Hybrid and Collaborative Networks Approach: Online Learning Integrated Project and Kolb Learning Style in Mechanical Engineering Courses

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Abstract—Engineering education is very important to prepare quality graduates because technology is developing so rapidly that employers need a competent workforce. This study aims to explain the online learning integrated project and Kolb learning style in mechanical engineering courses to enhance students' academic achievement which is implemented through a hybrid and collaborative networks approach. The research method used is a quantitative approach with the posttest control group design method. We carry out learning activities using Project and Kolb Learning on higher education students from Mechanical Engineering Education who take part in learning this project. Students who participate are limited to small groups, which are divided according to their learning styles groups, and the implementation is carried out in a hybrid and collaborative through e-learning and face-to-face. Collecting data using Kolb Learning Styles Inventory, and achievement test. While the data analysis used descriptive analysis and one-way Anova with the help of SPSS software. The results of this study indicate that there is a difference in the average academic achievement of students based on the four learning style groups, and the thinker learning style group has the highest average academic achievement among the four. The selection of appropriate learning styles and learning models has an impact on optimal and effective academic achievement.

Keywords—hybrid and collaborative networks, project, Kolb learning style, mechanical engineering

1 Introduction

Hybrid and collaborative networks approach in blended learning has become an alternative learning trend in recent years in the field of education. The combination of learning models and learning styles applied in blended learning is an alternative choice [1], as well as in engineering education. Hybrid learning gives students the opportunity to combine face-to-face and online learning. The main basis in hybrid learning, cannot replace face-to-face classes but to improve and discuss concepts that exist in the classroom. The hybrid learning process is carried out alternately, online

classes in media are completed either synchronously using real-time meeting sessions or asynchronously where students interact at different times.

Learning styles have an important role in creating effective learning [2], including learning in engineering education [3], [4]. The success of the learning process cannot be separated from the student's learning style [5]. Each student learns in a different way. A student can feel uncomfortable and frustrated if forced to learn something with a method that is not his learning style. One particular learning style does not necessarily work for all students. If students understand their own learning style, it will be easier for them to learn something and increase motivation to learn [6]. A person's learning style is a combination of how he absorbs and then organizes and manages information [7], [8]. Learning style is part of student characteristics. Each student has different characteristics, for example: motivation and IQ. Characteristics of students are part of the learning conditions. Where learning conditions as factors that influence the method in improving learning outcomes [9], [10]. Students learn in various ways, some learn by listening, some learn by reading, and some learn by finding [6]. These diverse student learning styles are known as learning styles.

Some research results show that learning outcomes are related to student learning styles [11], [12]. So that learning styles have a role in influencing student learning achievement [13], because each student not only learns at different speeds but also processes information and experiences in different ways [14]. Kolb's learning style [15], is a learning style based on experience. This places students in a model characterized by a four-step process, namely concrete experience (feeling), reflective observation (watching), abstract conceptualization (thinking) and active experimentation (doing). In addition, the learning style of engineering education students is influenced by the process of forming experiences and different learning environments, so it needs to be adapted to appropriate learning methods or strategies to be used in the learning process [16], including learning in mechanical engineering education. Learning in engineering education which is predominantly project and product oriented requires a learning model that is able to adapt to the conditions of the learning environment, learning styles and characteristics of engineering education students [17], [18], also during and after the Covid-19 pandemic. One of the alternative learning models with characteristic conditions in engineering education is Project Based Learning (PjBL) [19], [20], which is also possible to implement in a hybrid and collaborative.

PjBL is not limited in terms of knowledge and information, but with the help of lecturers it can give students the opportunity to change themselves during the learning process [21]. Nowadays, learning to read is no longer enough, instead learning to solve problems, work collaboratively and think innovatively are considered as important skills of the 21st century [22]. Therefore, PjBL is accepted as an effective method for the teaching process in engineering education. Another positive result of using PjBL is a reduction in student anxiety [23], and an increase in the quality of student learning compared to conventional teaching methods [24].

The novelty of this research is how to implement PjBL with online learning system that integrates the Kolb Learning style in the learning, and what is effect it to students' academic achievement. Students do project task grouply, where each group consists of students who have four different learning styles based on Kolb learning style is the novelty in learning with PjBL implementation. The information technology that keeps growing will make the learning is not just implemented by face to face in classroom, but it can be implemented by onlone learning. In mechanical engineering education, the learning that has related to concept and theory have been implented by using e-learning, students can easily access and learn individually. For the good understanding about concept and theory that have been studied dan practice skills, face to face learning is still required to be implemented in the workshop and laboratorium.

2 Research methods

2.1 Research types and procedures

In order to see the effect of online learning implemented with PjBL ingrated Kolb Learning, the research was conducted by a quantitative approach to the posttest control group design method [25]. Before taking the PjBl approach, a pretest was carried out to determine the students' initial abilities, and after being given treatment, a post test was carried out at the end of the treatment. The implementation of this research applies the concept of hybrid and collaborative networks approach in blended PjBL integrated kolb learning style in mechanical engineering courses. The materials have been prepared into the developed Moodle e-learning platform, with the site name https://elearning2.unp.ac.id/. Furthermore, the implementation to explain the concept of material and theory is carried out online by accessing e-learning, while the implementation of the project is carried out face-to-face using PjBL.

In this study, students were given a PjBL approach, the stages of PjBL used were stages that had been developed under the name The seven steps of PjBL model [26], show in Figure 1. This seven steps of PjBL have sevent stages syntax to be implemented in learning, where the seven steps was devided in 3 main stages, namely Skill Competency Debriefing that has three syntax in it, Project Work that has three syntax in it and evaluation that has one syntax in it.

Each syntax has activities that have been conducted by teacher and students, this seven steps of PjBL that implemented in this research integrate wth Kolb Learning Style. The seven steps of PjBL in detal can be seen in Figure 1.

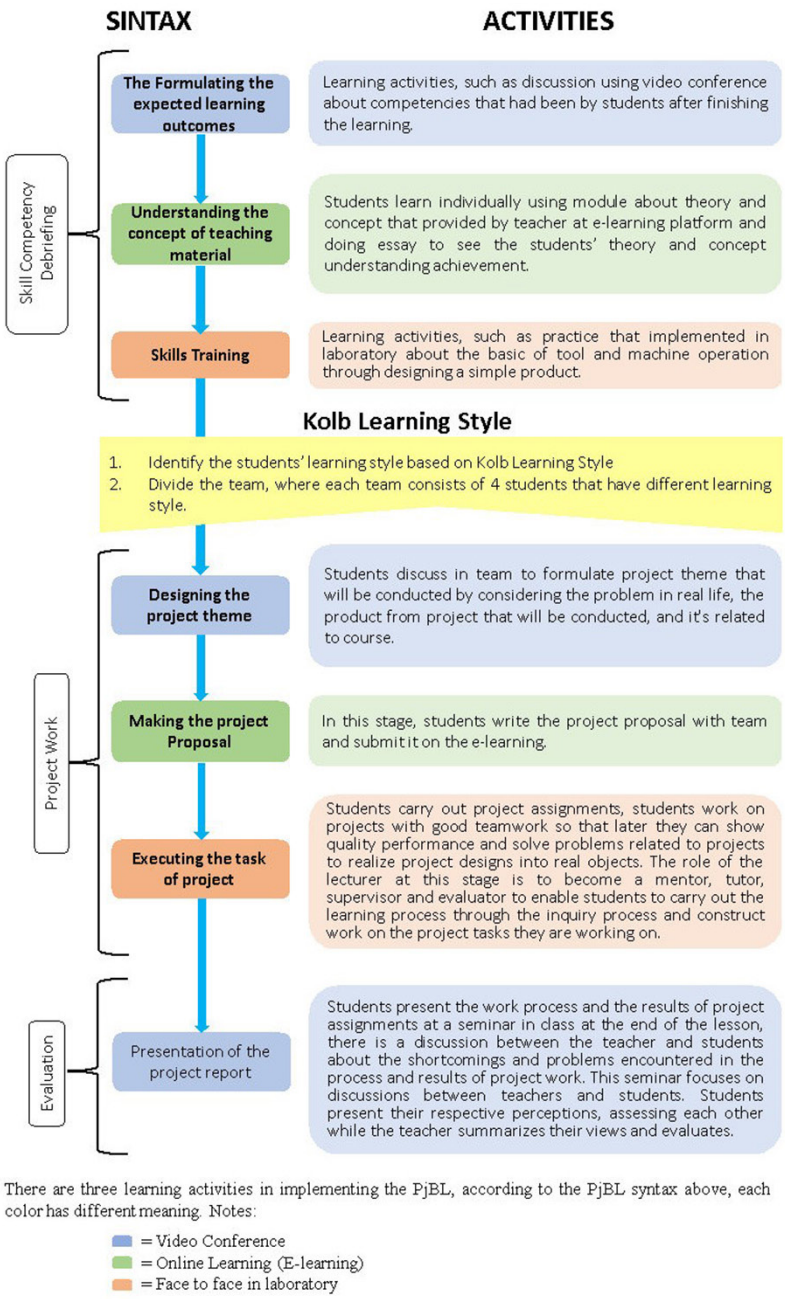

Fig. 1. Syntax project-based learning with integrated hybrid learning Kolb learning style

2.2 Participants

We conduct our project activities at Universitas Negeri Padang (Indonesia) special students "Mechanical Engineering Education" take part in the learning of this project in the mechanical engineering course. The students who participated in this study were 65 students, this number was determined using a purposive sampling technique, with 21 female and 44 male. The students who participated in this study were aged 20 to 22 years.

2.3 Data collection and analysis

Collecting data using Kolb Learning Styles Inventory [27], To determine student learning styles before giving PjBl treatment to students and achievement test to see the success of PjBL's treatment of all learning styles. The achievement test used was objective and essay test, where both of test has been valid and reliable to be used in this research. Beside the test, Kolb learning Styles Inventory also used in this research. The instrument used to assess students learning style determination.

While the data analysis used descriptive and inferential analysis, with the help of SPSS software. Data description is needed to get the mean, standard deviation, maximum score and minimum score, while Inferential statistics is used to see differences in learning outcomes between students' learning styles. The prerequisite test used is the homogeneity test, analyzed using the Levene Test, and to test the differences in Kolb's learning styles, namely doer, feeler, thinker, and watcher with Project Base Learning on academic achievement using one way Anova.

3 Results and discussion

Engineering education that is unique in the learning process really needs to be careful in having a learning style and learning model. Choosing the right learning style and learning model has an impact on Academic achievements. Furthermore, the results of the academic achievement obtained follow the steps and stages described in the previous research method section, at this stage the results of the average of academic achievement are presented, the results of the analysis of proof of the differences in academic achievement of the four learning styles and learning style groups with average results. the average of the highest academic achievement.

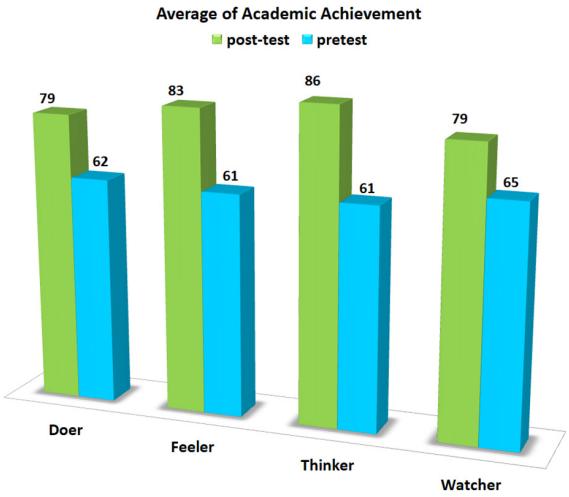

Fig. 2. Evaluation of academic achievement of mechanical engineering education students

The results shown in Figure 2 are the Evaluation of Academic Achievement of Mechanical Engineering Education Students using Project-Based Learning which was carried out in two stages, namely pretest and post-test. At the pretest stage, the average student ability was obtained with a score of 62. At this pretest stage, the lowest score was 61 on the Feeler and Thinker learning styles, while the highest score was 65 on the Watcher learning styles. Furthermore, at the post-test stage, it was seen that there was an increase, although not significant, namely the average ability of students with a score of 82. At this post-test stage, the lowest score was 79 on the Doer and Watcher learning styles, while the highest score was 86 on the Thinker learning style.

Table 1. Descriptive analysis of academic achievements

	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Doer	16	79	10.724	2.681	56	89
Feeler	21	83	8.265	1.804	57	94
Thinker	15	86	5.088	1.314	71	91
Watchers	13	79	5.300	1.470	70	90
Total	65	82	8.208	1.018	56	94

From Table 1 descriptive it appears that students with Doer learning style on average from Academic Achievement of 79, then Feeler average of academic achievement of 83, then Thinker's average of academic achievement of 86, and Watcher's average of academic achievement of 79. Furthermore, to see the test we see in Table 3 ANOVA.

Table 2. Test of homogeneity of variances

Levene Statistics	df1	df2	Sig.
4.691	3	61	0.235

Before continuing with the ANOVA test, keep in mind that one of the assumptions of ANOVA is that the variances are the same. From Table 2 Test of Homogeneity of Variances, it can be seen that the test results show that the variance of the four learning style groups is the same as the P-value (Sig.) = 0.235, so the Anova test is valid to test this relationship.

Table 3. ANOVA analysis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	520.991	3	173.664	2.795	0.048
Within Groups	3790.763	61	62.144		
Total	4311.754	64			

Furthermore, to see if there are differences in academic achievement of the four learning styles. Let's look at the ANOVA table, from Table 3 in the Sig column. obtained P value (P-value) = 0.048. Thus, at the level of significance = 0.05, we reject Ho, so the conclusion obtained is that there is a significant difference in average academic achievement based on the four learning style groups.

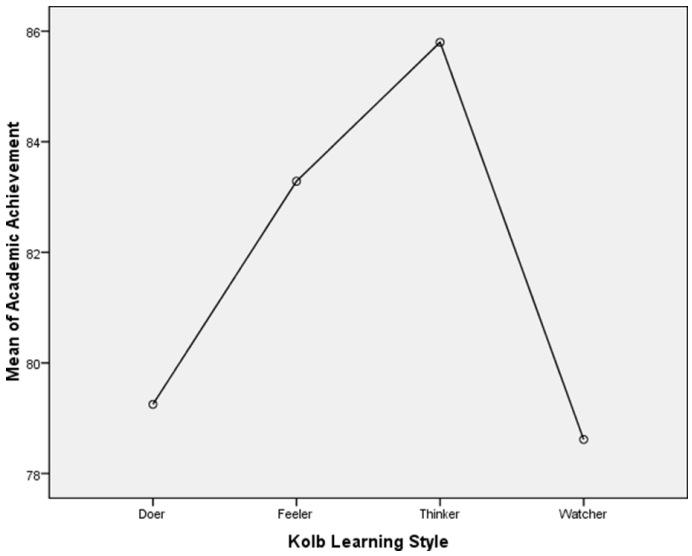

Fig. 3. Mean plots between Kolb learning style and mean of academic achievement

The mean plot shows the graph of the mean of academic achievement in the Kolb learning style group, namely doer, feeler, thinker, and watcher. From Figure 3, it can be seen that the thinker learning style group has the highest average academic achievement among the four.

This study explains that the evaluation of academic achievement of Mechanical Engineering Education students using project based learning at this pretest stage obtained the lowest score was 61 on the Feeler and Thinker learning styles, while the

highest score was 65 on the Watcher learning style. The pretest was carried out to see the initial conditions of student learning styles before implementing and using project based learning. At this stage the Watcher learning style is the highest because this learning style is dominated by observing activities rather than doing activities. In this initial evaluation condition, the lowest score is Feeler and Thinker learning style, Feeler learning style has concrete experience characteristics, and this learning style is good for solving a problem. While the Thinker learning style is characterized by abstract conceptualization, this learning style likes information conveyed in a coherent manner and is very good at understanding information. Then, after the pretest was carried out on the students, it was continued with learning activities using project based learning.

The only program and method that is effective to increase students' motivation and activity in learning has been identified as project based learning that allows it to be applied in engineering education [28]. Why project based learning, because it helps students in active learning [29], [30], students can work together [31], [32], communicate in providing learning experiences in groups [33], [34], and have an impact on improvement of students' social and emotional control in learning [35]. After carrying out learning activities using project based learning, students need to be evaluated to see the results of the learning process academic achievements. In this post-test stage, the lowest score was 79 on the Doer and Watcher learning styles, while the highest score was 86 on the Thinker learning styles. At this post-test stage, the learning style Thinker becomes the highest because its characteristics are abstract conceptualization; this learning style likes information conveyed in a coherent manner and is very good at understanding information. While the lowest score is learning style Doers and Watchers, Doer's learning style has the characteristics of active experimentation in the form of activities, and prefers trial and error. While the Watcher learning style is this learning style dominated by observation activities rather than doing activities.

Furthermore, this study also explains that there are differences in average academic achievement based on the four learning style groups. There is a difference in the average academic achievement due to the characteristics of student learning styles that are unique and different when applying project based learning. Implementation of learning in Mechanical Engineering Education with The Project Based Learning approach used is the stages that have been developed under the name the seven steps of Project Based Learning model [26]. In the implementation with the seven steps of Project Based Learning model, it can be seen that the implementation is carried out in a structured and coherent manner which also has an impact on increasing the productivity of student competencies [26]. The implementation of structured and coherent learning is very suitable for Thinker's learning style, because the characteristics of this learning style are Abstract conceptualization, this learning style likes information conveyed in a coherent manner and is very good at understanding information. So that Thinker learning style has the highest average academic achievement among the other three learning styles in implementing the learning process using project based learning.

The implementation of project based learning in Engineering Education is an important issue [36], especially when combined with certain learning styles [37], not least in Mechanical Engineering Education because it prepares graduates to be skilled and have competence in the field of machinery that is able to compete in the market work. Current engineering education learning must be product oriented [38], [39], [40],

commercially potential [41]–[42], and integrated with technology [43], so that graduates have the ability to compete in the industrial world [44], the job market and have good career maturity [45]. In addition, several previous research results also confirm that project based learning to enhance problem solving skills and student competency skills [46], [47], helps students' skills in designing products in project based learning [48], supports group work and impact on learning outcomes [49], and able to collaborate with other learning tools and on different materials [50], also on blended project based learning [51], [52].

4 Conclusion

This study reveals that the PjBl learning approach can be applied to hybrid learning, both online and face-to-face, the PjBl approach can be applied to all learning styles, especially the Kolb learning style which consists of doer, feeler, thinker, and watcher. Student learning outcomes are distinguished based on Kolb's learning style using the PjBl approach, there are differences in average learning achievement based on the four groups of learning styles and learning styles Thinker has the highest average learning achievement among the other four learning styles in carrying out the learning process using project based learning in mechanical engineering education. The right learning approach and in accordance with student learning styles can improve student learning outcomes so that it has an optimal impact on the competence of engineering education students, so that education graduates are able and ready to work in the job market and mature in their careers.

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