of School Transitions: Policies, Practice and Participants*, vol. 9789400741, Springer Netherlands, 2012, pp. 23–42.

[48] M. Singh, "Educational practice in India and its foundations in Indian heritage: A

synthesis of the East and West?," *Comp. Educ.*, vol. 49, no. 1, pp. 88–106, Feb. 2013.

[49] R. Maclean and M. Pavlova, "Vocationalization of secondary and higher education: pathways to the world of work," *Revisiting Glob. trends TVET*, vol. 1, no. 1, pp. 40–85, 2013.

[50] S. Billett, "Changing Work, Work Practice: The Consequences for Vocational Education," in *International Handbook of Education for the Changing World of Work*, Springer Netherlands, 2009, pp. 175–187.

[51] S. Billett, "Vocational Learning: Contributions of Workplaces and Educational Institutions," in *International Handbook of Education for the Changing World of Work*, Springer Netherlands, 2009, pp. 1711–1723.

[52] L. Hiniker and R. A. Putnam, "Partnering to Meet the Needs of a Changing Workplace," in *International Handbook of Education for the Changing World of Work*, R. Maclean and D. Wilson, Eds. Springer Netherlands, 2009, pp. 203–217.

[53] A. DeFalco, "Dewey and vocational education: Still timely?," *J. Sch. Soc.*, vol. 3, no. 1, pp. 54–64, 2016.

[54] E. J. Hyslop-Margison, "An Assessment of the Historical Arguments in Vocational Education Reform," *J. Career Tech. Educ.*, 2000.

[55] P. Sudira, *21st Century Vocational Learning Methodology*. Yogyakarta: UNY Press, 2018.

[56] S. Yondri, S. Yondri, Ganefri, Krismadinata, Nizwardi Jalinus, and Sukardi, "A New Syntax of Teaching Factory IR 4.0 Model in Vocational Education," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 10, no. 6, pp. 2270–2275, 2020.

[57] P. G. S. Habiba, B. Sujanto, and N. Karnati, "Evaluation of Implementation of Teaching Factory Programs in State Vocational School, South Jakarta," *Int. J. Educ. Res.*, vol. 8, no. 1, pp. 157–164, 2020.

[58] Wafroturrohmah, M. F. J. Syah, Suyatmini, F. Faathirisshofia, and N. Rofi'ah, "Evaluation on teaching factory implementation: Studies in management, workshop, and learning-pattern aspects," *Int. J. Innov. Creat. Chang.*, vol. 12, no. 2, pp. 203–215, 2020.

[59] R. Efendi, P. Wulan Andang, Yusron, Andra, A. Yulastri, and B. Herawan Hayadi, "Implementation competency based learning model of learning computer network courses at vocational education," *J. Adv. Res. Dyn. Control Syst.*, vol. 11, no. 1, pp. 501–505, 2019.

[60] M. Henri, M. D. Johnson, and B. Nepal, "A Review of Competency-Based Learning: Tools, Assessments, and Recommendations," *J. Eng. Educ.*, vol. 106, no. 4, pp. 607–638, Oct. 2017.

[61] R. A. Voorhees, "Competency-Based Learning Models: A Necessary Future," *New Dir. Institutional Res.*, vol. 2001, no. 110, pp. 5–13, 2001.

[62] C. F. Herreid and N. A. Schiller, "Case studies and the flipped classroom," *J. Coll. Sci. Teach.*, vol. 42, no. 5, pp. 62–66, 2013.

[63] N. S. Goedhart, N. Blignaut-van Westrhenen, C. Moser, and M. B. M. Zweekhorst, "The flipped classroom: supporting a diverse group of students in their learning," *Learn. Environ. Res.*, vol. 22, no. 2, pp. 297–310, Jul. 2019.

[64] R. A. Rasheed *et al.*, "Self-regulated learning in flipped classrooms: A systematic literature review," *Int. J. Inf. Educ. Technol.*, vol. 10, no. 11, pp. 848–853, Nov. 2020.

[65] L. Abeysekera and P. Dawson, "Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research," *High. Educ. Res. Dev.*, vol. 34, no. 1, pp. 1–14, 2015.

[66] F. Deng, "Literature review of the flipped classroom," *Theory Pract. Lang. Stud.*, vol. 9, no. 10, pp. 1350–1356, 2019.

[67] N. Kushairi and A. Ahmi, "Flipped classroom in the second decade of the Millenia: a Bibliometrics analysis with Lotka's law," *Educ. Inf. Technol.*, vol. 26, no. 4, pp. 4401–4431, Jul. 2021.

[68] Saira, F. Ajmal, and M. Hafeez, "Critical review on flipped classroom model versus traditional lecture method," *Int. J. Educ. Pract.*, vol. 9, no. 1, pp. 128–140, 2021.

[69] T. Long, J. Cummins, and M. Waugh, "Use of the flipped classroom instructional model in higher education: instructors' perspectives," *J. Comput. High. Educ.*, vol. 29, no. 2, pp. 179–200, Aug. 2017.

[70] M. B. Gilboy, S. Heinerichs, and G. Pazzaglia, "Enhancing student engagement using the flipped classroom," *J. Nutr. Educ. Behav.*, 2015.

[71] J. L. Jensen, T. A. Kummer, and P. D. D. M. Godoy, "Improvements from a flipped classroom may simply be the fruits of active learning," *CBE Life Sci. Educ.*, 2015.

[72] T. Green, "Flipped Classrooms: An Agenda for Innovative Marketing Education in the Digital Era," *Mark. Educ. Rev.*, vol. 25, no. 3, pp. 179–191, 2015.

[73] J. Mehring, "The flipped classroom," in *Innovations in Flipping the Language Classroom: Theories and Practices*, 2017.

[74] The New Economics Education, "Definition and types of learning model," *Economics Education*, 2017. [Online]. Available: http://neweconomicseducation.blogspot.com/2012/07/definition-and-types-of-learning-model.html. [Accessed: 01-Jan-2021].

[75] Alley, "Learning Model," *Online glossary*, 2021. [Online]. Available: https://www.alleydog.com/glossary/definition.php?term=Learning+Model. [Accessed: 05-May-2021].

[76] H. Keser and D. Karahoca, "Designing a project management e-course by using project based learning," in *Procedia - Social and Behavioral Sciences*, 2010.

[77] H. Fazlollahtabar and A. Muhammadzadeh, "A knowledge-based user interface to optimize curriculum utility in an E-learning system," *Int. J. Enterp. Inf. Syst.*, vol. 8, no. 3, 2012.

[78] O. V. Galustyan, Y. V. Borovikova, N. P. Polivaeva, B. R. Kodirov, and G. P. Zhirkova, "E-learning within the Field of Andragogy," *Int. J. Emerg. Technol.*

Learn., vol. 14, no. 9, 2019.

[79] L. Stošić and M. Bogdanović, "M-learning - A new form of learning and education," *Int. J. Cogn. Res. Sci. Eng. Educ.*, vol. 1, no. 2, 2013.

[80] P. J. B. Tan, "English e-learning in the virtual classroom and the factors that influence ESL (English as a Second Language): Taiwanese citizens' acceptance and use of the Modular Object-Oriented Dynamic Learning Environment," *Soc. Sci. Inf.*, vol. 54, no. 2, 2015.

[81] B. N. Cvetković, L. Stošić, and A. Belousova, "Media and information literacy-the basis for applying digital technologies in teaching from the discourse of educational needs of teachers," *Croat. J. Educ.*, vol. 20, no. 4, 2018.

[82] A. Sattari, M. Abdekhoda, and V. Z. Gavgani, "Determinant factors affecting the web-based training acceptance by health students, applying UTAUT model," *Int. J. Emerg. Technol. Learn.*, vol. 12, no. 10, 2017.

[83] P. J. B. Tan, "Applying the UTAUT to understand factors affecting the use of english e-learning websites in Taiwan," *SAGE Open*, vol. 3, no. 4, 2013.

[84] A. Lu, Q. Chen, Y. Zhang, and T. Chang, "Investigating the Determinants of Mobile Learning Acceptance in Higher Education Based on UTAUT," in *Proceedings - 2016 International Computer Symposium, ICS 2016*, 2017.

[85] P. J. B. Tan and M. H. Hsu, "Designing a system for English evaluation and teaching devices: A PZB and TAM model analysis," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 14, no. 6, 2018.

[86] S. S. Oyelere, J. Suhonen, G. M. Wajiga, and E. Sutinen, "Design, development, and evaluation of a mobile learning application for computing education," *Educ. Inf. Technol.*, vol. 23, no. 1, 2018.

[87] P. J. B. Tan and M. H. Hsu, "Developing a system for English evaluation & teaching devices," in *Proceedings of the 2017 IEEE International Conference on Applied System Innovation: Applied System Innovation for Modern Technology, ICASI 2017*, 2017.

[88] A. Irina, B. Irina, G. Anastasia, and D. Elena, "Active learning technologies in distance education of gifted students," *Int. J. Cogn. Res. Sci. Eng. Educ.*, vol. 7, no. 1, 2019.

[89] A. Aydin and C. Aytekin, "Teaching Materials Development and Meeting the Needs of the Subject: A Sample Application," *Int. Educ. Stud.*, vol. 11, no. 8, p. 27, Jul. 2018.

[90] S. Ayvazo, P. Ward, and P. T. Stuhr, "Teaching and Assessing Content Knowledge in Preservice Physical Education," *J. Phys. Educ. Recreat. Danc.*, vol. 81, no. 4, 2010.

[91] Designing buildings, "Construction drawing," 2021. [Online]. Available: https://www.designingbuildings.co.uk/wiki/Construction_drawing. [Accessed: 01-May-2021].

[92] A. W. Moore, " Democracy and Education . John Dewey ," *Int. J. Ethics*, vol. 26, no. 4, 1916.

[93] H. Sturt and J. Dewey, "The Influence of Darwin on Philosophy, and other Essays in Contemporary Thought.," *J. Philos. Psychol. Sci. Methods*, vol. 7, no. 20, 1910.

[94] J. Piaget, "Piaget ' s Theory Piaget ' s Assumptions About Children Nature vs . Nurture Continuous vs . Discontinuous," *Children*, pp. 1–13, 1920.

[95] J. P., J. Piaget, and M. Gabain, "The Child's Conception of Physical Causality," *Am. J. Psychol.*, vol. 44, no. 3, 1932.

[96] C. O. Weber, J. Piaget, and M. Warden, "The Language and Thought of the Child," *Am. J. Psychol.*, vol. 38, no. 2, 1927.

[97] L. Smith and J. T. Macgregor, "What is Collaborative Learning ?," *Assessment*, vol. 117, no. 5, pp. 10–30, 1992.

[98] B. R. Kurniawan, "Collaborative learning," *Kurniawan Budi*, 2013. [Online]. Available: https://kurniawanbudi04.wordpress.com/2013/05/27/collaborative-learning/.

[99] K. Yahiji, C. Mahfud, and M. A. Mu'ammar, "Vocational Education in Indonesia Facing ASEAN Economic Community," *Indones. Res. J. Educ.* |*IRJE*|, 2019.

[100] H. Efendy and J. Nurhanifa, "Developing of entrepreneurial spirit in the era of ASEAN economic community in vocational high school," *Int. J. Learn. Dev.*, vol. 7, no. 3, 2017.

[101] Sami Ullah and Zilakat Khan Malik, "Socio-Economic and Political Impacts of Vocational Trainings on Tribal Community of Pakistan," *J. Bus. Soc. Rev. Emerg. Econ.*, vol. 6, no. 4, 2020.

[102] A. Albert, "A study on the vocational education in the ASEAN Economic Community (AEC) countries and its implications to Indonesia," *Econ. Bus. Solut. J.*, vol. 4, no. 2, 2020.

[103] S. Bell, "Project-Based Learning for the 21st Century: Skills for the Future," *Clear. House A J. Educ. Strateg. Issues Ideas*, 2010.

[104] T. Markham, "Project Based Learning A Bridge Just Far Enough," *Teach. Libr.*, 2011.

[105] S. Boss, "Project-Based Learning: A Short History | Edutopia," *edutopia*, 2011. .

[106] S. Boss and J. Krauss, "Reinventing Project-Based Learning: Your field guide to Real-World projects in the digital age," *Int. Soc. Technol. Educ.*, 2007.

[107] J. Larmer and J. R. Mergendoller, "Gold Standard PBL: Essential Project Design Elements | Blog | Project Based Learning | BIE," *Setting the Standard for Project Based Learning: A Proven Approach to Rigorous Classroom Instruction*, 2015. [Online]. Available: https://www.pblworks.org/blog/gold-standard-pbl-essential-project-design-elements. [Accessed: 14-Mar-2021].

[108] Edutopia, "Top ten tips for assessing project-based learning," *Georg. Lucas Educ.*

Found., 2011.

[109] M. M. H. Ahmed and B. Indurkhya, "Investigating cognitive holding power and equity in the flipped classroom," *Heliyon*, vol. 6, no. 8, 2020.

[110] E. Colomo-Magaña, R. Soto-Varela, J. Ruiz-Palmero, and M. Gómez-García, "University students' perception of the usefulness of the flipped classroom methodology," *Educ. Sci.*, vol. 10, no. 10, 2020.

[111] J. Mehring and A. Leis, *Innovations in flipping the language classroom: Theories and practices*. Springer Singapore, 2017.

[112] B. Lucas, E. Spencer, and G. Claxton, *How to Teach Vocational Education : A Theory of Vocational Pedagogy*, vol. 1, no. 1. London: The City and Guilds of London Institute, 2012.

[113] C. Revermann, P. Georgieff, and S. (Fraunhofer I. Kimpeler, "eLearning in der beruflichen Aus- und Weiterbildung," in *Europäische Wissensgesellschaft - Potenziale des eLearning*, 2009.

[114] M. D. Gall, W. R. Borg, and J. P. Gall, *Educational research: An introduction, 6th ed.* 1996.

[115] suharsimi arikunto, *prosedur penelitian*. 2014.

[116] Edutopia, "How Does Project-Based Learning Work?," *The George Lucas Educational Foundation*, 2007. .

[117] F. Hrbek and A. Stix, "The Nine Steps of Project-Based Learning," in *Teachers as Classrom Coaches*, Alexandria: ASCD, 2006, pp. 2–5.

[118] Direktorat Jenderal Manajemen Pendidikan Dasar dan Menengah, *Implementation of internship/Pelaksanaan praktik kerja industri (prakerin)*, 1st ed. Jakarta, 2008.

[119] W. Djojonegoro, *Human resource development through vocational high school/Pengembangan sumberdaya manusia melalui SMK*. Jakarta: Jayakarta Agung, 1998.

[120] L. K. J. Baartman and E. De Bruijn, "Integrating knowledge, skills and attitudes: Conceptualising learning processes towards vocational competence," *Educational Research Review*. Elsevier Inc, pp. 125–134, 2011.

[121] N. Kilbrink, V. Bjurulf, L. K. J. Baartman, and E. de Bruijn, "Transfer of learning in Swedish technical vocational education: student experiences in the energy and industry programmes," *J. Vocat. Educ. Train.*, vol. 70, no. 3, pp. 455–475, 2018.

[122] B. H. Cameron, "Experience-Based Learning," in *Encyclopedia of Information Technology Curriculum Integration*, 1st ed., S. Reed, Ed. Pennsylvania: IGI Global, 2011, pp. 308–315.

[123] D. Bancroft, "Learning from experience," in *Practical Leadership in Nursing and Health Care: A Multi-Professional Approach*, 1st ed., S. Henwood, Ed. Boca Raton: CRC Press, 2014, pp. 147–156.

[124] S. Olusegun, "Constructivism Learning Theory: A Paradigm for Teaching and

Learning," *IOSR J. Res. Method Educ. Ver. I*, vol. 5, no. 6, pp. 66–70, 2015.

[125] S. N. Elliott, J. F. Travers, T. R. Kratochwill, and J. Littlefield Cook, *Educational psychology: Effective teaching, effective learning*, 3rd ed. New York: McGraw-Hill, 2000.

[126] T. Schaul, J. Quan, I. Antonoglou, and D. Silver, "Prioritized experience replay," in *4th International Conference on Learning Representations*, 2016, pp. 1–21.

[127] A. H. Setiawan, "Guided demonstration model on CAD learning with video media/Model demonstrasi terbimbing pada pembelajaran CAD dengan media video," in *Prosiding Seminar Nasional UNS Vocational Day*, 2018, pp. 540–552.

[128] A. Steinmetz, "The Discrepancy Evaluation Model," in *Evaluation in Education and Human Services*, 1st ed., D. L. Stufflebeam, G. F. Madaus, and T. Kellaghan, Eds. Dordrecht: Springer Netherlands, 2000, pp. 127–143.

[129] L. R. Aiken, "Content validity and reliability of single items or questionnaires," *Educ. Psychol. Meas.*, vol. 40, no. 4, pp. 955–959, 1980.

[130] P. E. Shrout and J. L. Fleiss, "Intraclass correlations: Uses in assessing rater reliability," *Psychol. Bull.*, vol. 86, no. 2, pp. 420–428, 1979.

[131] S. Hadi, *Statistics 2nd edition/Statistik jilid 2*, 2nd ed. Yogyakarta: Andi Offset, Indonesia, 2006.

[132] I. N. L. Jayanta, K. D. Suryantari, and M. Sumantri, "An Analysis of Discrepancy between the Lesson Plan and the Implementation of Curriculum," *J. Educ. Res. Eval.*, vol. 1, no. 2, pp. 73–81, 2017.

[133] H. Le, J. Janssen, and T. Wubbels, "Collaborative learning practices: teacher and student perceived obstacles to effective student collaboration," *Cambridge J. Educ.*, vol. 48, no. 1, pp. 103–122, 2018.

[134] A. H. Setiawan, "Development of CAD learning media/ Pengembangan media pembelajaran CAD sebagai penunjang perkuliahan pendidikan teknik bangunan dan pembelajaran SMK jurusan bangunan," *J. Ilm. Pendidik. Tek. dan Kejuru.*, vol. 6, no. 1, pp. 1–5, 2013.

[135] H. Sofyan and K. Komariah, "Problem Based Learning in the Implementation of Curriculum 2013 in Vocational High School," *J. Pendidik. Vokasi*, vol. 6, no. 3, pp. 260–271, 2016.

[136] S. Sukatiman, M. Akhyar, Siswandari, and Roemintoyo, "Enhancing higher-order thinking skills in vocational education through scaffolding-problem based learning," *Open Eng.*, 2020.

[137] E. Tovar *et al.*, "Do MOOCs sustain the UNESCO's quality education goal?," in *IEEE Global Engineering Education Conference, EDUCON*, 2019, pp. 1499–1503.

[138] E. Tovar, B. Tabuenca, and N. Piedra, "EntreCom4ALL MODEL to sustain the entrepreneurship competence needs," in *IEEE Global Engineering Education Conference, EDUCON*, 2020, pp. 1937–1940.

[139] V. Odell, P. Molthan-Hill, S. Martin, and S. Sterling, "Transformative Education to

Address All Sustainable Development Goals," in *Quality Education*, R. Pretorius, Ed. 2020, pp. 905–916.

[140] J. B. Haseman, "Indonesia," in *Asian Security Handbook: Assessment of Political-security Issues in the Asia-Pacific Region*, Abingdon-on-Thames: Taylor and Francis, 2019, pp. 159–165.

[141] Badan Pusat Statistik, "Februari 2019: Open unemployment rate/Tingkat pengangguran terbuka (TPT) sebesar 5,01 persen," 2019.

[142] United Nation, "Transforming our world: The 2030 agenda for sustainable development," 2015.

[143] Global Education Monitoring Report Team, "Global education monitoring report, 2020: Inclusion and education: all means all," 2020.

[144] UNESCO, "Strategy for Technical and Vocational Education and Training (2016-2021)," Bonn Germany, 2016.

[145] President of Republic of Indonesia, *Presidential Instruction Number 9 Year 2016 concerning revitalization of vocational high schools*. Indonesia, 2016, pp. 1–7.

[146] Ditpsmk, "Four focuses on vocational revitalization/Empat fokus revitalisasi SMK," *psmk.kemdikbud.go.id*, 2017. [Online]. Available: https://www.kemdikbud.go.id/main/blog/2017/05/empat-fokus-revitalisasi-smk. [Accessed: 12-Jun-2020].

[147] W. Kamdi, "Revitalization of vocational schools: Boosting national excellence/Revitalisasi SMK: mendongkrak unggulan nasional," *DitPSMK Direktorat Jenderal Pendidikan Dasar dan Menengah Kementerian Pendidikan dan Kebudayaan*, 2017. [Online]. Available: http://smk.kemdikbud.go.id/konten/2637/revitalisasi-smk-mendongkrak-unggulan-nasional. [Accessed: 11-Sep-2017].

[148] A. W. Khurniawan and G. Erda, "[Improving the quality of vocational education through sustainable revitalization]," *Vocat. Educ. Policy*, vol. 1, no. 19, pp. 1–14, 2019.

[149] M. N. Udin, A. H. Setiawan, and B. Siswanto, "Developing drawing techniques Learning media using macromedia flash/Perancangan media pembelajaran menggambar teknik dengan menggunakan macromedia flash," *Indones. J. Civ. Eng. Educ.*, vol. 2, no. 1, pp. 1–12, 2018.

[150] A. H. Setiawan, "Implementing the STAD based on instructional media to draw buildings/Penerapan metode STAD berbasis media video pembelajaran menggambar bangunan gedung pada sekolah kejuruan," in *Prosiding Seminar Nasional UNS Vocational Day*, 2016, pp. 355–363.

[151] N. Yarrow, *The Promise of Education in Indonesia*. The World Bank, 2020.

[152] P. Carey, "Civilization on loan: The making of an upstart polity: Mataram and its successors, 1600–1830," *Mod. Asian Stud.*, vol. 31, no. 3, pp. 711–734, 1997.

[153] S. A. Whyte, "Advancing shūrā: A social agent for democratization," *Islam Christ.*

Relations, vol. 30, no. 3, pp. 345–362, Jul. 2019.

[154] T. Vasinayanuwatana, T. W. Teo, and J. Ketsing, "Shura-infused STEM professional learning community in an Islamic School in Thailand," *Cult. Stud. Sci. Educ.*, vol. 16, no. 1, pp. 109–139, Mar. 2021.

[155] M. Pickthall William, *The meaning of the glorious quran*, Later Prin. Chicago: Kazi Publications, 1996.

[156] A. Yusuf Ali, *The meaning of Holy Qur'an*, 11th ed. Beltsville USA: Amana Publications, 2006.

[157] A. Irajpour, F. Ghaljaei, and M. Alavi, "Concept of collaboration from the Islamic perspective: The view points for health providers," *J. Relig. Health*, vol. 54, no. 5, pp. 1800–1809, Oct. 2015.

[158] D. Abbas and C. Tan, "Transformational Islamic leadership: A case study from Singapore," *Glob. Perspect. Teach. Learn. Paths Islam. Educ.*, vol. 1, no. August, pp. 76–91, 2019.

[159] N. Krieger, "Methods for the scientific study of discrimination and health: An ecosocial approach," *Am. J. Public Health*, vol. 102, no. 5, pp. 936–945, 2012.

[160] A. Cook, "Statistics," in *Surgical Critical Care and Emergency Surgery: Clinical Questions and Answers: Second Edition*, 2018.

[161] T. Hartono, "Conceptions of theory and reality from a methodological perspective/Konsepsi teori dan realitas perspektif metodologi," *J. An-Nida*, vol. 40, no. 1, pp. 60–68, 2015.

[162] Dirjen Dikdasmen Ministry of Education, *Directorate General Regulation Number 7 Year 2018 concerning vocational high school curriculum structure/Struktur kurikulum sekolah menengah kejuruan*. Indonesia, 2018, pp. 1–307.

[163] Dikdasmen Directorate General Ministry of Education Republic of Indonesia, *Appendix of Vocational High School curriculum structure/struktur kurikulum sekolah menengah kejuruan*. Indonesia, 2017, pp. 1–301.

[164] Ministry of Education and Culture of Republic of Indonesia, *Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 21 of 2016 concerning content standards for primary and secondary education*. Indonesia, 2016, pp. 1–4.

[165] Ministry of Education and Culture of Republic of Indonesia, *Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 22 of 2016 concerning standards of process*. Indonesia, 2016, pp. 1–3.

[166] Public Works Department of Republic of Indonesia, *Architecture droughtsman, Indonesian national work competency standards*. Jakarta: Public Works Department of Republic of Indonesia, 2006.

[167] Jane, "Strategies to develop skills for positive training transfer," *Adult High. Educ. Alliance*, vol. 1, no. 1988, pp. 93–99, 2018.

[168] C. Cochran and S. Brown, "Andragogy and the adult learner," *Support. success adult*

online students, no. 2, 2017.

[169] V. X. Wang, "Andragogy and Pedagogy in Learning Theories," in *Encyclopedia of Human Resources Information Systems*, IGI Global, 2009, pp. 42–47.

[170] L. R. Aiken, "Three coefficients for analyzing the reliability and validity of ratings," *Educ. Psychol. Meas.*, vol. 45, no. 1, pp. 131–142, 1985.

[171] Budiyono, *Statistics for research/Statistika untuk penelitian*, 2nd ed. Surakarta: UNS Press, 2016.

[172] R. G. Sudarmanto, *Multiple linear regression analysis with SPSS/Analisis regresi linear ganda dengan SPSS*, vol. 1. 2005.

[173] E. C. Alexopoulos, "Introduction to multivariate regression analysis," *Hippokratia*, vol. 14, no. 1, pp. 23–28, 2010.

[174] G. M. Duncan, W. D. Berry, and S. Feldman, "Multiple regression in practice," *J. Mark. Res.*, vol. 23, no. 3, pp. 309–310, 1986.

[175] H. Latan, *Statistical data analysis application for social sciences with IBM SPSS*, 1st ed. Bandung: Alfabeta, 2014.

[176] N. R. Draper and H. Smith, *Applied regression analysis*. New Jersey: Wiley, 2014.

[177] V. J. Ma and X. Ma, "A comparative analysis of the relationship between learning styles and mathematics performance," *Int. J. STEM Educ.*, vol. 1, no. 1, pp. 1–13, 2014.

[178] C. E. Weinstein and L. M. Hume, *Study strategies for lifelong learning.* Lexington: American Psychological Association, 1998.

[179] P. K. Murphy and P. A. Alexander, "Contextualizing learner-centered principles for teachers and teaching," in *The Keys to Effective Schools: Educational Reform as Continuous Improvement, Second Edition*, 2nd ed., Corwin Press, Inc, 2007, pp. 13–32.

[180] C. D. Jerald, "Defining a 21st century education," *Cent. Public Educ.*, vol. 1, no. July, pp. 1–82, 2009.

[181] D. Laux, A. Luse, and B. E. Mennecke, "Collaboration, connectedness, and community: An examination of the factors influencing student persistence in virtual communities," *Comput. Human Behav.*, vol. 57, no. 1, pp. 452–464, 2016.

[182] C. Kusmana and A. Hikmat, "The biodiversity of flora in Indonesia/Keanekaragaman hayati flora di Indonesia," *J. Nat. Resour. Environ. Manag.*, vol. 5, no. 2, pp. 187–198, 2015.

[183] OECD, *Education policy in Japan: Building bridges towards 2030*. Paris: OECD, 2018.

[184] OECD, *PISA 2015 results (Volume III)*, vol. III. Paris: OECD, 2018.

[185] A. Takahashi and T. McDougal, "Collaborative lesson research: maximizing the impact of lesson study," *ZDM - Math. Educ.*, vol. 48, no. 4, pp. 513–526, 2016.

[186] H. Y. Ku, H. W. Tseng, and C. Akarasriworn, "Collaboration factors, teamwork satisfaction, and student attitudes toward online collaborative learning," *Comput. Human Behav.*, vol. 29, no. 3, pp. 922–929, 2013.

[187] V. Popov *et al.*, "Perceptions and experiences of, and outcomes for, university students in culturally diversified dyads in a computer-supported collaborative learning environment," *Comput. Human Behav.*, vol. 32, no. 1, pp. 186–200, 2014.

[188] S. Montgomery and L. Groat, "Student learning styles and their implications for teaching," *Occasional paper*, vol. 10. The University of Michigan, Ann Arbor, pp. 1–8, 1998.

[189] M. Taqi-ud-Din Al-Hilali and M. Muhsin Khan, *Interpretation of the Meaning of The Noble Qur'an*, Revised. Riyadh: Darussalam, 2011.

[190] F. Abdullah, A. K. Azmin, and N. H. Salleh, "Developing graduates' collaboration skill based on Islamic perspective through integrated multi-disciplinary course in the built environment," *Int. J. Soc. Sci. Humanit.*, vol. 4, no. 2, pp. 117–121, 2014.

[191] N. R. B. M. Zain, I. F. B. Zulkarnain, and P. D. R. Hassan, "Shari'ah corporate governance structure of malaysian Islamic banking and finance: The traces of shura," *J. Islam. Bank. Financ.*, vol. 3, no. 1, pp. 26–34, 2015.

[192] M. Laal, "Positive interdependence in collaborative learning," *Procedia - Soc. Behav. Sci.*, vol. 93, no. 1, pp. 1433–1437, 2013.

[193] M. Laal and M. Laal, "Collaborative learning: What is it?," *Procedia - Soc. Behav. Sci.*, vol. 31, no. 1, pp. 491–495, 2012.

[194] W. . Borg and M. . Gall, "Educational Research an Introduction fourth edition," *Longman Inc*, vol. 1, no. 1, pp. 24–34, 1983.

[195] N. Bennett, W. R. Borg, and M. D. Gall, "Educational Research: An Introduction," *Br. J. Educ. Stud.*, vol. 32, no. 3, p. 274, Oct. 1984.

[196] W. R. Gall, M. D., Gall, J. P., & Borg, "I dentifying a Research Problem and Question , and Searching," *Educ. Res. An Introd.*, 2006.

[197] P. D. Sugiyono, "Metode Penelitian Pendidikan (Kuantitatif, Kualitatif, Kombinasi, R&d dan Penelitian Pendidikan)," *Metod. Penelit. Pendidik.*, p. 117,118,124,148,194,199, 2019.

[198] J. T. Roscoe, *Fundamental Research Statistics for The Behavioural Sciences (2nd Edition)*. 1975.

[199] Sugiyono, *Educational Research Methods/Metode penelitian pendidikan*. Bandung: Alfabeta, 2008.

[200] Optimize Smart, "Wordpress architecture explained in great detail," *Wordpress CEO*, 2021. [Online]. Available: https://www.optimizesmart.com/wordpress-ninja-15-minutes/. [Accessed: 01-Jan-2021].

[201] Epignosis, *Efront refreshing elearning*, 1st ed. San Francisco: Epignosis, 2003.

[202] A. N. Adianto, "Pengembangan e-vocational sebagai media pembelajaran mata

kuliah program CAD 2d," Sebelas Maret University, 2018.

[203] R. O'Leary, Y. Choi, and C. M. Gerard, "The skill set of the successful collaborator," *Public Adm. Rev.*, vol. 72, no. S1, pp. S70–S83, 2012.

[204] J. E. Brindley, C. Walti, and L. M. Blaschke, "Creating effective collaborative learning groups in an online environment," *Int. Rev. Res. Open Distance Learn.*, vol. 10, no. 3, pp. 1–18, 2009.

[205] I. Inayat, R. U. Amin, Z. Inayat, and S. S. Salim, "Effects of Collaborative Web Based Vocational Education and Training (VET) on Learning Outcomes," *Comput. Educ.*, vol. 68, no. 1, pp. 153–166, 2013.

[206] G. Siemens, "Connectivism: A learning theory for the digital age," *Int. J. Instr. Technol. Distance Learn.*, vol. 2, no. 1, pp. 3–10, 2005.

[207] M. M. Grant, "Getting a grip on project-based learning: Theory, cases and recommendations," *Meridian A Middle Sch. Comput. J.*, 2002.

[208] George Lucas Educational Foundation, "How Does Project-Based Learning Work?," *edutopia*, 2007. [Online]. Available: https://www.edutopia.org/project-based-learning-guide-implementation. [Accessed: 14-Mar-2021].

[209] J. O'Flaherty and C. Phillips, "The use of flipped classrooms in higher education: A scoping review," *Internet High. Educ.*, vol. 25, no. 1, pp. 85–95, 2015.

[210] R. Van Wageningen, "The role of technological change in culture," *Orange Business Services*, 2017. [Online]. Available: https://www.orange-business.com/en/blogs/connecting-technology/innovation/the-role-of-technological-change-in-culture. [Accessed: 14-Mar-2021].

[211] D. Yoneoka *et al.*, "Early SNS-based monitoring system for the covid-19 outbreak in Japan: A population-level observational study," *J. Epidemiol.*, vol. 30, no. 8, 2020.

[212] M. Tateno, D. J. Kim, A. R. Teo, N. Skokauskas, A. P. S. Guerrero, and T. A. Kato, "Smartphone addiction in Japanese college students: Usefulness of the japanese version of the smartphone addiction scale as a screening tool for a new form of internet addiction," *Psychiatry Investig.*, vol. 16, no. 2, 2019.

[213] C. Custer, "WeChat blasts past 700 million monthly active users, tops China's most popular apps," *Tech in Asia*, 2016. [Online]. Available: https://www.techinasia.com/wechat-blasts-700-million-monthly-active-users-tops-chinas-popular-apps. [Accessed: 02-Feb-2020].

[214] T. L. Sandel, C. Ou, D. Wangchuk, B. Ju, and M. Duque, "Unpacking and describing interaction on Chinese WeChat: A methodological approach," *J. Pragmat.*, vol. 143, 2019.

[215] H. Junawan and N. Laugu, "Eksistensi Media Sosial,Youtube, Instagram dan Whatsapp Ditengah Pandemi Covid-19 Dikalangan Masyarakat Virtual Indonesia," *Baitul 'Ulum J. Ilmu Perpust. dan Inf.*, 2020.

[216] R. Munadi, A. Rakhman, and D. Perdana, "Smart garage implementation and design using WhatsApp communication media," *Telkomnika (Telecommunication Comput.*

Electron. Control., vol. 16, no. 3, 2018.

[217] S. Azwar, *Reliability and validity, 4th edition*, 4th ed. Yogyakarta: Pustaka Pelajar, 2018.

[218] G. A. Morgan, K. C. Barrett, N. L. Leech, and G. W. Gloeckner, *IBM SPSS for Introductory Statistics: Use and Interpretation*. New York: Lawrence Erlbaum, 2019.

[219] R. R. Hake, "Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses," *Am. J. Phys.*, vol. 66, no. 1, 1998.

[220] K. Vladimirova and D. Le Blanc, "How well are the links between education and other sustainable development goals covered in UN flagship reports?," New York, 146, 2015.

[221] CERI/OECD, "21st Century Learning: Research, Innovation and Policy - Directions from recent OECD analyses," in *OECD/CERI International Conference -Learning in the 21st Century: Research, Innovation and Policy*, 2008, pp. 1–13.

[222] B.S.Bloom and D. . Krathwohl, *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook 1: The Cognitive Domain*. 1956.

[223] A. dan Krathwohl, "Anderson and Krathwohl - Understanding the New Version of Bloom ' s Taxonomy The Cognitive Domain : Anderson and Krathwohl - Bloom ' s Taxonomy Revised," *A succinct Discuss. Revis. to Bloom. Class. Cogn. Taxon. by Lorin Anderson David Krat. how to use them Eff.*, vol. 41, no. 2, pp. 19–72, 2001.

[224] M. Conley, "Quotes That Celebrate Teamwork, Hard Work, and Collaboration," 2021. [Online]. Available: https://blog.hubspot.com/marketing/teamwork-quotes. [Accessed: 01-May-2021].

[225] A. H. Setiawan, R. Takaoka, A. Tamrin, Roemintoyo, E. S. Murtiono, and L. Trianingsih, "Contribution of collaborative skill toward construction drawing skill for developing vocational course," *Open Eng.*, vol. 11, no. 1, pp. 755–771, 2021.

APPENDIX

1. E-vocational Construction Drawing (ECD) Learning Model

a. Learning Module

<table>
<tr>
<th>Introduction Module</th>
<th>Module 1. Building Regulations</th>
<th>Module 2. The Concept of Drawing the Building Shop Drawing</th>
</tr>
<tr>
<td>1. Pre-test
a. Basic drawing pre-test
b. Student skill assessment for construction drawing
2. Challenges and examples
3. Determining teamwork group</td>
<td rowspan="2">1. Building Regulations.
a. Government Regulation of the Republic of Indonesia Number 36 of 2005 concerning Implementing Regulations of Law Number 28 of 2002 concerning Buildings.
b. National Spatial Plan (RTRW). (tutorial video)
c. Space utilization intensity (Basic Building Coefficient (KDB)/Building Coverage Ratio (BCR), Building Floor Coefficient (KLB)/Floor-Area Ratio (FAR), Basement Tread Coefficient (KTB), & Green Basic Coefficient (KDH). (tutorial video),
d. Guide to download the National and Regional RTRW in Indonesia.
2. Google document link for group assignments
3. RTRW Surakarta city
a. Map of the spatial structure of Surakarta city
b. Map of spatial pattern plan (protected area and cultivation area) Surakarta city in 2031
c. Map of the strategic area of Surakarta city
d. Spatial Planning and Utilization Database Link
4. Building Permit (IMB)
a. Building Boundary Lines
b. River Boundary Line
5. Detailed Urban Spatial Planning/ Rencana Detail Tata Ruang Kawasan Perkotaan (RDTRK) of Surabaya City
a. RTDRK for the city of Surabaya
6. Surakarta City Building and Environmental Planning (RTBL)
a. Link Database Perencanaan dan Pemanfaatan Ruang
7. Bonus Stage
8. Group Project (Calculation of Space Utilization Intensity)
9. Open-ended and multiple-choice quiz
10. Zoom Meeting, Regular dan After Class
11. Team contextual tasks. (Site Plan Drawings Intensity of Space Utilization)</td>
<td rowspan="2">1. Architectural Drawing
a. Site plan, the functions, and settings
b. Various kinds of engineering and architectural drawings
c. Guide to read architectural drawings that look like buildings
d. Guide to apply building regulations in floor plan
e. Structural Design and Construction in Architecture
f. Accommodating Functions and Space in Buildings
g. Planning buildings based on the main aspects
2. Designing a Floor Plan
a. Mindmap of floor plans
b. Floor plan Animation Videos.
c. Example of floor plans
3. Building view design
a. The principle of projection to draw view.
b. Front and side view drawings of Jambuwuluk Hotel Malioboro Hotel Yogyakarta
c. Guide to draw view and section drawings.
d. The concept of drawing floor plans, views, sections, and building details with precise and clear descriptions
4. The concept of drawing non-Structural elements.
a. Drawing the wall
b. Drawing the floor.
c. Drawing the ceiling/plafond
5. Drawing exterior elements
a. Exterior walls and the variety
b. How to design and draw building openings (windows and doors)
6. Structure drawings
a. Foundation structures
b. Stair structures
c. Column, beam, floor slab Structures
d. Roof Structures
e. Section drawings
7. Building utility drawings
a. Multi-story building utility system
8. Zoom meeting regular dan after-class
9. Individual assignment (creating a quiz via google form as a task for deepening the shop drawing concept lesson material)
10. Contextual team assignment
a. Designing the floor plan (including doors and windows)
b. Drawing the group's project location site plan</td>
</tr>
<tr>
<th>Project show room Module</th>
</tr>
<tr>
<td>1. Project plan
2. Project achievement
3. Shop drawing project result</td>
</tr>
</table>

Module 3. Managing CAD Drawing Commands for Construction Drawing	Module 4. Drawing Applied Objects on Buildings	Module 5. Drawing Floor Plan and Building View
1. Drawing building sections. a. Example of floor plans drawing. (The Jambuluwuk Malioboro Yogyakarta hotel) b. Example of section drawing. (the Jambuluwuk Malioboro hotel Yogyakarta) c. Sections drawing principles 2. Section drawing concept 3. Drawing A-A section. 4. Drawing foundation section. a. Tutorial video of drawing foundation section. 5. Drawing building floor section. 6. Drawing of stairs section. a. Drawing stairs section tutorial video. 7. Drawing roof construction section. 8. Drawing objects in section drawings. a. Drawing objects in section drawings video 9. Giving notation to the section. a. Giving notation of elevation with dimension style and block editor. (tutorial video) b. Giving automated elevation notation with dimension style. (tutorial video) 10. Drawing B-B section. a. Drawing B-B section part 1. (tutorial video) b. Drawing B-B section part 2. (tutorial video) 11. Quiz. (drawing sections) 12. Contextual team assignment (drawing the group's project building sections)	1. Advance sections drawing a. Foundation sections drawing b. Roof construction sections drawing 2. Foundation Concept a. Varieties of foundation b. Foundation lesson material download link c. Foundation drawing plans tutorial video d. Section drawing plans tutorial video e. Section's foundation drawing plans tutorial video f. Detailed sections drawing plans of foot-plate foundation tutorial video g. Detailed sections drawing plans of basic river stone foundation tutorial video 3. Quiz 1. Sections foundation drawing 4. Roof constructions a. Types of roofs b. Criteria for roofing materials and the angle. c. Roof construction drawing plan d. Roof construction drawing lesson material download link e. Tutorial video of roof construction drawing plan 5. Quiz 2. Roof construction section drawing. 6. Roof Truss Construction Concept a. Roof Truss Construction principles. b. Types of roof truss construction. c. Knock down truss types of roof constructions. d. Roof Truss Construction lesson material download link e. Drawing Roof Truss Construction tutorial video f. Drawing Roof Truss Construction plan tutorial video g. Drawing Detailed Roof Truss Construction tutorial video 7. Quiz 3. Roof truss construction drawing 8. Criteria of wooden roof truss construction 9. General concept of reinforced concrete a. Reinforced concrete lesson material download link b. Drawing details of columns, concrete slope, concrete floor plate, and beams tutorial video 10. Quiz 4. Reinforced concrete a. Example of a foundation drawing plan and details b. Example of roof drawing plan and details c. Samples of roof truss construction drawing plans and details d. Example of columns, concrete slope, concrete floor plate, and beams details drawing 11. Contextual team assignment a. drawing the group's project building roof construction b. Drawing columns, concrete slope, concrete floor plate, and beams plans c. Drawing detailed columns, concrete slope, concrete floor plate, and beams d. Drawing stairs plans and details	1. Drawing Plumbing System a. Examples of clean water installation drawings b. Examples of used water and sewage installation drawings 2. Clean water installation drawings a. Examples of a clean water installation plan for 1st and 2nd floors building b. Clean water plumbing drawing concept tutorial video c. Isometric drawing of clean water installation d. Clean water isometric drawing tutorial video e. Clean water system diagram f. Schematic drawing of clean water distribution g. The roof tank plan drawing and details 3. Drawing of dirty water (used) and sewage installations a. Examples of used water and dirty water installation plan drawing on the 1st and 2nd floors b. Used water and sewage installation drawing tutorial video c. Isometric drawing of used or dirty water installation d. Isometric drawing of used water, dirty water and vent tutorial video e. Used water, sewage and vent system diagrams 4. Mechanical and Electrical Drawing (ME) a. Electrical distribution schematic diagram b. Example of a 2nd floor lighting plan c. Example of lighting installation details d. Electrical installation simulation video e. Electrical installation plans drawing part 1 and part 2 tutorial video 5. Quiz. Utility building drawing 6. Contextual team assignment (Drawing the plumbing and ME plans)
Module 6. Sections Drawing	**Module 7. Advanced Sections Drawing**	**Module 8. Utility Building Drawing**
1. Drawing building sections. a. Example of floor plans drawing. (the Jambuluwuk Malioboro Yogyakarta hotel) b. Example of section drawing. (the Jambuluwuk Malioboro hotel Yogyakarta) c. Sections drawing principles	1. Advance sections drawing a. Foundation sections drawing b. Roof construction sections drawing 2. Foundation Concept a. Varieties of foundation b. Foundation lesson material download link c. Foundation drawing plans tutorial video d. Section drawing plans tutorial video	1. Drawing Plumbing System a. Examples of clean water installation drawings b. Examples of used water and sewage installation drawings 2. Clean water installation drawings

2. Section drawing concept 3. Drawing A-A section. 4. Drawing foundation section. a. Tutorial video of drawing foundation section. 5. Drawing building floor section. 6. Drawing of stairs section. a. Drawing stairs section tutorial video. 7. Drawing roof construction section. 8. Drawing objects in section drawings. a. Drawing objects in section drawings video 9. Giving notation to the section. a. Giving notation of elevation with dimension style and block editor. (tutorial video) b. Giving automated elevation notation with dimension style. (tutorial video) 10. Drawing B-B section. a. Drawing B-B section part 1. (tutorial video) b. Drawing B-B section part 2. (tutorial video) 11. Quiz. (drawing sections) 12. Contextual team assignment (drawing the group's project building sections)	e. Section's foundation drawing plans tutorial video f. Detailed sections drawing plans of foot-plate foundation tutorial video g. Detailed sections drawing plans of basic river stone foundation tutorial video 3. Quiz 1. Section's foundation drawing 4. Roof constructions a. Types of roofs b. Criteria for roofing materials and the angle. c. Roof construction drawing plan d. Roof construction drawing lesson material download link e. Tutorial video of roof construction drawing plan 5. Quiz 2. Roof construction section drawing. 6. Roof Truss Construction Concept a. Roof Truss Construction principles. b. Types of roof truss construction. c. Knock down truss types of roof constructions. d. Roof Truss Construction lesson material download link e. Drawing Roof Truss Construction tutorial video f. Drawing Roof Truss Construction plan tutorial video g. Drawing Detailed Roof Truss Construction tutorial video 7. Quiz 3. Roof truss construction drawing 8. Criteria of wooden roof truss construction 9. General concept of reinforced concrete a. Reinforced concrete lesson material download link b. Drawing details of columns, concrete slope, concrete floor plate, and beams tutorial video 10. Quiz 4. Reinforced concrete a. Example of a foundation drawing plan and details b. Example of roof drawing plan and details c. Samples of roof truss construction drawing plans and details d. Example of columns, concrete slope, concrete floor plate, and beams details drawing 11. Contextual team assignment a. drawing the group's project building roof construction b. Drawing columns, concrete slope, concrete floor plate, and beams plans c. Drawing detailed columns, concrete slope, concrete floor plate, and beams d. Drawing stairs plans and details	a. Examples of a clean water installation plan for 1st and 2nd floors building b. Clean water plumbing drawing concept tutorial video c. Isometric drawing of clean water installation d. Clean water isometric drawing tutorial video e. Clean water system diagram f. Schematic drawing of clean water distribution g. The roof tank plan drawing and details 3. Drawing of dirty water (used) and sewage installations a. Examples of used water and dirty water installation plan drawing on the 1st and 2nd floors b. Used water and sewage installation drawing tutorial video c. Isometric drawing of used or dirty water installation d. Isometric drawing of used water, dirty water and vent tutorial video e. Used water, sewage and vent system diagrams 4. Mechanical and Electrical Drawing (ME) a. Electrical distribution schematic diagram b. Example of a 2nd floor lighting plan c. Example of lighting installation details d. Electrical installation simulation video e. Electrical installation plans drawing part 1 and part 2 tutorial video 5. Quiz. Utility building drawing 6. Contextual team assignment (Drawing the plumbing and ME plans)
Module 9. Drawing Plot	**Module 10. Project Building Shop Drawing**	**Evaluation Module**
1. Printing the drawing a. Settings for drawing plot b. Page setup c. Printer/plotter d. Paper size, plot area e. Plot offset f. Number of copies g. Plot scale h. Plot style table i. Shaded viewport options j. Plot options k. Drawing orientation 2. Plotting/printing with page setup manager 3. The technique of drawing plot with model space and paper space 4. Plotting/printing the drawing tutorial video	1. List of Shop Drawing Projects a. Site plan drawing of intensity of space utilization (KDB, KLB, etc.) b. The site plan of the project location drawing c. Project floor plan drawing d. Project foundation plan drawing e. Project foundation detail drawing f. Project doors and windows plan drawing g. Detail of project doors and windows drawing h. Project roof construction plan drawing i. Project roof construction detail drawing j. Project view drawings k. Project concrete slope, columns, beams, floor slabs plans drawing l. Detail drawing of project concrete slope, columns, beams, floor slabs plans. m. Project stairs plans and details drawing n. Project sections drawings	1. Summative test a. Building regulations b. The concept of drawing the building shop drawing c. AutoCAD basic drawing commands for construction drawing d. Drawing applied objects on buildings e. Drawing floor plan and building view f. Sections drawing g. Advanced sections drawing h. Utility building drawing i. Drawing plot j. Drawing the building shop drawing by applying the building regulations

a. Plotting/printing the drawing with model space b. Plotting/printing the drawing with paper space/layout 5. Lesson material of plotting/printing the drawing download link 6. Quiz. Plotting/printing the drawing 7. Summary of plotting/printing the drawing	o. Project ceiling plan and ceiling details drawings p. Project plumbing construction plan drawing q. Project mechanical and electrical plan drawing 2. Project title bock 3. Project time schedule 4. Project shop drawings upload link 5. Regular class dan after class Zoom meeting 6. Project shop drawing consultation forum	2. Student Skill Assessment for Construction Drawing a. Professional construction drawing skills b. Collaborative skills

b. Lesson Plan

Lesson 1 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 1 **Schedule**: 1. Synchronous (Only for **pre-class 1**) Monday, Feb 15, 2021 **Time:** 10.50-12.50 Western Indonesia Time (WIB) UTC+07:00 2. Asynchronous Monday-Sunday, Feb 15-28, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 1 objective:** 1. Identify the building drawing projects 2. Plan the determined building construction project 3. Propose work time schedule 4. Identify the collaborative mindset to socialize with the team 5. Define the collaboration between peers is the best strategy to finish the project optimally	**Synchronous** 1. Greeting, motivating, and asking the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Introduction Module,** Pre-test topic (basic drawing), and join the embedded zoom link. (1') 4. Giving apperception and motivation. (10') a. Always do the best in every project for the best future. b. Collaborative mindset motivation, collaboration between peers is the best strategy to finish the project optimally. 5. Conduct Pre-test (basic drawing). (20') 6. Enter the **Introduction Module,** Challenges and examples topic 7. **Setting the challenging stage by giving examples and essential sustained questions. (1)** Challenging to design a building construction drawing with various difficulty levels and determine the Project. (15') 8. Evaluate the Pre-test, creating teamworks. (20') 9. Announcing the teamwork members list. Create determining teamwork group topic (1') 10. Giving direction to organize the teamwork. (5') 11. Creating Zoom Discussion Rooms for teamwork working. (7') 12. Open all the Zoom discussion room, monitoring the **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (30') 13. Moving to the Zoom mainroom. (10') a. Concluding the lesson together with the students and following up by giving assignment for the activity in the asynchronous pre-class 1. b. Giving lesson connection and guiding for the next meeting, (asynchronous pre-class and regular class 1). **Asynchronous** 1. Greeting, motivating, asking the student to prepare for learning, and informing about the learning activity by the Whatsapp SNS group. (at the beginning of the **Asynchronous** class) 2. Giving apperception and motivation. (by asynchronous e-learning) a. Always do the best in every project for the best future. b. Collaborative mindset motivation, collaboration between peers is the best strategy to finish the project optimally. 3. Enter the **Introduction Module,** Pre-test topic (monitoring the students in doing the pre-test of Student skill assessment for construction drawing) 4. Conduct and monitor the teamwork working in collecting information about the designing	**Synchronous** 1. Receiving the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Introduction Module,** Pre-test topic (basic drawing), and join the embedded zoom link. (1') 4. Hearing the lecture and understanding the collaborative mindset enthusiastically. (10') a. Motivated to do the best in every project for the best future. b. Following the collaborative mindset motivation, collaboration between peers is the best strategy to finish the project optimally. 5. Doing Pre-test (basic drawing). (20') 6. Enter the **Introduction Module,** Challenges and examples topic **7. Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project. (1)** (15') 8. Learning the challenging stage and examples by e-vocational platform. (20') 9. Hearing the announcement enthusiastically and learning to socialize with new teamwork. members. Open the determining teamwork group topic (1') 10. Hearing the teacher direction and identifying how to organized the teamwork. (5') 11. Preparing to join the teamwork discussion room for teamwork working. (7') 12. Enter the discussion room. Organize the teamwork to **actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** (30') 13. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in the asynchronous pre-class 1. b. Mastering the lesson connection for the next meeting, (asynchronous pre-class and regular class 1). **Asynchronous** 1. Receiving the teacher greetings, motivated and begin to prepare for learning, and identifying the informations about the learning activity by the Whatsapp SNS group. (at the beginning of the **Asynchronous** class) 2. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project for the best future. b. Practice to collaborate with peers to get the best strategy to finish the project optimally. 3. Enter the **Introduction Module,** Pre-test topic (**Doing the pre-test** of Student skill assessment for construction drawing) 4. Collecting information about the designing Project, including the project location, land

	Project, including the project location, land area, and the building regulations set at the area. (by Whatsapp SNS Group and information at the e-learning) 5. Monitor the determining of the best building construction project to design in a teamwork discussion. (by Whatsapp SNS Group and elearning) 6. Monitor Teamwork in giving each team a chance to find and get a client who needs to build the building project. (by Whatsapp SNS Group and elearning) 7. Monitor each teamwork member involves communicating with the client to get the land area measurement data and government regulations data for doing the project planning. (by Whatsapp SNS Group and elearning) 8. Negotiating the evaluating criteria of the Project in teamwork and lecturers. (by Whatsapp SNS Group and elearning forum) 9. Challenging to create the schedule and work on the Project. (by Whatsapp SNS Group and elearning forum) 10. Encouraging to creating the schedule and work on the Project. (by Whatsapp SNS Group and elearning)	area, and the building regulations set at the site. (based on each group discussion) 5. Determining the best building construction project to design in a teamwork discussion. (based each group appointment, by elearning forum and Whatsapp SNS Group) 6. Giving a chance to each team for finding and getting a client who needs to build the building project. (based on each group discussion) 7. Each teamwork member involves communicating with the client to get the land area measurement data and government regulations data for doing the project planning. (based on each group discussion) 8. Negotiating the evaluating criteria of the Project in teamwork and lecturers. (based each group appointment, by elearning forum and Whatsapp SNS Group) 9. Challenged to create the schedule and work on the Project 10. Creating the schedule and work on the Project. (based each group appointment, by elearning forum and Whatsapp SNS Group)
Regular-Class 1 Time: Monday, Feb 22, 2021 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous Methods: Lecture, demonstration, discussion Media: e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	1. Greeting, motivating, and asking the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the Modul 1 **Building Regulations** topic, and join the embedded zoom link. (1') 4. Giving apperception and motivation to prioritizing group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to create the schedule and work on the Project actively. (3)**. Planing the determined building construction project (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to create the schedule and work on the Project actively. (3)** Planing the determined building construction project (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation. (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together with the students and following up by giving assignment for the activity in after-class 1. b. Giving lesson connection and guiding for the next meeting (after-class 1).	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the Modul 1 **Building Regulations** topic, and join the embedded zoom link. (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to organize the teamwork and directed **to create the schedule and work on the Project actively (3)** in Planing the determined building construction project. (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create the schedule and work on the Project authentically. (3)** Planing the determined building construction project (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 1. b. Identifying the lesson connection for the next meeting, (after-class 1).
After-Class 1 Time: Monday, Feb 22, 2021 19.30-21.30 (120') Western Indonesia Time (WIB) UTC+07:00	1. Greeting, motivating, and asking the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the Modul 1 **Building Regulations** topic, and join the embedded zoom link. (1')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the Modul 1 **Building Regulations** topic, and join the embedded zoom link. (1')

Synchronous Methods: Lecture, demonstration, discussion Media: e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	4. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 5. Guiding the students in **presenting the Project to collect critique and revision. (6)** (13'x7=91') Monitor the student in learning to socialize and interact with people in a presentation forum Monitor the student in collecting critique and revision 6. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 7. Giving connection and guiding for the next pre-class 2. (7')	4. Hearing the apperception and motivation of prioritizing team choices for the best achievement. (10') 5. **Presenting the Project to collect critique and revision. (6)** (13'x7=91') Learning to socialize and interact with people in a presentation forum Collecting critique and revision 6. Doing **reflection and evaluation as the criteria planned. (7)** (10') 7. Identifying the connection between the present lesson with the next lesson in pre-class 2. (7')

Lesson Plan 2 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 2 **Schedule:** Thursday-Sunday, Feb 25-28, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 2 objective:** 1. Planing the space utilization intensity 2. Drawing site Plan space utilization intensity 3. Practice the collaborative mindset to socialize with the team 4. Illustrate the collaboration between peers is the best strategy to finish the project optimally	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the Modul 1 **Building Regulations** topic. 4. Giving apperception and motivation. (by asynchronous e-learning) a. Always do the best in every project for the best future. b. Collaborative mindset motivation, collaboration between peers is the best strategy to finish the project optimally. 5. **Setting the challenging stage by giving examples and essential sustained questions. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, Building Regulations Topic. (by asynchronous e-learning) 7. Monitoring and assessing the student (by asynchronous e-learning) a. Bonus Stage assignment b. Group Project c. Answer the open-ended and multiple-choice quiz questions d. Contextual team assignment. Drawing Site Plan Space Utilization Intensity 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Correcting the individual student assignments (from the e-learning) 11. Supervising student teamwork project assignments (by forum discussions of the e-learning)	1. Greets the teacher and friends, motivated, preparing to learn, and receiving the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the Modul 1 **Building Regulations** topic. 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project for the best future. b. Practice to collaborate with peers to get the best strategy to finish the project optimally.. 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project. (1)** 6. Learning the **building regulation** topic. a. Government Regulation of the Republic of Indonesia Number 36 of 2005 concerning Implementation Regulations of Law Number 28 of 2002 concerning Buildings b. Learning National Territory Spatial Planning/ Rencana Tata Ruang Wilayah Nasional (RTRW) c. Basic Building Coefficient/ Koefisien Dasar Bangunan (KDB), d. Building Floor Coefficient/ Koefisien Lantai Bangunan (KLB), e. Basement Tread Coefficient/ Koefisien Tapak Basement (KTB), f. Green Base Coefficient/ Koefisien Dasar Hijau (KDH), g. Building permit h. Building Boundaries i. River Border Line j. Detailed Urban Spatial Planning /Rencana Detail Tata Ruang Kawasan Perkotaan (RDTRK) k. Building and Environmental Planning/ Rencana Tata Bangunan dan Lingkungan (RTBL) l. Learning Database Planning and Space Utilization, link available 7. Doing assessment a. Bonus Stage assignment b. Doing Group Project (Calculation of Space Utilization Intensity)

		c. Answer the Open-ended and multiple-choice quiz questions d. Doing Contextual team assignment. Drawing Site Plan Space Utilization Intensity. 8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the project 10. Continue learning 11. Project supervision (by forum discussions of the e-learning)
Regular-Class 2 Time: Monday, March 1, 2021 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous Methods: Lecture, demonstration, teamwork working, discussion Media: e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	1. Greeting, motivating, and asking the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the Modul 1 **Building Regulations** topic, and join the embedded zoom link. (1') 4. Giving apperception and motivation to prioritizing group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively create**/update **the schedule and work on the Project actively** (Lesson) **(3)** in applying the building regulation to the determined building construction project, calculating the Space Utilization Intensity, and drawing the Project Site Plan with intensity of space utilization. (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create the schedule and work on the Project authentically** (Application) **(3)** in applying the building regulation to the determined building construction project, calculating the Space Utilization Intensity, and drawing the Project Site Plan with Intensity of Space Utilization (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (advancing the first presentation at after-class 2). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together with the students and following up by giving assignment for the activity in after-class 2. b. Giving lesson connection and guiding for the next meeting (after-class 2)	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the Modul 1 **Building Regulations** topic, and join the embedded zoom link. (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to organize the teamwork and directed **to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the building regulation to the determined building construction project, calculating the Space Utilization Intensity, and drawing the Project Site Plan with intensity of space utilization. (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create the schedule and work on the Project authentically** (Application) **(3)** in applying the building regulation to the determined building construction project, calculating the Space Utilization Intensity, and drawing the Project Site Plan with Intensity of Space Utilization (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (advancing the first presentation at after-class 2) (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 2. b. Mastering the lesson connection for the next meeting, (after-class 2).
After-Class 2 Time: Monday, March 1, 2021 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous Methods: Lecture, demonstration, teamwork working discussion Media: e-vocational blended learning	1. Greeting, motivating, and asking the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the module 1 **Building Regulations** topic, and join the embedded zoom link. (1') 4. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 5. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the building regulation, calculating the Space Utilization Intensity. (13'x7=91')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the module 1 **Building Regulations** topic, and join the embedded zoom link. (1') 4. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 5. **Presenting the Project to collect critique and revision (6)** in applying the building regulation, calculating the Space Utilization Intensity (13'x7=91')

platform-WordPress-Efront-Zoom Meeting	Monitor the student in learning to socialize and interact with people in a presentation forum Monitor the student in collecting critique and revision 6. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 7. Giving connection and guiding for the next pre-class 3. (7')	Learning to socialize and interact with people in a presentation forum Collecting critique and revision 6. Doing **reflection and evaluation as the criteria planned. (7)** (10') 7. Identifying the connection between the present lesson with the next lesson in pre-class 3. (7')

Lesson Plan 3 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 3 **Schedule:** Tuesday-Sunday, March 2-7, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 3-4 objective:** 1. Identify the concept of drawing the building shop drawing 2. Practice the concept of building shop drawing to design the floor plan (including doors and windows) 3. Illustrate the coordinate system 4. Practice the CAD drawing commands 5. Drawing the floor plan 6. Drawing doors and windows plan 7. Apply the collaborative mindset to socialize with the team on designing the floor plan	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **module 2 The Concept of Drawing the Building Shop Drawing** topic. 4. Giving apperception and motivation. (by asynchronous e-learning) a. Encourage to do the best in every project. b. Motivate to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Notify about the completeness of the previous lesson mastery learning. d. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (updating the project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, **module 2,** the Concept of Drawing the Building Shop Drawing. (by asynchronous e-learning) 7. Monitoring and assessing the student (by asynchronous e-learning) a. Individual Quiz, creating a quiz via google form as a task for deepening the shop drawing concept lesson material b. Contextual team assignment Designing the floor plan (including doors and windows) 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment, designing the floor plan (by forum discussions of the e-learning and Whatsapp SNS group)	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **module 2 The Concept of Drawing the Building Shop Drawing** topic. 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team to get the best strategy to finish the project optimally. c. Confirm the completeness of the previous lesson mastery learning d. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (updating the project)**. (1)** 6. Learning the **module 2,** the Concept of Drawing the Building Shop Drawing. (by asynchronous e-learning). a. Architectural drawing b. Designing the floor plan drawing c. Designing the building view drawing d. The concept of drawing non-Structural elements. e. Drawing exterior elements 7. Doing assessment a. Individual Quiz, creating a quiz via google form as a task for deepening the shop drawing concept lesson material b. Contextual team assignment, designing the floor plan (including doors and windows) 8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning)
Regular-Class 3 Time: Monday, March 8, 2021 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous Methods: Lecture, demonstration, discussion Media: e-vocational blended learning	1. Greeting, motivating, and asking the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **module 2 The Concept of Drawing the Building Shop Drawing** topic, and join the embedded zoom link. (1') 4. Giving apperception and motivation to prioritizing group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively**	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **module 2 The Concept of Drawing the Building Shop Drawing** topic, and join the embedded zoom link. (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to organize the teamwork and directed **to actively**

platform-Wordpress-Efront-Zoom Meeting	**create**/update **the schedule and work on the Project actively** (Lesson) **(3)** in applying the The Concept of Drawing the Building Shop Drawing to design building construction project on floor plan drawing. (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the The Concept of Drawing the Building Shop Drawing to design building construction project on floor plan drawing. (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (the 2nd preliminary presentation at after-class 2). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson with the students and following up by giving assignment for the activity in after-class 3. b. Giving lesson connection and guiding for the next meeting (after-class 3)	**create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the The Concept of Drawing the Building Shop Drawing to design building construction project on floor plan drawing. (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the The Concept of Drawing the Building Shop Drawing to design building construction project on floor plan drawing. (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (the 2nd preliminary presentation at after-class 2) (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 3. b. Mastering the lesson connection for the next meeting, (after-class 3).
After-Class 3 Time: Monday, March 8, 2021 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous Methods: Lecture, demonstration, discussion Media: e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	1. Greeting, motivating, and asking the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **module 2 The Concept of Drawing the Building Shop Drawing** topic, and join the embedded zoom link. (1') 4. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 5. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the The Concept of Drawing the Building Shop Drawing to design building construction project on floor plan drawing. (13'x7=91') Monitor the student in learning to socialize and interact with people in a presentation forum Monitor the student in collecting critique and revision 6. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 7. Giving connection and guiding for the next pre-class 4. (7')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **module 2 The Concept of Drawing the Building Shop Drawing** topic, and join the embedded zoom link. (1') 4. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 5. **Presenting the Project to collect critique and revision (6)** in applying the The Concept of Drawing the Building Shop Drawing to design building construction project on floor plan drawing. (13'x7=91') Learning to socialize and interact with people in a presentation forum Collecting critique and revision 6. Doing **reflection and evaluation as the criteria planned. (7)** (10') 7. Identifying the connection between the present lesson with the next lesson in pre-class 4. (7')

Lesson Plan 4 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 4 **Schedule:** Tuesday-Sunday, March 9-14, 2021 **Time:** free (minimum learning time of 2 x 60 minutes)	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **module 2 The Concept of Drawing the Building Shop Drawing** part 2 and **module 3 Managing CAD Drawing Commands for Construction Drawing.** The coordinate system for construction	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **module 2 The Concept of Drawing the Building Shop Drawing** part 2 and **Module 3 Managing CAD Drawing Commands for Construction Drawing.** The coordinate system for construction

Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 3-4 objective:** 1. Identify the concept of drawing the building shop drawing 2. Practice the concept of building shop drawing to design the floor plan (including doors and windows) 3. Illustrate the coordinate system 4. Practice the CAD drawing commands 5. Drawing the floor plan 6. Drawing doors and windows plan 7. Apply the collaborative mindset to socialize with the team on designing the floor plan	drawing, drawing operations, CAD Basic Drawing Commands. 4. Giving apperception and motivation. (by asynchronous e-learning) a. Encourage to do the best in every project. b. Motivate to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Notify about the completeness of the previous lesson mastery learning. d. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (updating the project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, **Module 2,** the Concept of Drawing the Building Shop Drawing part 2 and **Module 3 Managing CAD Drawing Commands for Construction Drawing.** The coordinate system for construction drawing, drawing operations, CAD Basic Drawing Commands. (by asynchronous e-learning) 7. Monitoring and assessing the student (by asynchronous e-learning) a. Quiz CAD Basic Drawing Commands b. Drawing door/window frame with the coordinate system c. Drawing the floor plan (including doors and windows) d. Drawing the group's project location site plan 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment, designing the floor plan (by forum discussions of the e-learning and Whatsapp SNS group)	drawing, drawing operations, CAD Basic Drawing Commands. 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team to get the best strategy to finish the project optimally. c. Confirm the completeness of the previous lesson mastery learning d. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (updating the project)**. (1)** 6. Learning the **Module 2,** the Concept of Drawing the Building Shop Drawing Part 2 and **Module 3 Managing CAD Drawing Commands for Construction Drawing.** The coordinate system for construction drawing, drawing operations, CAD Basic Drawing Commands. (by asynchronous e-learning). a. Drawing exterior elements b. Structure drawings c. The coordinate system for construction drawing d. Drawing operations e. CAD Basic Drawing Commands f. Modify the drawing 7. Doing assessment a. Quiz CAD Basic Drawing Commands b. Drawing door/window frame with the coordinate system c. Drawing the floor plan (including doors and windows) d. Drawing the group's project location site plan 8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning)
Regular-Class 4 **Schedule:** Monday, March 15, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **module** 4. **e 2 The Concept of Drawing the Building Shop Drawing** part 2 and **module 3 Managing CAD Drawing Commands for Construction Drawing.** The coordinate system for construction drawing, drawing operations, CAD Basic Drawing Commands. (1') 5. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10') 6. Giving direction to organize the teamwork and directing **the student to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the Concept of Drawing the Building Shop Drawing and **Managing CAD Drawing Commands for Construction Drawing** to design building construction project on floor plan drawing including doors and windows. (20')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **module 2 The Concept of Drawing the Building Shop Drawing** part 2 and **module 3 Managing CAD Drawing Commands for Construction Drawing.** The coordinate system for construction drawing, drawing operations, CAD Basic Drawing Commands. (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to manage the teamwork and directed **to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the Concept of Drawing the Building Shop Drawing and **Managing CAD Drawing Commands for Construction Drawing** to design building construction project on floor plan drawing including doors and windows. (20')

	7. Creating Zoom Discussion Rooms for teamwork working. (5') **8.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the The Concept of Drawing the Building Shop Drawing and **Managing CAD Drawing Commands for Construction Drawing** to design building construction project on floor plan drawing including doors and windows. (30') **9. Monitoring the student activity and the progress of the Project. (4)** (10') **10.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **11.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (advancing the 2nd preliminary presentation at after-class 3). (5') 12. Moving to the Zoom mainroom. (10') a. Concluding the lesson together with the students and following up by giving assignment for the activity in after-class 4. b. Giving lesson connection and guiding for the next meeting (after-class 4)	6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the The Concept of Drawing the Building Shop Drawing and **Managing CAD Drawing Commands for Construction Drawing** to design building construction project on floor plan drawing including doors and windows. (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (advancing the 2nd preliminary presentation at after-class 3) (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 4. b. Mastering the lesson connection for the next meeting, (after-class 4).
After-Class 4 **Schedule:** Monday, March 15, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **module 2 The Concept of Drawing the Building Shop Drawing** part 2 and **Module 3 Managing CAD Drawing Commands for Construction Drawing.** 4. Join the embedded zoom link. (1') 5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the The Concept of Drawing the Building Shop Drawing and **Managing CAD Drawing Commands for Construction Drawing** to design building construction project on floor plan drawing including doors and windows. (13'x7=91') Monitor the student in learning to socialize and interact with people in a presentation forum Monitor the student in collecting critique and revision 7. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 8. Giving connection and guiding for the next pre-class 5. (7')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **module 2 The Concept of Drawing the Building Shop Drawing** part 2 and **Module 3 Managing CAD Drawing Commands for Construction Drawing.** 4. Join the embedded zoom link. (1') 5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 6. **Presenting the Project to collect critique and revision (6)** in applying the The Concept of Drawing the Building Shop Drawing and **Managing CAD Drawing Commands for Construction Drawing** to design building construction project on floor plan drawing including doors and windows. (13'x7=91') Learning to socialize and interact with people in a presentation forum Collecting critique and revision 7. Doing **reflection and evaluation as the criteria planned. (7)** (10') 8. Identifying the connection between the present lesson with the next lesson in pre-class 5. (7')

Lesson Plan 5 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 5 **Schedule:** Tuesday-Sunday, March 16-21, 2021 **Time:** free (minimum learning time of 2 x 60 minutes)	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings**.	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings**.

Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 5-6 objective:** 1. Practice the concept of building shop drawing to design doors and windows details 2. Practice the concept of building shop drawing to design foundation plan 3. Drawing doors and windows details 4. Drawing the foundation plan 5. Apply the collaborative mindset to socialize with the team on drawing the doors and windows details (including foundation plan)	4. Giving apperception and motivation. (by asynchronous e-learning) a. Encourage to do the best in every project. b. Motivate to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Explain the ten collaborative indicators to build a good teamwork achievement. d. Notify about the completeness of the previous lesson mastery learning. e. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (update the determined project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings.** (by asynchronous e-learning) 7. Monitoring and assessing the student assignment (by asynchronous e-learning) a. Drawing door frame with block editor technique (individual assignment) b. Drawing a 2-storey residential house plan with the block editor technique (individual assignment) c. Drawing doors and windows details (teamwork) d. Drawing the group's project foundation plans (teamwork) 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment, designing the floor plan (by forum discussions of the e-learning and Whatsapp SNS group)	4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team to get the best strategy to finish the project optimally. c. Identify the ten collaborative indicator to build a good teamwork achievement d. Confirm the completeness of the previous lesson mastery learning e. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (update the determined project)**. (1)** 6. Learning the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings.** (by asynchronous e-learning). a. CAD Basic Drawing Commands b. Drawing applied objects and building elements c. Dimension Style in AutoCAD d. AutoCAD initial setup e. Layers operations f. Block editor technique g. Drawing door frame with block editor technique h. Drawing a 2-storey residential house plan with the block editor technique 7. Doing assessment a. Drawing door frame with block editor technique (individual assignment) b. Drawing a 2-storey residential house plan with the block editor technique (individual assignment) c. Drawing doors and windows details (teamwork) d. Drawing the group's project foundation plans and details (teamwork) 8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning)
Regular-Class 5 **Schedule:** Monday, March 22, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings**. (1') 4. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on drawing doors and windows details also foundation plan. (20')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings**. (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to manage the teamwork and directed **to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on drawing doors and windows details also foundation plan. (20')

	6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on drawing doors and windows details also foundation plan. (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (3rd preliminary presentation at after-class 5). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding of the lesson together with the students and following up by giving assignment for the activity in after-class 5. b. Giving lesson connection and guiding for the next meeting (after-class 5)	6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on drawing doors and windows details also foundation plan. (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (3rd preliminary presentation at after-class 5) (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 5. b. Mastering the lesson connection for the next meeting, (after-class 5).
After-Class 5 **Schedule:** Monday, March 22, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings.** 4. Join the embedded zoom link. (1') 5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the Concept of the Building Shop, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on drawing doors and windows details also foundation plan. (13'x7=91') Monitor the student in learning to socialize and interact with teams in a presentation forum Monitor the student in collecting critique and revision 7. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 8. Giving connection and guiding for the next pre-class 6. (7')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings..** 4. Join the embedded zoom link. (1') 5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 6. **Presenting the Project to collect critique and revision (6)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on drawing doors and windows details also foundation plan. (13'x7=91') Learning to socialize and interact with teams in a presentation forum Collecting critique and revision 7. Doing **reflection and evaluation as the criteria planned. (7)** (10') 8. Identifying the connection between the present lesson with the next lesson in pre-class 6. (7')

Lesson Plan 6 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 6 **Schedule:** Tuesday-Sunday, March 23-28, 2021	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform.	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform.

Time: free (minimum learning time of 2 x 60 minutes) Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 5-6 objective:** 1. Practice the concept of building shop drawing to design doors and windows details 2. Practice the concept of building shop drawing to design foundation plan 3. Drawing doors and windows details 4. Drawing the foundation plan 5. Apply the collaborative mindset to socialize with the team on drawing the doors and windows details (including foundation plan)	3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 2. (advance) 4. Giving apperception and motivation. (by asynchronous e-learning) a. Encourage to do the best in every project. b. Motivate to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Explain the ten collaborative indicators to build a good teamwork achievement. d. Notify about the completeness of the previous lesson mastery learning. e. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (update the determined project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings.** (by asynchronous e-learning) 7. Monitoring and assessing the student assignment (by asynchronous e-learning) a. Drawing door frame with block editor technique (individual assignment) b. Drawing a 2-storey residential house plan with the block editor technique (individual assignment) c. Drawing doors and windows details (teamwork) d. Drawing the group's project foundation plans (teamwork) 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment, designing the floor plan (by forum discussions of the e-learning and Whatsapp SNS group)	3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 2. (advance) 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team to get the best strategy to finish the project optimally. c. Identify the ten collaborative indicator to build a good teamwork achievement d. Confirm the completeness of the previous lesson mastery learning e. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (update the determined project)**. (1)** 6. Learning the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings.** (by asynchronous e-learning). a. CAD Basic Drawing Commands b. Drawing applied objects and building elements c. Dimension Style in AutoCAD d. AutoCAD initial setup e. Layers operations f. Block editor technique g. Drawing door frame with block editor technique h. Drawing a 2-storey residential house plan with the block editor technique i. Drawing Building Structural Elements j. Drawing foundation plans and details 7. Doing assessment a. Drawing door frame with block editor technique (individual assignment) b. Drawing a 2-storey residential house plan with the block editor technique (individual assignment) c. Drawing doors and windows details (teamwork) d. Drawing the group's project foundation plans and details (teamwork) 8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning)
Regular-Class 6 **Schedule:** Monday, March 29, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 2. (Advance) (1') 4. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the Concept of the Building Shop	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 2. (Advance) (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to manage the teamwork and directed **to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the Concept of the Building Shop

	Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on drawing doors and windows details also foundation plan. (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on drawing doors and windows details also foundation plan. (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (3rd presentation at after-class 6). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding of the lesson together with the students and following up by giving assignment for the activity in after-class 6. b. Giving lesson connection and guiding for the next meeting (after-class 6)	Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on drawing doors and windows details also foundation plan. (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on drawing doors and windows details also foundation plan. (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (3rd presentation at after-class 6) (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 6. b. Mastering the lesson connection for the next meeting, (after-class 6).
After-Class 6 **Schedule:** Monday, March 29, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 2. (advance) 4. Join the embedded zoom link. (1') 5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on drawing doors and windows details also foundation plan. (13'x7=91') Monitor the student in learning to socialize and interact with teams in a presentation forum Monitor the student in collecting critique and revision 7. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 8. Giving connection and guiding for the next pre-class 7. (7')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 2. (advance). 4. Join the embedded zoom link. (1') 5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 6. **Presenting the Project to collect critique and revision (6)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on drawing doors and windows details also foundation plan. (13'x7=91') Learning to socialize and interact with teams in a presentation forum Collecting critique and revision 7. Doing **reflection and evaluation as the criteria planned. (7)** (10') 8. Identifying the connection between the present lesson with the next lesson in pre-class 7. (7')

Lesson Plan 7 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 7 **Schedule:** Tuesday-Sunday, March 30 - April 4, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 7-8 objective:** 1. Apply the concept of building shop drawing to design foundation details 2. Apply the concept of building shop drawing to design roof construction plan 3. Manage the CAD drawing commands 4. Drawing foundation details 5. Drawing the roof construction plan 6. Apply the collaborative mindset to organize the team on the foundation details and the roof construction plan	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing, Module 4. Drawing Applied Objects on Buildings** part 3. 4. Giving apperception and motivation. (by asynchronous e-learning) a. Motivate to do the best in every project. b. Encourage to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Explain the ten collaborative indicators to build a good teamwork achievement. d. Notify about the completeness of the previous lesson mastery learning. e. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (update the determined project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3**.** (by asynchronous e-learning) 7. Monitoring and assessing the student assignment (by asynchronous e-learning) a. Drawing the group's project foundation details (teamwork) b. Drawing the group's project roof construction plans (teamwork) 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment, designing the floor plan (by forum discussions of the e-learning and Whatsapp SNS group) a. Drawing the group's project foundation details (teamwork) b. Drawing the group's project roof construction plans (teamwork)	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3. 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team to get the best strategy to finish the project optimally. c. Identify the ten collaborative indicator to build a good teamwork achievement d. Confirm the completeness of the previous lesson mastery learning e. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (update the determined project)**. (1)** 6. Learning the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3**.** (by asynchronous e-learning). a. CAD Drawing Commands b. Drawing applied objects and building elements c. Dimension Style in AutoCAD d. AutoCAD initial setup e. Layers operations f. Block editor technique g. Drawing door frame with block editor technique h. Drawing a 2-storey residential house plan with the block editor technique i. Drawing Building Structural Elements j. Drawing foundation plans and details k. Drawing roof plans and details 7. Doing assessment a. Drawing the group's project foundation details (teamwork) b. Drawing the group's project roof construction plans (teamwork) 8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning)
Regular-Class 7 **Schedule:** Monday, April 5, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3. (1')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3. (1')

Methods: Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	4. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on foundation details and roof construction plans. (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on foundation details and roof construction plans. (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (4th preliminary presentation at after-class 7). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and following up by giving assignment for the activity in after-class 7. b. Giving lesson connection and guiding for the next meeting (after-class 7)	4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to manage the teamwork and directed **to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on foundation details and roof construction plans. (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on foundation details and roof construction plans. (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (4th preliminary presentation at after-class 7). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 7. b. Mastering the lesson connection for the next meeting, (after-class 7).
After-Class 7 **Schedule:** Monday, April 5, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3. 4. Join the embedded zoom link. (1') 5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on foundation details and roof construction plans. (13'x7=91') Monitor the student in learning to socialize and interact with teams in a presentation forum Monitor the student in collecting critique and revision 7. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 8. Giving connection and guiding for the next pre-class 8. (7')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3. 4. Join the embedded zoom link. (1') 5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 6. **Presenting the Project to collect critique and revision (6)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on foundation details and roof construction plans. (13'x7=91') Learning to socialize and interact with teams in a presentation forum Collecting critique and revision 7. Doing **reflection and evaluation as the criteria planned. (7)** (10') 8. Identifying the connection between the present lesson with the next lesson in pre-class 8. (7')

Lesson Plan 8 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 8 **Schedule:** Tuesday-Sunday, April 6-11, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 7-8 objective:** 1. Apply the concept of building shop drawing to design foundation details 2. Apply the concept of building shop drawing to design roof construction plan 3. Manage the CAD drawing commands 4. Drawing foundation details 5. Drawing the roof construction plan 6. Apply the collaborative mindset to organize the team on the foundation details and the roof construction plan	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing, Module 4. Drawing Applied Objects on Buildings** part 3. (advance) 4. Giving apperception and motivation. (by asynchronous e-learning) a. Motivate to do the best in every project. b. Encourage to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Explain the ten collaborative indicators to build a good teamwork achievement. d. Notify about the completeness of the previous lesson mastery learning. e. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (update the determined project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3**.** (by asynchronous e-learning) 7. Monitoring and assessing the student assignment (by asynchronous e-learning) a. Drawing the group's project foundation details (teamwork) b. Drawing the group's project roof construction plans (teamwork) 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment, designing the floor plan (by forum discussions of the e-learning and Whatsapp SNS group) a. Drawing the group's project foundation details (teamwork) b. Drawing the group's project roof construction plans (teamwork)	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3. (advance) 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team to get the best strategy to finish the project optimally. c. Identify the ten collaborative indicator to build a good teamwork achievement d. Confirm the completeness of the previous lesson mastery learning e. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (update the determined project)**. (1)** 6. Learning the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3**.** (by asynchronous e-learning). a. CAD Drawing Commands b. Drawing applied objects and building elements c. Dimension Style in AutoCAD d. AutoCAD initial setup e. Layers operations f. Block editor technique g. Drawing door frame with block editor technique h. Drawing a 2-storey residential house plan with the block editor technique i. Drawing Building Structural Elements j. Drawing foundation plans and details k. Drawing roof plans and details 7. Doing assessment a. Drawing the group's project foundation details (teamwork) b. Drawing the group's project roof construction plans (teamwork) 8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning)
Regular-Class 8 **Schedule:** Monday, April 12, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3. (advance) (1') 4. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3. (advance) (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10')

Media: e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	5. Giving direction to organize the teamwork and directing **the student to actively create/**update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on foundation details and roof construction plans. (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on foundation details and roof construction plans. (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (4th presentation at after-class 8). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding of the lesson together with the students and following up by giving assignment for the activity in after-class 8. b. Giving lesson connection and guiding for the next meeting (after-class 8)	5. Hearing the teacher direction to manage the teamwork and directed **to actively create/**update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on foundation details and roof construction plans. (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on foundation details and roof construction plans. (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (4th presentation at after-class 8). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 8. b. Mastering the lesson connection for the next meeting, (after-class 8).
After-Class 8 **Schedule:** Monday, April 12, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3. (advance) 4. Join the embedded zoom link. (1') 5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on foundation details and roof construction plans. (13'x7=91') 7. Monitor the student in organizing the team, socializing, and interacting with teams in the presentation forum 8. Monitor the student in collecting critique and revision 9. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 10. Giving connection and guiding for the next pre-class 9. (7')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 3 Managing CAD Drawing Commands for Construction Drawing and Module 4. Drawing Applied Objects on Buildings** part 3. (advance) 4. Join the embedded zoom link. (1') 5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 6. **Presenting the Project to collect critique and revision (6)** in applying the Concept of the Building Shop Drawing, **Managing CAD Drawing Commands for Construction Drawing, and Drawing Applied Objects on Buildings** to design and draw the building construction project on foundation details and roof construction plans. (13'x7=91') 7. Organizing the team, socializing, and interacting with teams in the presentation forum 8. Collecting critique and revision 9. Doing **reflection and evaluation as the criteria planned. (7)** (10') 10. Identifying the connection between the present lesson with the next lesson in pre-class 9. (7')

Lesson Plan 9 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 9 **Schedule:** Tuesday-Sunday, April 13-18, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 9-10 objective:** 1. Apply the concept of building shop drawing to design building view drawing 2. Apply the concept of building shop drawing to design building sections. 3. Drawing building view 4. Drawing the building sections 5. Apply the collaborative mindset to organize the team on drawing the building views and building sections	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** 4. Giving apperception and motivation. (by asynchronous e-learning) a. Motivate to do the best in every project. b. Encourage to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Explain the ten collaborative indicators to build a good teamwork achievement. d. Notify about the completeness of the previous lesson mastery learning. e. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (update the determined project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing..** (by asynchronous e-learning) 7. Monitoring and assessing the student assignment (by asynchronous e-learning) a. Quiz (building view drawing) b. Drawing building views (teamwork) c. Drawing the group's project building sections 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment (by forum discussions of the e-learning and Whatsapp SNS group) a. Drawing the group's building views project (teamwork) b. Drawing the group's project building sections (teamwork)	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team to get the best strategy to finish the project optimally. c. Identify the ten collaborative indicator to build a good teamwork achievement d. Confirm the completeness of the previous lesson mastery learning e. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (update the determined project)**. (1)** 6. Learning the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (by asynchronous e-learning). a. Drawing applied objects and building elements b. Drawing Building Structural Elements c. Drawing foundation plans and details d. Drawing roof plans and details e. drawing floor plans f. Drawing walls and roofs g. Building view drawing, (front, side, and back) h. Drawing building sections i. Sections drawing principles j. Drawing A-A section 7. Doing assessment a. Quiz (building view drawing) b. Drawing building views (teamwork) a. Drawing the group's project building sections (teamwork) 8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning)
Regular-Class 9 **Schedule:** Monday, April 19, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (1')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (1')

Media: e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	4. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively create/**update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design and draw the building construction project on building view dan building sections drawing. (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design and draw the building construction project on building view dan building sections drawing. (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (5th preliminary presentation at after-class 9). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding of the lesson together with the students and following up by giving assignment for the activity in after-class 9. b. Giving lesson connection and guiding for the next meeting (after-class 9)	4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to manage the teamwork and directed **to actively create/**update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design and draw the building construction project on building view dan building sections drawing. (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design and draw the building construction project on building view dan building sections drawing. (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (5th preliminary presentation at after-class 9). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 9. b. Mastering the lesson connection for the next meeting, (after-class 9).
After-Class 9 **Schedule:** Monday, April 19, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** 4. Join the embedded zoom link. (1') 5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design and draw the building construction project on building view dan building sections drawing. (13'x7=91') 7. Monitor the student in organizing the team, socializing, and interacting with teams in the presentation forum	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** 4. Join the embedded zoom link. (1') 5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 6. **Presenting the Project to collect critique and revision (6)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design and draw the building construction project on building view dan building sections drawing. (13'x7=91') 7. Organizing the team, socializing, and interacting with teams in the presentation forum 8. Collecting critique and revision

	8. Monitor the student in collecting critique and revision 9. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 10. Giving connection and guiding for the next pre-class 10. (7')	9. Doing **reflection and evaluation as the criteria planned. (7)** (10') 10. Identifying the connection between the present lesson with the next lesson in pre-class 10. (7')

Lesson Plan 10 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 10 **Schedule:** Tuesday-Sunday, April 20-25, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 9-10 objective:** 1. Apply the concept of building shop drawing to design building view drawing 2. Apply the concept of building shop drawing to design building sections. 3. Manage the coordinate system 4. Manage the CAD drawing commands 5. Drawing building view 6. Drawing the building sections 7. Apply the collaborative mindset to organize the team on drawing the building views and building sections	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** 4. Giving apperception and motivation. (by asynchronous e-learning) a. Motivate to do the best in every project. b. Encourage to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Explain the ten collaborative indicators to build a good teamwork achievement. d. Notify about the completeness of the previous lesson mastery learning. e. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (update the determined project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing..** (by asynchronous e-learning) 7. Monitoring and assessing the student assignment (by asynchronous e-learning) a. Drawing building views (teamwork) b. Drawing the group's project building sections 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment (by forum discussions of the e-learning and Whatsapp SNS group) a. Drawing the group's building views project (teamwork) b. Drawing the group's project building sections (teamwork)	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team optimally. c. Identify the ten collaborative indicator to build a good teamwork achievement d. Confirm the completeness of the previous lesson mastery learning e. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (update the determined project)**. (1)** 6. Learning the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (by asynchronous e-learning). a. Drawing applied objects and building elements b. Drawing Building Structural Elements c. Drawing foundation plans and details d. Drawing roof plans and details e. drawing floor plans, walls and roofs f. Building view drawing, (front, side, and back) g. Drawing building sections h. Sections drawing principles i. Drawing A-A, B-B, C-C sections j. Drawing foundation section k. Drawing building floor section l. Drawing stairs section. m. Drawing roof construction section n. Drawing objects in section o. Giving notation to the section. p. Advance sections drawing q. Drawing Roof constructions r. Drawing Roof truss constructions s. General concept of reinforced concrete t. Drawing details of columns, concrete slope, concrete floor plate, and beams 7. Doing assessment a. Drawing building views (teamwork) b. Drawing the group's project building sections

		8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning)
Regular-Class 10 **Schedule:** Monday, April 26, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (1') 4. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design and draw the building construction project on building view dan building sections drawing. (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design and draw the building construction on building view dan building sections drawing. (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (5th presentation at after-class 10). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding of the lesson with the students and following up by giving assignment for the activity in after-class 10. b. Giving lesson connection and guiding for the next meeting (after-class 10)	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to manage the teamwork and directed **to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design and draw the building construction project on building view dan building sections drawing. (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design and draw the building construction project on building view dan building sections drawing. (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (5th presentation at after-class 10). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 10. b. Mastering the lesson connection for the next meeting, (after-class 10).
After-Class 10 **Schedule:** Monday, April 26, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (advance) 4. Join the embedded zoom link. (1') 5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (advance) 4. Join the embedded zoom link. (1') 5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10')

platform-WordPress-Efront-Zoom Meeting	6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design and draw the building construction project on building view dan building sections drawing. (13'x7=91') 7. Monitor the student in organizing the team, socializing, and interacting with teams in the presentation forum 8. Monitor the student in collecting critique and revision 9. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 10. Giving connection and guiding for the next pre-class 11. (7')	6. **Presenting the Project to collect critique and revision (6)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design and draw the building construction project on building view dan building sections drawing. (13'x7=91') 7. Organizing the team, socializing, and interacting with teams in the presentation forum 8. Collecting critique and revision 9. Doing **reflection and evaluation as the criteria planned. (7)** (10') 10. Identifying the connection between the present lesson with the next lesson in pre-class 11. (7')

Lesson Plan 11 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 11 **Schedule:** Tuesday-Sunday, April 27 – May 2, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 11-13 objective:** 1. Manage the concept of building shop drawing to design building roof construction details drawing 2. Manage the concept of building shop drawing to design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams) 3. Drawing building roof construction details drawing 4. Drawing the stairs plans	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** 4. Giving apperception and motivation. (by asynchronous e-learning) a. Motivate to do the best in every project. b. Encourage to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Explain the ten collaborative indicators to build a good teamwork achievement. d. Notify about the completeness of the previous lesson mastery learning. e. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (update the determined project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams)**.** (by asynchronous e-learning) 7. Monitoring and assessing the student assignment (by asynchronous e-learning) a. Quiz 1. Sections foundation drawing (individual assignment) b. Quiz 2. Roof construction section drawing. (individual assignment) c. Drawing the group's project building roof construction (teamwork)	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team optimally. c. Identify the ten collaborative indicator to build a good teamwork achievement d. Confirm the completeness of the previous lesson mastery learning e. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (update the determined project)**. (1)** 6. Learning the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (by asynchronous e-learning). a. Drawing applied objects and building elements b. Drawing Building Structural Elements c. Drawing foundation plans and details d. Drawing roof plans and details e. drawing floor plans, walls and roofs f. Building view drawing, (front, side, and back) g. Drawing building sections h. Sections drawing principles i. Drawing A-A, B-B, C-C sections j. Drawing foundation section k. Drawing building floor section l. Drawing stairs section.

5. Drawing columns, concrete slope, concrete floor plate, and beams plans and details drawing 6. Apply the collaborative mindset to organize the team on drawing the roof construction details and Building Structural Elements	d. Drawing columns, concrete slope, concrete floor plate, and beams plans e. Drawing detailed columns, concrete slope, concrete floor plate, and beams f. Drawing stairs plans and details 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment (by forum discussions of the e-learning and Whatsapp SNS group) a. Drawing the group's project building roof construction (teamwork) b. Drawing columns, concrete slope, concrete floor plate, and beams plans c. Drawing detailed columns, concrete slope, concrete floor plate, and beams d. Drawing stairs plans and details	m. Drawing roof construction section n. Drawing objects in section o. Giving notation to the section. p. Advance sections drawing q. Drawing Roof constructions r. Drawing Roof truss constructions s. General concept of reinforced concrete t. Drawing details of columns, concrete slope, concrete floor plate, and beams 7. Doing assessment a. Quiz. Sections foundation drawing (individual assignment) b. Quiz. Roof construction section drawing. (individual assignment) c. Drawing the group's project building roof construction (teamwork) d. Drawing columns, concrete slope, concrete floor plate, and beams plans e. Drawing detailed columns, concrete slope, concrete floor plate, and beams c. Drawing stairs plans and details 8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning)
Regular-Class 11 **Schedule:** Monday, May 3, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (1') 4. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively create/**update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing. Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams). (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing. Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams) (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to manage the teamwork and directed **to actively create/**update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing. Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams) (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing. Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams) (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8')

	10. Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation 6th preliminary presentation at after-class 11) (5') 11. Moving to the Zoom mainroom. (10') a. Concluding of the lesson together with the students and following up by giving assignment for the activity in after-class 11. b. Giving lesson connection and guiding for the next meeting (after-class 11)	10. Review and compile the working result and preparing for a presentation. (6th preliminary presentation at after-class 11). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 11. b. Mastering the lesson connection for the next meeting, (after-class 11).
After-Class 11 **Schedule:** Monday, May 3, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (advance 2) 4. Join the embedded zoom link. (1') 5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams). (13'x7=91') 7. Monitor the student in organizing the team, socializing, and interacting with teams in the presentation forum 8. Monitor the student in collecting critique and revision 9. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 10. Giving connection and guiding for the next pre-class 12. (7')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (advance 2) 4. Join the embedded zoom link. (1') 5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 6. **Presenting the Project to collect critique and revision (6)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams). (13'x7=91') 7. Organizing the team, socializing, and interacting with teams in the presentation forum 8. Collecting critique and revision 9. Doing **reflection and evaluation as the criteria planned. (7)** (10') 10. Identifying the connection between the present lesson with the next lesson in pre-class 12. (7')

Lesson Plan 12 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 12 **Schedule:** Tuesday-Sunday, May 4-9, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** 4. Giving apperception and motivation. (by asynchronous e-learning) a. Motivate to do the best in every project. b. Encourage to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Explain the ten collaborative indicators to build a good teamwork achievement. d. Notify about the completeness of the previous lesson mastery learning.	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team optimally. c. Identify the ten collaborative indicator to build a good teamwork achievement d. Confirm the completeness of the previous lesson mastery learning

Lesson 11-13 objective: 1. Manage the concept of building shop drawing to design building roof construction details drawing 2. Manage the concept of building shop drawing to design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams) 3. Drawing building roof construction details drawing 4. Drawing the stairs plans 5. Drawing columns, concrete slope, concrete floor plate, and beams plans and details drawing 6. Apply the collaborative mindset to organize the team on drawing the roof construction details and Building Structural Elements	e. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (update the determined project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams)**.** (by asynchronous e-learning) 7. Monitoring and assessing the student assignment (by asynchronous e-learning) a. Quiz 3. Roof truss construction drawing (individual assignment) b. Drawing the group's project building roof construction (teamwork) c. Drawing columns, concrete slope, concrete floor plate, and beams plans d. Drawing detailed columns, concrete slope, concrete floor plate, and beams e. Drawing stairs plans and details 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment (by forum discussions of the e-learning and Whatsapp SNS group) a. Drawing the group's project building roof construction (teamwork) b. Drawing columns, concrete slope, concrete floor plate, and beams plans c. Drawing detailed columns, concrete slope, concrete floor plate, and beams d. Drawing stairs plans and details	e. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (update the determined project)**. (1)** 6. Learning the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (by asynchronous e-learning). a. Drawing applied objects and building elements b. Drawing Building Structural Elements c. Drawing foundation plans and details d. Drawing roof plans and details e. drawing floor plans, walls and roofs f. Building view drawing, (front, side, and back) g. Drawing building sections h. Sections drawing principles i. Drawing A-A, B-B, C-C sections j. Drawing foundation section k. Drawing building floor section l. Drawing stairs section. m. Drawing roof construction section n. Drawing objects in section o. Giving notation to the section. p. Advance sections drawing q. Drawing Roof constructions r. Drawing Roof truss constructions s. General concept of reinforced concrete t. Drawing details of columns, concrete slope, concrete floor plate, and beams 7. Doing assessment a. Quiz 3. Roof truss construction drawing (individual assignment) b. Drawing the group's project building roof construction (teamwork) c. Drawing columns, concrete slope, concrete floor plate, and beams plans d. Drawing detailed columns, concrete slope, concrete floor plate, and beams d. Drawing stairs plans and details 8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning)
Regular-Class 12 **Schedule:** Monday, May 10, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (1') 4. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6.**	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to manage the teamwork and directed **to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6.**

	Sections Drawing, and Module 7. Advanced Sections Drawing. Drawing to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams). (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing. Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams) (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation 6th preliminary 2 presentation at after-class 12) (5') 11. Moving to the Zoom mainroom. (10') a. Concluding of the lesson together with the students and following up by giving assignment for the activity in after-class 12. b. Giving lesson connection and guiding for the next meeting (after-class 12)	**Sections Drawing, and Module 7. Advanced Sections Drawing. Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams) (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing. Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams) (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (6th preliminary 2 presentation at after-class 12). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 12. b. Mastering the lesson connection for the next meeting, (after-class 12).
After-Class 12 **Schedule:** Monday, May 10, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (advance 3) 4. Join the embedded zoom link. (1') 5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams). (13'x7=91') 7. Monitor the student in organizing the team, socializing, and interacting with teams in the presentation forum 8. Monitor the student in collecting critique and revision 9. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 10. Giving connection and guiding for the next pre-class 13. (7')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (advance 3) 4. Join the embedded zoom link. (1') 5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 6. **Presenting the Project to collect critique and revision (6)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams). (13'x7=91') 7. Organizing the team, socializing, and interacting with teams in the presentation forum 8. Collecting critique and revision 9. Doing **reflection and evaluation as the criteria planned. (7)** (10') 10. Identifying the connection between the present lesson with the next lesson in pre-class 13. (7')

Lesson Plan 13 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 13 **Schedule:** Tuesday-Sunday, May 11-16, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 11-13 objective:** 1. Manage the concept of building shop drawing to design building roof construction details drawing 2. Manage the concept of building shop drawing to design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams) 3. Drawing building roof construction details drawing 4. Drawing the stairs plans 5. Drawing columns, concrete slope, concrete floor plate, and beams plans and details drawing 6. Apply the collaborative mindset to organize the team on drawing the roof construction details and Building Structural Elements	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** 4. Giving apperception and motivation. (by asynchronous e-learning) a. Motivate to do the best in every project. b. Encourage to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Explain the ten collaborative indicators to build a good teamwork achievement. d. Notify about the completeness of the previous lesson mastery learning. e. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (update the determined project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams)**.** (by asynchronous e-learning) 7. Monitoring and assessing the student assignment (by asynchronous e-learning) a. Quiz 4. Reinforced concrete (individual assignment) b. Drawing the group's project building roof construction (teamwork) c. Drawing columns, concrete slope, concrete floor plate, and beams plans d. Drawing detailed columns, concrete slope, concrete floor plate, and beams e. Drawing stairs plans and details 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment (by forum discussions of the e-learning and Whatsapp SNS group) a. Drawing the group's project building roof construction (teamwork) b. Drawing columns, concrete slope, concrete floor plate, and beams plans c. Drawing detailed columns, concrete slope, concrete floor plate, and beams	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team optimally. c. Identify the ten collaborative indicator to build a good teamwork achievement d. Confirm the completeness of the previous lesson mastery learning e. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (update the determined project)**. (1)** 6. Learning the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (by asynchronous e-learning). a. Drawing applied objects and building elements b. Drawing Building Structural Elements c. Drawing foundation plans and details d. Drawing roof plans and details e. drawing floor plans, walls and roofs f. Building view drawing, (front, side, and back) g. Drawing building sections h. Sections drawing principles i. Drawing A-A, B-B, C-C sections j. Drawing foundation section k. Drawing building floor section l. Drawing stairs section. m. Drawing roof construction section n. Drawing objects in section o. Giving notation to the section. p. Advance sections drawing q. Drawing Roof constructions r. Drawing Roof truss constructions s. General concept of reinforced concrete t. Drawing details of columns, concrete slope, concrete floor plate, and beams 7. Doing assessment a. Quiz 4. Reinforced concrete (individual assignment) b. Drawing the group's project building roof construction (teamwork) c. Drawing columns, concrete slope, concrete floor plate, and beams plans d. Drawing detailed columns, concrete slope, concrete floor plate, and beams e. Drawing stairs plans and details

	d. Drawing stairs plans and details	8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning and Whatsapp SNS group)
Regular-Class 13 **Schedule:** Monday, May 17, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (1') 4. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing. Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams). (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing. Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams) (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (6^{th} presentation at after-class 13) (5') 11. Moving to the Zoom mainroom. (10') a. Concluding of the lesson with the students and following up by giving assignment for the activity in after-class 13. b. Giving lesson connection and guiding for the next meeting (after-class 13)	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to manage the teamwork and directed **to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing. Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams) (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing. Drawing** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams) (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (6^{th} presentation at after-class 13). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 13. b. Mastering the lesson connection for the next meeting, (after-class 13).
After-Class 13 **Schedule:** Monday, May 17, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (advance 4) 4. Join the embedded zoom link. (1')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** (advance 4) 4. Join the embedded zoom link. (1')

Methods: Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams). (13'x7=91') 7. Monitor the student in organizing the team, socializing, and interacting with teams in the presentation forum 8. Monitor the student in collecting critique and revision 9. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 10. Giving connection and guiding for the next pre-class 14. (7')	5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 6. **Presenting the Project to collect critique and revision (6)** in applying the **Module 4. Drawing Applied Objects on Buildings, Module 5. Drawing Floor Plan and Building View, Module 6. Sections Drawing, and Module 7. Advanced Sections Drawing.** to design building roof construction details drawing and design Building Structural Elements (columns, concrete slope, concrete floor plate, and beams). (13'x7=91') 7. Organizing the team, socializing, and interacting with teams in the presentation forum 8. Collecting critique and revision 9. Doing **reflection and evaluation as the criteria planned. (7)** (10') 10. Identifying the connection between the present lesson with the next lesson in pre-class 14. (7')

Lesson Plan 14 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 14 **Schedule:** Tuesday-Sunday, May 18-23, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 14-15 objective:** 1. Manage the concept of building shop drawing to design building utility drawing 2. Manage the concept of building shop drawing to organize the result of construction drawing 3. Drawing the Plumbing System 4. Drawing Clean water installation 5. Drawing of dirty water (used) and	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** 4. Giving apperception and motivation. (by asynchronous e-learning) a. Motivate to do the best in every project. b. Encourage to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Explain the ten collaborative indicators to build a good teamwork achievement. d. Notify about the completeness of the previous lesson mastery learning. e. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (update the determined project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, especially **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing (by asynchronous e-learning) 7. Monitoring and assessing the student assignment (by asynchronous e-learning) a. Quiz. Utility building drawing (individual assignment) b. Drawing the group's project Drawing the plumbing plans (teamwork) c. Drawing the group's project Drawing the ME plans (teamwork) 8. Encouraging teamwork in **designing the authentic Project by collecting**	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team optimally. c. Identify the ten collaborative indicator to build a good teamwork achievement d. Confirm the completeness of the previous lesson mastery learning e. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (update the determined project)**. (1)** 6. Learning the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing**.** (by asynchronous e-learning). a. Drawing Plumbing System b. Clean water installation drawings c. Drawing of dirty water (used) and sewage installations d. Examples of used water and dirty water installation plan drawing on the 1st and 2nd floors e. Mechanical and Electrical Drawing f. Printing the drawing g. Plotting/printing with page setup manager

sewage installations 6. Drawing the Mechanical and Electrical Drawing 7. Organize the whole construction drawing result 8. Manage the collaborative mindset to finish the building shop drawing project with the team	**information and negotiating the evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment (by forum discussions of the e-learning and Whatsapp SNS group) a. Drawing the group's project Drawing the plumbing plans (teamwork) b. Drawing the group's project Drawing the ME plans (teamwork)	h. The technique of drawing plot with model space and paper space 7. Doing assessment a. Quiz. Utility building drawing (individual assignment) b. Drawing the group's project Drawing the plumbing plans (teamwork) f. Drawing the group's project Drawing the ME plans (teamwork) 8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning and Whatsapp SNS group)
Regular-Class 14 **Schedule:** Monday, May 24, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** (1') 4. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (7th preliminary presentation at after-class 14). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding of the lesson together with the students and following up by giving assignment for the activity in after-class 14. b. Giving lesson connection and guiding for the next meeting (after-class 14)	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to manage the teamwork and directed **to actively create**/update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (7th preliminary presentation at after-class 14). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 14. b. Mastering the lesson connection for the next meeting, (after-class 14).
After-Class 14 **Schedule:** Monday, May 24, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.**	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.**

Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	4. Join the embedded zoom link. (1') 5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing. (13'x7=91') 7. Monitor the student in organizing the team, socializing, and interacting with teams in the presentation forum 8. Monitor the student in collecting critique and revision 9. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 10. Giving connection and guiding for the next pre-class 15. (7')	4. Join the embedded zoom link. (1') 5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 6. **Presenting the Project to collect critique and revision (6)** in applying the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing. (13'x7=91') 7. Organizing the team, socializing, and interacting with teams in the presentation forum 8. Collecting critique and revision 9. Doing **reflection and evaluation as the criteria planned. (7)** (10') 10. Identifying the connection between the present lesson with the next lesson in pre-class 15. (7')

Lesson Plan 15 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 15 **Schedule:** Tuesday-Sunday, May 25-30, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 14-15 objective:** 1. Manage the concept of building shop drawing to design building utility drawing 2. Manage the concept of building shop drawing to organize the result of construction drawing 3. Drawing the Plumbing System 4. Drawing Clean water installation 5. Drawing of dirty water (used) and sewage installations	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** 4. Giving apperception and motivation. (by asynchronous e-learning) a. Motivate to do the best in every project. b. Encourage to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Explain the ten collaborative indicators to build a good teamwork achievement. d. Notify about the completeness of the previous lesson mastery learning. e. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (update the determined project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, especially **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing (by asynchronous e-learning) 7. Monitoring and assessing the student assignment (by asynchronous e-learning) a. Quiz. Plotting/printing the drawing (individual assignment) b. Drawing the group's project Drawing the plumbing plans (teamwork) c. Drawing the group's project Drawing the ME plans (teamwork) 8. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the**	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team optimally. c. Identify the ten collaborative indicator to build a good teamwork achievement d. Confirm the completeness of the previous lesson mastery learning e. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (update the determined project)**. (1)** 6. Learning the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing**.** (by asynchronous e-learning). a. Drawing Plumbing System b. Clean water installation drawings c. Drawing of dirty water (used) and sewage installations d. Examples of used water and dirty water installation plan drawing on the 1st and 2nd floors e. Mechanical and Electrical Drawing f. Printing the drawing g. Plotting/printing with page setup manager h. The technique of drawing plot with model space and paper space 7. Doing assessment

6. Drawing the Mechanical and Electrical Drawing 7. Organize the whole construction drawing result 8. Manage the collaborative mindset to finish the building shop drawing project with the team	**evaluating criteria. (2)** (by e-learning and Whatsapp group) 9. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 10. Supervising student teamwork project, contextual team assignment (by forum discussions of the e-learning and Whatsapp SNS group) a. Drawing the group's project Drawing the plumbing plans (teamwork) b. Drawing the group's project Drawing the ME plans (teamwork)	a. Quiz. Plotting/printing the drawing (individual assignment) b. Drawing the group's project Drawing the plumbing plans (teamwork) g. Drawing the group's project Drawing the ME plans (teamwork) 8. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 9. Continue learning/collecting information for building the shop drawing project 10. Project supervision (by forum discussions of the e-learning and Whatsapp SNS group)
Regular-Class 15 **Schedule:** Monday, May 31, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** (1') 4. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively create/**update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (7th presentation at after-class 15). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding of the lesson together with the students and following up by giving assignment for the activity in after-class 15. b. Giving lesson connection and guiding for the next meeting (after-class 15)	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to manage the teamwork and directed **to actively create/**update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') **7.** Enter the discussion room, organize the teamwork to **Actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (7th presentation at after-class 15). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 15. b. Mastering the lesson connection for the next meeting, (after-class 15).
After-Class 15 **Schedule:** Monday, May 31, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** 4. Join the embedded zoom link. (1')	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** 4. Join the embedded zoom link. (1')

Methods: Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting	5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing. (13'x7=91') 7. Monitor the student in organizing the team, socializing, and interacting with teams in the presentation forum 8. Monitor the student in collecting critique and revision 9. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 10. Giving connection and guiding for the next pre-class 16. (7')	5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 6. **Presenting the Project to collect critique and revision (6)** in applying the **Module 8. Utility Building Drawing, Module 9. Drawing Plot, Module 10. Project Building Shop Drawing.** to design and draw utility building drawing, organize the project building shop drawing, and plot the drawing. (13'x7=91') 7. Organizing the team, socializing, and interacting with teams in the presentation forum 8. Collecting critique and revision 9. Doing **reflection and evaluation as the criteria planned. (7)** (10') 10. Identifying the connection between the present lesson with the next lesson in pre-class 16. (7')

Lesson Plan 16 of 16

Class Information	Activity and Learning Experiences	
	Teacher	**Student**
Pre-class 16 **Schedule:** Tuesday-Sunday, June 1-6, 2021 **Time:** free (minimum learning time of 2 x 60 minutes) Western Indonesia Time (WIB) UTC+07:00 Asynchronous. **Synchronous**. (Assessment) (June 3, 2021, Thursday, 10.50-12.30 WIB) **Methods:** Self-Directed Learning, demonstration video, and free Whatsapp discussion **Media:** e-vocational blended learning platform-WordPress-Efront-Zoom Meeting **Lesson 16 objective:** 1. Arrange the building shop drawing project 2. Propose the building shop drawing project result in a presentation 3. Organize the teamwork for proposing the building shop drawing project result	1. Greet, motivate, ask the student to prepare for learning, and announce the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 10. Project Building Shop Drawing and Evaluation Module.** 4. Giving apperception and motivation. (by asynchronous e-learning) a. Motivate to do the best in every project. b. Encourage to strengthen the collaborative mindset, collaboration between peers is the best strategy for the best achievement. c. Explain the ten collaborative indicators to build a good teamwork achievement. d. Notify about the completeness of the previous lesson mastery learning. e. Giving connection between the previous and the current lesson and guiding for learning it. 5. **Setting the challenging stage by giving examples and essential sustained questions** (update the determined project)**. (1)** (by e-learning material) 6. Monitor the student in entering the available topic, especially **Module 10. Project Building Shop Drawing and Evaluation Module** to organize the project building shop drawing and propose the building shop drawing project result in a presentation and evaluate the learning result (by asynchronous e-learning) 7. Announce for assessment by SNS WhatsApp **Synchronous**. (June 3, 2021, Thursday, 10.50-12.30 WIB) 1. Monitoring and assessing the student assignment (by asynchronous e-learning) a. Summative test (individual assignment) b. Student Skill Assessment for Construction Drawing (individual assignment) c. Organize the building shop drawing project (teamwork) 2. Encouraging teamwork in **designing the authentic Project by collecting information and negotiating the**	1. Reply the teacher greetings, motivated, and receive the announcement about the activity by Whatsapp SNS group. 2. Accessing the e-vocational platform. 3. Enter the **Module 10. Project Building Shop Drawing and Evaluation Module.** 4. Having apperception and motivation. (by asynchronous e-learning) a. Practice to do the best in every project b. Practice to collaborate with the team optimally. c. Identify the ten collaborative indicator to build a good teamwork achievement d. Confirm the completeness of the previous lesson mastery learning e. Summarize the connection between the previous and the current lesson and learn it 5. **Challenged and motivated to design a building construction drawing with various difficulty levels and determine the Project and plan the ideal Project** (update the determined project)**. (1)** 6. Learning the **Module 10. Project Building Shop Drawing and Evaluation Module** to organize the project building shop drawing and propose the building shop drawing project result in a presentation and evaluate the learning result (by asynchronous e-learning). a. List of Shop Drawing Projects b. Project title bock c. Project time schedule d. Summative test e. Student Skill Assessment for Construction Drawing 7. Receiving SNS WhatsApp assessment information **Synchronous** (June 3, 2021, Thursday, 10.50-12.30 WIB) 1. Doing assessment a. Summative test (individual assignment) b. Student Skill Assessment for Construction Drawing (individual assignment)

	evaluating criteria. (2) (by e-learning and Whatsapp group) 3. Checking/creating/updating Zoom Meeting for the upcoming Regular and After Class (embed to the e-learning) 4. Supervising student teamwork project, contextual team assignment (by forum discussions of the e-learning and Whatsapp SNS group) Organize the building shop drawing project (teamwork)	c. Organize the building shop drawing project (teamwork) 2. **Actively design the authentic Project by collecting information and negotiate the evaluating criteria**. **(2)** 3. Continue learning/collecting information for building the shop drawing project 4. Project supervision (by forum discussions of the e-learning and Whatsapp SNS group)
Regular-Class 16 **Schedule:** Monday, June 7, 2021 **Time:** 10.50-12.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning platform-Wordpress-Efront-Zoom Meeting	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 10. Project Building Shop Drawing and Evaluation Module.** (1') 4. Giving apperception and motivation to prioritize group responsibilities and learning interdependence. (10') 5. Giving direction to organize the teamwork and directing **the student to actively create/**update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 10. Project Building Shop Drawing and Evaluation Module** to organize the project building shop drawing and propose the building shop drawing project result in a presentation and evaluate the learning result (20') 6. Creating Zoom Discussion Rooms for teamwork working. (5') **7.** Open all the Zoom discussion room, monitoring **the student to actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 10. Project Building Shop Drawing and Evaluation Module** to organize the project building shop drawing and propose the building shop drawing project result in a presentation and evaluate the learning result (30') **8. Monitoring the student activity and the progress of the Project. (4)** (10') **9.** Monitor the Students **Understanding the Project to prepare for the presentation. (5)** (8') **10.** Entering each Zoom discussion room, directing and motivating students to compile the working result and preparing for a presentation (8th presentation at after-class 16). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding of the lesson together with the students and following up by giving assignment for the activity in after-class 16. b. Giving lesson connection and guiding for the next meeting (after-class 16)	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 10. Project Building Shop Drawing and Evaluation Module.** (1') 4. Hearing the apperception and motivated, recognize prioritizing group responsibilities and learning interdependence. (10') 5. Hearing the teacher direction to manage the teamwork and directed **to actively create/**update **the schedule and work on the Project authentically** (Lesson) **(3)** in applying the **Module 10. Project Building Shop Drawing and Evaluation Module** to organize the project building shop drawing and propose the building shop drawing project result in a presentation and evaluate the learning result (20') 6. Preparing to join the teamwork discussion room for teamwork working. (5') 7. Enter the discussion room, organize the teamwork to **actively create/update the schedule and work on the Project authentically** (Application) **(3)** in applying the **Module 10. Project Building Shop Drawing and Evaluation Module** to organize the project building shop drawing and propose the building shop drawing project result in a presentation and evaluate the learning result (30') 8. Continuously work on the progress of the project authentically. **Activity and progress monitored. (4)** (10') 9. **Understanding the Project to prepare for the presentation. (5)** (8') 10. Review and compile the working result and preparing for a presentation. (8th presentation at after-class 16). (5') 11. Moving to the Zoom mainroom. (10') a. Concluding the lesson together and understanding the assignment given for the activity in after-class 16. b. Mastering the lesson connection for the next meeting, (after-class 16).
After-Class 16 **Schedule:** Monday, June 7, 2021 **Time:** 19.30-21.30 Western Indonesia Time (WIB) UTC+07:00 Synchronous **Methods:** Lecture, demonstration, discussion **Media:** e-vocational blended learning	1. Greet, motivate, and ask the student to prepare for learning by the Whatsapp SNS group. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 10. Project Building Shop Drawing and Evaluation Module.** 4. Join the embedded zoom link. (1') 5. Giving apperception and motivation of prioritizing team choices for the best achievement. (10') 6. Guiding the students in **presenting the Project to collect critique and revision (6)** in applying the **Module 10. Project**	1. Receive the teacher greetings by Whatsapp SNS group, motivated and begin to prepare for learning. (before the class start) 2. Access the e-vocational platform (1') 3. Enter the **Module 10. Project Building Shop Drawing and Evaluation Module.** 4. Join the embedded zoom link. (1') 5. Having the apperception and motivated of prioritizing team choices for the best achievement. (10') 6. **Presenting the Project to collect critique and revision (6)** in applying the **Module 10. Project Building Shop Drawing and**

platform-WordPress-Efront-Zoom Meeting	**Building Shop Drawing and Evaluation Module** to organize the project building shop drawing and propose the building shop drawing project result in a presentation and evaluate the learning result. (13'x7=91') 7. Monitor the student in organizing the team, socializing, and interacting with teams in the presentation forum 8. Monitor the student in collecting critique and revision 9. Conducting the student in doing **reflection and evaluate as the criteria planned. (7)** (10') 10. Giving connection between the course with other courses and workplace job 16. (7')	**Evaluation Module** to organize the project building shop drawing and propose the building shop drawing project result in a presentation and evaluate the learning result. (13'x7=91') 7. Organizing the team, socializing, and interacting with teams in the presentation forum 8. Collecting critique and revision 9. Doing **reflection and evaluation as the criteria planned. (7)** (10') 10. Identifying the connection between the course with other courses and workplace job. (7')

2. Chapter 3 Appendix

The appendix of chapter 3 is presented at the available link as follow:

https://drive.google.com/drive/folders/1LGO5vqQSk0bRW_C1BzzLDrG8k3yMy7tQ?usp=sharing

3. Chapter 4 Appendix

To see the appendix of chapter 4, kindly access the available link as follow:

https://drive.google.com/drive/folders/13_KXWXTM7djfS8vcPZmEYjSLAaSi35sG?usp=sharing

4. Chapter 5 Appendix

The appendix of chapter 5 is presented at the available link as follow:

https://drive.google.com/drive/folders/109UGBhL48g3E9nfTyw4dTpwuz1IDsI-d?usp=sharing

5. Chapter 6 Appendix

To see the appendix of chapter 6, kindly access the available link as follow:

https://drive.google.com/drive/folders/17EnhkYDUdOD60JODE0Q0SHcNlmNJOdlK?usp=sharing

6. Chapter 7 Appendix

The appendix of chapter 7 is presented at the available link as follow:

https://drive.google.com/drive/folders/1QxNBKL505VMUJ59c2x9vwvhWckUvKmDm?usp=sharing

7. Chapter 8 Appendix

To see the appendix of chapter 8, kindly access the available link as follow:

https://drive.google.com/drive/folders/1c1uYjXaUtCiibtrpSNWJQjKC2rBfHJ09?usp=sharing

8. Research Instruments

The research instruments are presented at the available link as follow:

https://drive.google.com/drive/folders/1KYjHqeUdxtAnCMTz8TBP3ZRPp9o0Gksu?usp=sharing

9. Research Letters

The research letters are presented at the available link as follow:

https://drive.google.com/drive/folders/15fvJKr0V2IIfJkm0laZ8k7CrLfZubKvW?usp=sharing

10. Publications (Journal Articles and Conference Proceedings)

a. Journal Articles

The journal articles publications of this research are presented at the available link as follow:

https://drive.google.com/drive/folders/1S_09od4kAJK9E1XNx_1ZpYzSakT-Jer8?usp=sharing

b. Conference Proceedings

The conference proceedings publications of this research are presented at the available link as follow:

https://drive.google.com/drive/folders/1lSNMwP69VFCweVwHtSvozwR_bKS1R_O7?usp=sharing