



# DIFFERENCES CAPABILITY OF STUDENTS IN COLLABORATIVE ONLINE LEARNING

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## ABSTRACT

*The online and offline learning strategy accompanied by giving assignments at the end of Mechatronics learning so far has had several records, one of the most prominent is that student involvement in the learning process tends to continue to decline. Research activities begin with; (1) randomly selecting two classes from a total of three Mechatronics lecture classes, and assigning one class as the experimental group, and the other class as the control group; (2) giving an initial test (pre-test) to students in the experimental group/class and students in the control group; (3) applying Collaborative Online Learning strategies in the experimental class, and direct instructional online learning strategies in the control class; (4) measuring the Mechatronics learning outcomes of students in the experimental class and students in the control class. Collaborative online learning can have a better impact on improving Mechatronics learning outcomes. This is because collaborative online learning encourages students to be more active, gain more knowledge, and get students used to discussing. This nature of offering learning to share information will give students the courage to express themselves both behaviorally and verbally. There is an interaction effect between online learning strategies and prior knowledge of Mechatronics learning outcomes. This means that online learning strategies and prior knowledge are two factors that determine student Mechatronics learning outcomes. Therefore, in planning learning, teachers need to pay attention to the individual characteristics of students so they can determine appropriate learning strategies. An important note in this research shows that collaborative online learning is not only appropriate to teach for students who have high initial abilities but is also appropriate to teach for students who have low initial abilities.*

**Keywords:** *higher education, collaborative online learning, learning outcome, learning strategy, mechatronic*

## 1. INTRODUCTION

Higher education in Indonesia applies for practical learning internships in the business / industrial world. Especially vocational education is carried out for one semester, causing problems in the process of implementing theoretical courses in class. This two-year internship program is carried out using *online learning methods*. The learning results so far have been obtained using formative and summative evaluations in the form of multiple-choice tests. Although the results are different between the pre-test and post-test, it is not yet conclusive whether the student will be able to solve the problem. Therefore, the learning method needs to combine online learning with problem-based learning, which is then evaluated with problem-solving test instruments. But from several studies on MOOCs, online learning methods on MOOCs experience many who drop out of school. Therefore, the combination of learning methods is also with collaborative learning methods. The research that has been conducted aims to obtain information on the influence of collaborative online learning in problem-solving on learning outcomes shown by learning engagement, and answers to solutions to problems.

Collaborative learning can conceptually be adapted from the concept of cooperative learning. Referred to as cooperative learning if this model is applied to elementary and secondary education students/students, while if this model is applied to adult learning (students) it is called *Collaborative learning*. Thus, in this study, the notion of *collaborative learning* can be explained by the concept or understanding of *cooperative learning*. According to Arends (2009), *cooperative learning* is a learning model characterized by a cooperative structure of



tasks, goals, and feedback. Learners in cooperative/collaborative learning are encouraged, directed, or conditioned to work on the same task together and they must coordinate their efforts to complete a task.

Two or more individuals depend on each other for the rewards they will share if they succeed as a group. Collaborative learning has the following learning features; (a) learners work in teams to achieve learning objectives; (b) teams consisting of low, medium, and high achieving learners; (c) the *reward* system is group or individually oriented. Collaborative learning has several variations of models, including; the Student Teams Achievement Divisions (STAD) model, Jigsaw model, Group Investigation (GI) model, structural strategy model, Think-Pair-Share model, and Numbered Heads Together model.

*Collaborative online learning* (COL) is a synchronous online learning strategy, (*synchronous online*) in which the learning process is inserted into collaborative learning segments. The COL steps are as follows; (a) teachers open synchronous *online* classes using *video-conferencing* platforms; (b) Teachers deliver teaching materials online at a predetermined time to students in class (synchronous), with lectures, presentations, and question-and-answer methods; (c) The teacher divides students into 4 or 5 groups, and divides large classes into small classes as many as the number of groups in the class, and distributes the link of each class to the group that must be in that class; (d) The teacher assigns assignments to each group in each class that must be completed within a certain time during the online class; (e) The teacher visits each class via the shared class link and checks the progress of group assignments in each class; (f) Each group of students presented the results of their group work in a large class attended by all groups. The positive aspect of COL is cooperation and decision-making that influence each other giving rise to social dependence. These aspects include 1) communication, 2) the process of task distribution, 3) perceptions of other groups, and 4) work facilities (Shimizu, et.al, 2022).

## 2. METHODS

The research method is quasi-experimental. The research was conducted from January to June 2023 at Jakarta State University. The research design is as follows:

**Table 1. Factorial Design Experiment Design 2x2**

| Treatment Variables<br>(A)<br>Attribute Variables (B) | Collaborative Online<br>Learning Strategy<br>(A1) | Direct Instructional Online<br>Learning Strategy<br>(A2) |
|---|---|--|
| High Starting Ability<br>(B1)                         | A1B1<br>[Y]11k<br>k = 1, 2, ..., n <sub>10</sub>  | A2B1<br>[Y]21k<br>k = 1, 2, ..., n <sub>10</sub>         |
| Low Starting Ability<br>(B2)                          | A1B2<br>[Y]12k<br>k = 1, 2, ..., n <sub>10</sub>  | A2B2<br>[Y]21k<br>k = 1, 2, ..., n <sub>10</sub>         |

Information:

- A1 : student groups treated with *collaborative online learning strategies*
- A2 : Group of students treated with *direct instructional online learning strategies*
- B1 : Groups of students with high starting ability
- B2 : Groups of students with low starting ability student group
- A1B1 : Mechatronics learning outcomes with *collaborative online learning strategies* that have a high initial ability



- A2B1 : Mechatronics learning outcomes with *direct instruction online learning strategies that have high initial ability.*
- A1B2 : Mechatronics learning outcomes with *collaborative online learning strategies that have low initial ability.*
- A2B2 : Mechatronics learning outcomes with *direct collaborative online learning strategies that have low initial ability.*

Based on the types of research variables that exist, this experimental research was carried out using the *Treatment by Level experimental design* (Supardi, 2016, pp. 348-351). The dependent variable (Y) of this study was the learning outcome test score Mechatronics. The independent variable consists of two variables; (1) treatment variables, and (2) attribute variables. The treatment variable consists of an experimental variable and a control variable. An experimental variable is the collaborative online learning *strategy, and a control variable is the direct online learning strategy.* Attribute variable is the student's initial knowledge related to basic knowledge of Mechatronics. These attribute variables are divided into two categories, namely high initial knowledge, and low initial knowledge.

Students participating in mechatronics lectures in 2023 were respondents. There are 3 classes, namely 1 experimental class, 1 class as a control class, and 1 other class as a trial class. The number of respondents was 40 students, namely 20 students in the experimental class, and 20 students in the control class. The conceptual definition is the result of learning mechatronics is the ability of students after learning mechatronics theory in a certain time to be able to obtain cognitive competencies ranging from identifying problems, analyzing problems, designing, and demonstrating electronic control circuits in transmission systems and 1-phase electric motor rotation. The operational definition of mechatronics learning outcomes is the ability of students to meet the competence to elaborate the basic concepts of mechatronics, identify how sensors, actuators, and electronic-based controllers work, analyze mechanical, hydraulic, and pneumatic transmission control systems, design and demonstrate a series of motor rotation controllers 1 phase. The nine aspects of ability have different score weights, based on their cognitive level, to identify the weight 8%, demonstrate 10%, analyze 15%, and design 20%.

**Table 2. Data on Initial Ability and Mechatronics Learning Outcomes based on Statistical Measures.**

| Initial Ability (B)                     |                   | Online Learning Strategy (A)    |                |  |                | Σ              |                |
|---|-------------------|---------------------------------|----------------|--|----------------|----------------|----------------|
|   |                   | Collaborative (A <sub>1</sub> ) |                | Direct Instructional (A <sub>2</sub> ) |                |                |                |
|   |                   | X <sub>i</sub>                  | Y <sub>i</sub> | X <sub>i</sub>                         | Y <sub>i</sub> | X <sub>i</sub> | Y <sub>i</sub> |
| High starting Ability (B <sub>1</sub> ) | N                 | 10                              | 10             | 10                                     | 10             | 20             | 20             |
|   | $\bar{X}/\bar{Y}$ | 63,19                           | 80,32          | 61,81                                  | 72,70          | 62,50          | 76,51          |
|   | Mo                | 65,63                           | 80,00          | 62,50                                  | 71,43          | 62,50          | 71,43          |
|   | Me                | 65,63                           | 80,00          | 62,50                                  | 74,29          | 62,50          | 77,14          |
|   | SD                | 6,40                            | 5,43           | 7,93                                   | 5,55           | 7,03           | 6,75           |
|   | Min               | 50,00                           | 71,43          | 46,88                                  | 62,86          | 46,88          | 62,86          |
|   | Max               | 71,88                           | 88,57          | 71,88                                  | 80,00          | 71,88          | 88,57          |
| Low (B <sub>2</sub> )                   | N                 | 10                              | 10             | 10                                     | 10             | 20             | 20             |
|   | $\bar{X}/\bar{Y}$ | 56,25                           | 74,29          | 59,03                                  | 76,19          | 57,64          | 75,24          |
|   | Mo                | 50,00                           | 71,43          | 46,88                                  | 74,29          | 53,13          | 74,29          |
|   | Me                | 56,25                           | 71,43          | 56,25                                  | 74,29          | 56,25          | 74,29          |



| Initial Ability<br>(B) | Online Learning Strategy (A)       |                |  |                | $\Sigma$       |                |
|------------------------|------------------------------------|----------------|--|----------------|----------------|----------------|
|                        | Collaborative<br>(A <sub>1</sub> ) |                | Direct<br>Instructional<br>(A <sub>2</sub> ) |                |                |                |
|                        | X <sub>i</sub>                     | Y <sub>i</sub> | X <sub>i</sub>                               | Y <sub>i</sub> | X <sub>i</sub> | Y <sub>i</sub> |
| SD                     | 8,12                               | 6,55           | 10,18  | 7,00           | 9,05           | 6,65           |
| Min                    | 43,75                              | 65,71          | 46,88  | 65,71          | 43,75          | 65,71          |
| Max                    | 68,75                              | 85,71          | 75,00  | 88,57          | 75,00          | 85,57          |

**Table 3. Summary of Hypothesis Test with ANOVA**

| Sumber Varians        | JK <sub>y res</sub> | Db | RJK yres | F <sub>o</sub> | F-table $\alpha = 0,05$ |
|-----------------------|---------------------|----|----------|----------------|-------------------------|
| Antar A               | 98.00               | 1  | 98.00    | 9.64           | 4.20                    |
| Antar B               | 28.13               | 1  | 28.13    | 2.77           | 4.20                    |
| Interaksi A x B       | 103.67              | 1  | 103.67   | 10.20          | 4.20                    |
| Initial knowledge (X) | 902.11              | 1  | 902.11   | 88.74          | 4.20                    |
| Deep                  | 315.13              | 31 | 10.17    |                |                         |
| Total                 | 544.92              | 34 |          |                |                         |

\*\* = Significant ( $F_{calculate} > F_{table}$  on alpha 0.05)

<sup>is</sup> = insignificant ( $F_{calculate} < F_{table}$ )

Information:

db = free degree

JK<sub>res</sub> = Number of squares of residues

RJK<sub>res</sub> = Average sum of squares of residues

The results of the calculation of variance analysis (Table 4.14) on the source of variance of AxB interaction significantly there is an interaction between learning strategies and initial abilities as evidenced by  $F_{calculate} = 10,20 > F_{table} = 4,20$ ; then it is necessary to do further tests with the Tukey Test, and the calculation results are presented in Table 4.

**Table 4. Summary of Advanced Tests with Tukey Tests**

| Criterion  | Hypothesis  | Q <sub>count</sub> | Q <sub>table</sub> | Decision                |
|--|---|--------------------|--------------------|-------------------------|
| Rejected H <sub>0</sub> if<br>Q <sub>c</sub> > Q <sub>t</sub><br>Accepted H <sub>0</sub> if<br>Q <sub>c</sub> < Q <sub>t</sub> | H <sub>0</sub> : $\mu_{11} \leq \mu_{21}$<br>H <sub>1</sub> : $\mu_{11} > \mu_{21}$ | 6,33               | 4,41               | H <sub>0</sub> Rejected |
|  | H <sub>0</sub> : $\mu_{12} \geq \mu_{22}$<br>H <sub>1</sub> : $\mu_{12} < \mu_{22}$ | 0,11               | 4,41               | H <sub>0</sub> Accepted |



|  |   |      |      |                |
|--|---|------|------|----------------|
|  | $H_0: \mu_{11} \leq \mu_{12}$<br>$H_1: \mu_{11} > \mu_{12}$ | 1,47 | 4,41 | $H_0$ Accepted |
|  | $H_0: \mu_{21} \geq \mu_{22}$<br>$H_1: \mu_{21} < \mu_{22}$ | 4,96 | 4,41 | $H_0$ Rejected |

**Table 5. Residual Average Test Calculation Results**

| No. | Group                         | $\bar{Y}$ | $\bar{Y}$ (Corrected) |
|-----|-------------------------------|-----------|-----------------------|
| 1   | A <sub>1</sub>                | 77.30     | 77.52                 |
| 2   | A <sub>2</sub>                | 74.44     | 74.22                 |
| 3   | B <sub>1</sub>                | 76.98     | 75.42                 |
| 4   | B <sub>2</sub>                | 74.76     | 76.32                 |
| 5   | A <sub>1</sub> B <sub>1</sub> | 80.32     | 78.31                 |
| 6   | A <sub>1</sub> B <sub>2</sub> | 74.29     | 76.74                 |
| 7   | A <sub>2</sub> B <sub>1</sub> | 72.70     | 71.58                 |
| 8   | A <sub>2</sub> B <sub>2</sub> | 76.19     | 76.86                 |

Observational data shows student involvement in collaborative online learning and direct online learning groups as follows:

**Table 6. Number of Student Activities**

| No. | Experimental Class            |                               | Control Class                 |                               |
|-----|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
|     | A <sub>1</sub> B <sub>1</sub> | A <sub>1</sub> B <sub>2</sub> | A <sub>2</sub> B <sub>1</sub> | A <sub>2</sub> B <sub>2</sub> |
| 1   | 30                            | 28                            | 14                            | 14                            |
| 2   | 30                            | 30                            | 13                            | 14                            |
| 3   | 31                            | 30                            | 13                            | 13                            |
| 4   | 30                            | 32                            | 17                            | 16                            |
| 5   | 31                            | 32                            | 16                            | 16                            |
| 6   | 30                            | 30                            | 17                            | 16                            |
| 7   | 30                            | 29                            | 15                            | 15                            |
| 8   | 31                            | 30                            | 14                            | 14                            |
| 9   | 32                            | 32                            | 13                            | 13                            |
| 10  | 30                            | 30                            | 12                            | 12                            |
| Sum | 305                           | 303                           | 144                           | 143                           |



| No.     | Experimental Class            |                               | Control Class                 |                               |
|---------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
|         | A <sub>1</sub> B <sub>1</sub> | A <sub>1</sub> B <sub>2</sub> | A <sub>2</sub> B <sub>1</sub> | A <sub>2</sub> B <sub>2</sub> |
| Average | 55.45                         | 55.09                         | 26.18                         | 26.00                         |
| Maximum | 32                            | 32                            | 17                            | 16                            |
| Minimum | 30                            | 28                            | 12                            | 12                            |

**Table 7. One Sample Statistics**

| One-Sample Statistics |    |       |                |                 |
|-----------------------|----|-------|----------------|-----------------|
|                       | N  | Mean  | Std. Deviation | Std. Error Mean |
| A1B1                  | 10 | 30,50 | ,707           | ,224            |
| A1B2                  | 10 | 30,30 | 1,337          | ,423            |
| A2B1                  | 10 | 14,40 | 1,776          | ,562            |
| A2B2                  | 10 | 14,30 | 1,418          | ,448            |

**Table 8. One Sample Test**

| One-Sample Test |                |    |                 |                 |   |       |
|-----------------|----------------|----|-----------------|-----------------|---|-------|
|                 | Test Value = 0 |    |                 |                 |   |       |
|                 | t              | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference |       |
|                 |                |    |                 |                 | Lower                                     | Upper |
| A1B1            | 136,400        | 9  | ,000            | 30,500          | 29,99                                     | 31,01 |
| A1B2            | 71,639         | 9  | ,000            | 30,300          | 29,34                                     | 31,26 |
| A2B1            | 25,634         | 9  | ,000            | 14,400          | 13,13                                     | 15,67 |
| A2B2            | 31,887         | 9  | ,000            | 14,300          | 13,29                                     | 15,31 |

### 3. RESULTS & DISCUSSION

The results of the variance analysis test and Tukey test can be explained as follows:

#### 1. Differences in mechatronics learning outcomes between students who use *collaborative online learning* and *direct online learning strategies*

The results of the ANOVA calculation (Table 3) on the source of variance between A show that the value  $F_{\text{calculate}}$  as big as  $9,64 >$  value  $F_{\text{table}}$  By 4.20 at  $\alpha = 0.05$ , the null hypothesis is rejected Or there are differences in mechatronics learning outcomes between students taught with collaborative online learning and direct online learning strategies. Furthermore, the acquisition of the average score of learning outcomes of student groups taught with *collaborative online learning strategies*  $\bar{Y}_{A1} = 77,30$  and student groups taught with *direct online learning strategies*  $\bar{Y}_{A2} = 74,44$ .

#### 2. Differences in mechatronics learning outcomes of students who have high and low initial abilities (*main effect*)



The results of ANOVA calculations (Table 3) on the source of variance between B show that  $F_{\text{calculate}} = 2.77 < F_{\text{table}} = 4.20$  at  $\alpha = 0.05$  then  $H_0$  was accepted and  $H_1$  was rejected, or there was no difference in mechatronics learning outcomes between students who had high and low initial abilities. On the other hand, the average value of learning outcomes of students who have high initial ability scores is higher than the average value of learning outcomes of students who have low initial ability, but statistically, the difference is not significant. In other words, the learning outcomes of students who have high initial abilities with low are not much different or the same. So the research hypothesis states that there is a difference between the mechatronics learning outcomes of students who have high initial abilities, the same learning outcomes and those with low initial abilities.

### **3. The interaction between online learning strategies and initial abilities on mechatronics learning outcomes (*interaction effect*)**

The results of the ANOVA calculation (Table 3) on the source of variance of Interaction A x B show that the  $F_{\text{calculate}}$  price is  $10.20 >$  the  $F_{\text{table}}$  value is  $4.20$  at  $\alpha = 0.05$ , then  $H_0$  is rejected and  $H_1$  is accepted. This means that learning strategies have an influence on mechatronic learning outcomes depending on initial ability, and vice versa. Thus the research hypothesis states that there is an interaction between learning strategies and initial abilities on learning outcomes.

### **4 Differences in mechatronics learning outcomes of students who use collaborative online learning and Direct online learning strategies, in students who have high initial abilities (*simple effect*)**

The results of further tests with the Tukey test in Table 3 show that the comparison of mechatronics learning outcomes of students who use collaborative online learning and direct online learning in students who have high initial abilities obtained  $Q_{\text{calculate}}$  values =  $6.33 > Q_{\text{table}} = 4.41$  at  $\alpha = 0.05$ ,  $H_0$  was rejected and  $H_1$  was accepted, thus it can be said that the mechatronics learning outcomes of students who use collaborative online learning are higher than the value of learning outcomes Students who use direct online learning strategies in students who have high initial abilities.

Based on the average residual test results (Table 4) obtained values  $\bar{Y}_{(\text{res})A1B1} = 78,31 > \bar{Y}_{(\text{res})A2B1} = 71,58$ , This means that the mechatronics learning outcomes of students who learn using collaborative online learning strategies are higher than the learning outcomes of students who learn with direct online learning in students who have high initial abilities. These results also show that students who have high initial abilities will be very appropriate to be applied with collaborative online learning strategies. Thus, it can be concluded that the mechatronics learning outcomes of students who learn with collaborative online learning are better than the learning outcomes of students who learn using direct online learning for students who have high initial abilities. Furthermore, the research hypothesis that states that mechatronics learning outcomes for students who use collaborative online learning are higher than students who use direct online learning, in students who have high initial abilities are tested for truth.

### **5. Differences in mechatronics learning outcomes of students who use collaborative online learning and direct online learning strategies, in students who have low initial abilities (*simple effect*)**

Based on the results of further tests with the Tukey test in Table 3, it is known that the comparison of mechatronics learning outcomes of students taught using collaborative online learning and direct online learning strategies in students who have low initial abilities obtained scores  $Q_{\text{calculate}} = 0,11 < Q_{\text{table}} = 4,41$  in  $\alpha = 0,05$ ,  $H_0$



accepted and  $H_1$  Rejected, thus there is no difference in mechatronics learning outcomes of students who use collaborative online learning and direct online learning in students who have low initial abilities.

Based on the average residual test result (Table 4) obtained values  $\bar{Y}_{(res)A_1B_2} = 76,74 > \bar{Y}_{(res)A_2B_2} = 76,86$ . Thus, it can be concluded that there is no difference in mechatronics learning outcomes of students who learn with collaborative online learning and direct online learning, for students who have low initial abilities. Furthermore, the research hypothesis that states that the mechatronics learning outcomes of students who learn with collaborative online learning are lower than students who use direct online learning, in students who have a tendency to low initial abilities show untested. Table 6 shows that there are differences in student activity in providing responses in the form of problem-solving answers to questions given by lecturers. From the difference test to class groups  $A_1B_1$ ,  $A_1B_2$ ,  $A_2B_1$ ,  $A_2B_2$ , using the t-test, there are mean difference results of 30,500, 30,300, 14,400, and 14,300 which means that in the group of students who learn with collaborative online learning strategies grow higher activeness than direct online learning.

Data analysis of the results of the study showed that the learning outcomes of Mechatronics students who participated in learning with collaborative online learning (experimental class), were higher than students who participated in learning using direct online learning (control class). These empirical results are in line *with the concept of collaborative online learning*, which is learning that combines online independent *learning*, and face-to-face learning with the presence of teachers (teachers) in the classroom. This combination according to the Sloan Consortium effectively and efficiently reduces learning time.

Computer-aided online learning, especially to deliver brief explanations in workshops (shop-talk) and essential competency demonstration videos, makes learning materials can be studied repeatedly at any time according to student needs. Access to learning materials packaged in digital format as independent learning materials outside the classroom, helps students to study teaching materials early and do practice assignments and repeat them at any time so that students have *the prior knowledge* (supporting knowledge) needed for Mechatronics practice.

Self-study materials in digital formats, such as this video, cannot be included in teaching materials for direct online learning in the form of printed materials. This is the advantage of *computer-aided online teaching materials*. Demonstration videos can make it easier for students who take part in collaborative online learning to learn essential competencies repeatedly as desired. Through this video, students' understanding of the technique of operating a lathe becomes better. Students' understanding of the concept of Mechatronics is a good initial knowledge for the practice of compiling work steps in each Mechatronics practical task.

Higher Mechatronics learning outcomes are the result of allocating more time to interact with shop-talk materials and essential competence demonstration videos. This is in line with the results of Fisher's research, Rosenshine; Stallings & Kaskowitz, which state that the time allocated and used for a particular task (*academic learning time*) is very closely related to the academic achievement of learners. The classes where learners spend most of their time engaged in academic tasks are those that provide a place for students to achieve the highest academic achievement.

Allocation of more time for task completion independently, by not waiting for examples from friends in this *collaborative online learning class*, directly increases the opportunity to learn, which is the amount of time given by lecturers to students to complete certain academic tasks, and increases time on task, which is the time of involvement or time that students spend doing academic tasks. The allocation of time that causes higher *opportunity to learn* and *time on task*, combined with better prior knowledge (*prior knowledge*) is a factor that makes the Mechatronics learning outcomes of students who participate in learning using collaborative online



learning higher than students who follow learning with direct online learning.

Mechatronics learning outcomes of students who follow learning with collaborative online learning strategies, *higher than those who follow learning with direct online learning, which is predicted because they have better time on task*, is in line with the results or findings of research conducted by Cobanoglu & Yurdakul, that learning using collaborative online learning has a tendency to be more on additional elements of learning time, and learning resources that encourage interaction practices between students or learners with learning resources. Both variables open up a wide range of possibilities contributing to very positive outcomes for *collaborative online learning strategies*.

The results of this study are also in line with the opinions of some experts, and other research results. (Garrison & Kanuka, in Al-Azawei et al., 2017) Collaborative *online learning* has been widely adopted as a compromise between traditional and digital learning. *Collaborative online learning means "the integration of an immersive classroom face-to-face learning experience with an online learning experience"*. The results of research by Pérez-López and Rodríguez-Ariza (in Al-Azawei et al., 2017) also confirm the results of this study, that *collaborative online learning* can positively affect student satisfaction and performance.

The influence of such interaction, the influence of learning strategies on Mechatronics learning outcomes does not depend on the initial ability of students. Based on data that shows the interaction of influences in this study, it can be concluded that to improve Mechatronics learning outcomes students who have high *initial* abilities, it is more suitable to follow learning with collaborative online learning strategies, *while for students it is more suitable to follow Mechatronics learning with direct online learning*. As a consequence of the results of such research, Mechatronics learning is carried out with two strategies at once, *collaborative online learning* and direct online learning.

These empirical findings are in line with the theory of the influence of prior learning on learning. According to Gardner, a person's learning ability is influenced by an individual's innate potential, such as intelligence and prior knowledge. The characteristics of Mechatronics learning materials are identical to the characteristics of learning materials for the Mechanical Engineering expertise program. The compatibility of characteristics between learning materials following learning with collaborative online learning is easier and faster to understand learning materials, has more time to improve mastery of learning materials obtained from friends of group members.

The results of the study that students who participated in Mechatronics learning with collaborative online learning had higher learning outcomes than students who participated in learning with direct online learning, mainly due to better *prior knowledge*. The results of this study are in line with the results of Macbeth (Arends, 2009) research that knowledge is organized into knowledge networks, and previous knowledge filters new information so as to determine whether the information presented or presented will be integrated and stored in student memory. However, the difference in the average learning outcomes of Mechatronics, which is descriptively lower, after statistical analysis, the difference is not significant so that between the two average learning outcomes it is stated that there is no difference.

Mechatronics learning with collaborative online learning is learning that combines face-to-face, and independent online. Online self-study is conducted outside the classroom before face-to-face sessions. The steps, (a) access to teaching materials in the form of basic concepts of turning (text, illustration images); (b) study demonstration videos of work steps at each stage of Mechatronics practical assignments; (c) take computer-based teaching material mastery tests with direct feedback.

Students who take part in Mechatronics learning with collaborative online learning have difficulty in understanding Mechatronics learning materials that must be studied independently (*Autonomous Work Sheet*).



Difficulty understanding new teaching materials can be facilitated when it comes to the guided practice stage in face-to-face learning sessions in class. In guided training activities, there is interaction between lecturers and students, as well as remedial activities to improve mastery of the material, so students need more time to be able to understand teaching materials.

Students are easier to adapt to the conventional learning environment because they get direction, guidance, and intensive mentoring. Students in semester V will gain a better understanding of the learning material so that they are able to adapt to higher material which ultimately achieves higher Mechatronics learning outcomes.

However, in this study, the hypothesis states; Mechatronics learning outcomes of students who participate in learning with collaborative online learning are lower than students who follow learning with conventional strategies rejected or not proven. Regarding the rejection of the hypothesis, several things can be explained:

First, from the descriptive analysis, it can be seen that the Mechatronics learning outcomes of students who take part in learning with collaborative online learning are lower than students who follow learning with conventional strategies. However, the difference or difference in learning outcomes is relatively small, which from the results of statistical analysis is not significant so that the two Mechatronics learning outcomes are declared no different.

Second, the relatively small difference in Mechatronics learning outcomes between students who participated in learning with collaborative online learning and students who participated in learning with a conventional approach can be caused by weakness in internal validity control, especially in controlling the separation between experimental class samples and control classes. The research was conducted at the Machining Workshop of the Department of Mechanical Engineering Education FT UNJ whose implementation follows a regular lecture schedule. The samples of the experimental class and the control class are students of one batch who are taking the Mechatronics course. Outside of class, they see each other every college day. There is a possibility that outside the classroom they interact with each other, learn together, discuss Mechatronics teaching materials and so on so that their activities outside the classroom can affect Mechatronics learning outcomes.

Third, the difference in Mechatronics learning outcomes between students who take part in learning with collaborative online learning and students who follow learning with conventional strategies can be caused by the quality of Mechatronics learning outcomes tests that researchers develop. There is a possibility, even though it has been declared valid from testing content *validity* and empirical validity, and is declared reliable based on reliability analysis, but the test is weak in differentiation power or has low difference power so that it is less able to accurately measure differences in student Mechatronics learning outcomes with a small range.

## 6. CONCLUSION

**First:** Collaborative online learning can have a better impact on improving Mechatronics learning outcomes. This is because Collaborative online learning encourages students to be more active, gain more knowledge, and get students used to discussing. Because of its nature that offers to learn, giving (sharing information) will encourage in students to express themselves both in the form of behaviour and verbally. **Second:** There is an influence of interaction between online learning strategies and prior knowledge on Mechatronics learning outcomes. This means that online learning strategies and initial knowledge are two factors that determine student Mechatronics learning outcomes. Therefore, in planning lessons, teachers need to pay attention to the individual characteristics of students so that they can determine the right learning strategy.



**Third:** Important notes in this study show that collaborative online learning is not only appropriate to be taught for students who have high initial ability but also appropriate to teach for students who have low initial ability. This means that collaborative online learning is able to accommodate differences in individual characteristics of students.

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