Interaction Analysis Application of Arduino Industrial Automation Trainer Based on Project to Improve Cognitive Ability and The Bodily-Kinesthetic Ability

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Abstract. This research aims to determine the interaction/influence of the application of Arduino Industrial Automation trainer based on projects to enhance cognitive abilities and The Bodily-Kinesthetic abilities of college students. This research is in the form of quantitative descriptive research. The sample used in this study is one class taken using Saturated Sampling techniques. The research class was treated by using a project-based Arduino Industrial Automation trainer. The independent variables in this study are project-based Arduino Industrial Automation trainer, while the dependent variable is cognitive abilities and The Bodily-Kinesthetic abilities. There are 3 kinds of analysis techniques, namely instrument analysis techniques, prerequisite analysis techniques, and hypothesis analysis techniques. The measured research data are cognitive ability data and The Bodily-Kinesthetic ability data. The analysis of the hypothesis test of this study used the T-Test with a significance level of 5%. T-Test Criteria are as follows, Ho is accepted / H1 is rejected if T count is smaller than T table and Ho is rejected / H1 is accepted if T count is greater than T table. From the results of the instrument test, namely the validation test, there are 75% questions stated valid. For the prerequisite test for the normality of cognitive abilities and The Bodily-Kinesthetic abilities on the pretest and posttest obtained L count < L table means the sample is normally distributed. For the prerequisite test for homogeneity of cognitive abilities and The Bodily-Kinesthetic abilities obtained F count < F table means the sample is homogeneous. The results of the T-test for the first dependent variable cognitive ability obtained T count = 24.41 and T table = 1.697, because T count is greater than T table then Ho1 is rejected, meaning that there is an interaction/influence of the implementation of the Arduino Industrial Automation trainer based on projects in improving cognitive abilities. While the results of the T-test for the dependent variable The Bodily-Kinesthetic ability obtained T count = 18.33 with T table = 1.697, because T count is greater than T table then Ho2 is rejected, it means that there is an interaction/influence of the application of the Arduino Industrial Automation trainer based on the project in increasing The Bodily-Kinesthetic abilities. So that it can be concluded that there is an interaction/influence of the application of the Arduino Industrial Automation trainer based on projects in improving cognitive abilities and The Bodily-Kinesthetic abilities.

Keywords: Industrial Automation Trainer, Arduino, Project, Cognitive, The Bodily-Kinesthetic.
1. Preliminary
In the era of the industrial revolution both 4.0 and 5.0 human resources are required to be able to possess and master several abilities including the ability to innovate, the ability to solve problems, the ability to create something new, the ability to think critically and other abilities in dealing with the problems of science and technology development. Therefore the learning process is needed by an educator or educated to be able to have the knowledge and ability to create something useful for the development of science and technology.

With the ability of educators and educators, it is expected that the learning process will produce better products or outcomes so that this will have an impact on the achievement of the expected learning objectives. One of the learning innovations is to use interesting learning media and produce outcomes that can improve cognitive abilities and other measurable abilities. The use of appropriate learning media must provide stimulation for educated students in the ongoing learning process.

In the learning process in the classroom, it appears that learning has used instructor learning media with an experimental system and the results are still not optimal, because educated just use the media so educated still have difficulty in understanding the concept of electromechanical material. Where the media in question is an industrial automation media trainer that leads to the field of system assembly in the industrial world. This media is a device/system automation media. Utilization of control systems such as computers that are used to control industrial machines and process controls to replace human labor operators.

With this, the research in this study supports the improvement of the ability and work or educated product, so the learning process that is implemented must be truly capacity-based and product-based. One of the abilities needed is cognitive ability and The Bodily-Kinesthetic ability. To be able to measure the value of cognitive abilities and The Bodily-Kinesthetic abilities in the learning process required learning media based on projects. To improve cognitive abilities and educated The Bodily-Kinesthetic abilities, the use of project-based learning media can appropriately be optimized to be able to improve cognitive abilities as well as educated The Bodily-Kinesthetic abilities.

Educated ability can function as a reaction to the learning process carried out during learning activities, especially those relating to the assessment of cognitive domains and The Bodily-Kinesthetic educated abilities. In this study, to measure cognitive abilities and The Bodily-Kinesthetic abilities, industrial automation media trainers are used using project-based Arduino.

2. Method
2.1. Population
The population in this study was 6 (six) semester students totaling 31 students as an experimental class. The sampling procedure in this study uses the Saturated Sampling technique which means that in this study all students have the same opportunity or rights to be able to become a sample in the study.

2.2. Research design
In this study using an experimental research approach to the design of the Control Group pretest-posttest. The sampling procedure in this study used a purposive sampling technique. The sample of the research class was given treatment using an industrial automation media trainer using a project-based Arduino system. After the learning process in the experimental class is carried out, then calculated the average value of achievement (gain) to see changes in values. The independent variable in this study is the application of industrial automation media trainers using the project-based Arduino system. While the dependent variable is cognitive ability and The Bodily-Kinesthetic ability of students.
2.3. Data collection technique
Data collection techniques with the test method that is on the instrument test aspects of cognitive aspects and aspects of The Bodily-Kinesthetic ability. Taking the test scores using the instrument test in the form of a written test for aspects of cognitive abilities and oral tests for aspects of The Bodily-Kinesthetic aspects.

2.4. Data analysis technique
2.4.1. Analysis of Research Prerequisites
Data analysis of test results used to measure cognitive aspects and The Bodily-Kinesthetic aspects of students obtained from the pretest and posttest in the form of written test questions and oral tests. Student pretest and posttest data were tested for normality and homogeneity as a prerequisite test using Lilifort. The results of the prerequisite test are used as a basis for further testing using the T-test on the cognitive abilities and The Bodily-Kinesthetic abilities of students.

2.4.2. Research Hypothesis Analysis
Hypothesis analysis using The T-test. The hypothesis proposed is that there are interactions/effects of the application of industrial automation media trainers using the project-based Arduino system on the cognitive abilities and The Bodily-Kinesthetic abilities of students. The decision-making criteria are as follows:

a) If the significance value is smaller than 0.05 then $H_0$ rejected / $H_1$ be accepted.

b) If the significance value is greater than 0.05 then $H_0$ be accepted / $H_1$ rejected.

3. Results and Discussion
3.1. Results
3.1.1. Student Cognitive Ability Before Treatment (Pretest)
Data on the results of evaluations of students shows that the average value of learning outcomes is still low 50.64. Pretest results from 31 students, the highest score is 60, the lowest score is 35. There are 26 students with fewer categories, and 7 students with enough categories. The data shows that the students' cognitive abilities are not yet optimal.

| No | Class Intervals | Number of Student (f) |
|----|-----------------|-----------------------|
| 1  | 31-35           | 2                     |
| 2  | 36-40           | 4                     |
| 3  | 41-45           | 3                     |
| 4  | 46-50           | 8                     |
| 5  | 51-55           | 7                     |
| 6  | 56-60           | 7                     |
| Total |                   | 31                   |

Table 1. Pretest Cognitive Ability Score

![PEICHART 1. COGNITIVE ABILITY PRETEST SCORE](image)
3.1.2. Cognitive Ability of Students After Treatment (Postest)
Data on the results of evaluations of students after being treated in the process of teaching and learning using industrial automation media trainers using Arduino based on projects shows that the average value of cognitive abilities there is an increase from 50.64 increased to 83.54. This shows that there is a significant increase in the average value.

| No | Class Intervals | Number of Student (f) |
|----|----------------|----------------------|
| 1  | 66-70          | 2                    |
| 2  | 71-75          | 4                    |
| 3  | 76-80          | 3                    |
| 4  | 81-85          | 10                   |
| 5  | 86-90          | 5                    |
| 6  | 91-95          | 8                    |
|    | Total          | 31                   |

3.1.3. The Bodily-Kinesthetic Ability Before Treatment (Pretest)
Data from the evaluation of students' creative abilities shows that the average value of The Bodily-Kinesthetic abilities is still lacking at 50.67.

| No | Class Intervals | Number of Student (f) |
|----|----------------|----------------------|
| 1  | 43-45          | 2                    |
| 2  | 46-48          | 4                    |
| 3  | 49-51          | 3                    |
| 4  | 52-54          | 8                    |
| 5  | 55-57          | 7                    |
| 6  | 58-61          | 7                    |
|    | Total          | 31                   |
3.1.4. The Bodily-Kinesthetic Ability After Treatment (Postest)
Data on the results of evaluations of the The Bodily-Kinesthetic abilities of students after being treated in the teaching and learning process shows that the average value of the The Bodily-Kinesthetic abilities of students there is an increase from 50.67 to 73.87, This shows that there is a significant increase in the average value.

![Pie Chart 3. Pretest Score of Bodily Kinesthetic Ability]

| No | Class Intervals | Number of Student (f) |
|----|-----------------|-----------------------|
| 1  | 63-65           | 2                     |
| 2  | 66-68           | 4                     |
| 3  | 69-71           | 3                     |
| 4  | 72-74           | 8                     |
| 5  | 75-77           | 7                     |
| 6  | 78-80           | 7                     |
| Total |                  | 31                    |

![Pie Chart 4. Postest Score of Bodily Kinesthetic Ability]

3.2. Analysis results
3.2.1. Test for Normality and Homogeneity of Cognitive Abilities
From the results of the pretest normality test students obtained an L count of 0.144 with an L table of 0.161 which indicates that the L count is smaller than the L table, which means that the sample is normally distributed. Whereas for the posttest obtained L count of 0.155 and L table of 0.161 then the L count is smaller than The L table, meaning that the sample is normally distributed. From the pretest and posttest homogeneity test obtained an F count of 1.364 with an F table of 1.840. This shows that the F count is smaller than the F table, meaning that the sample is homogeneous.
Table 5. Cognitive Ability Normality Test Results

| Test  | L_count   | L_table | Test Decision | Conclusion          |
|-------|-----------|---------|---------------|---------------------|
| Pretest | 0.144     | L_{(0.05;22)} = 0.161 | H_0 Be accepted | Normal Distributed |
| Postest | 0.155     | L_{(0.05;22)} = 0.161  | H_0 Be accepted | Normal Distributed  |

Table 6. Homogeneity Test Cognitive Ability Analysis Results

| F_count | F_table | Criteria | Test Decision |
|---------|---------|----------|---------------|
| 1.364   | 1.840   | F_{hitung} ≤ F_{table} | H_0 Be accepted |
|         |         |          | Homogeneous Samples |

3.2.2. Test for Normality and Homogeneity in The Bodily-Kinesthetic Capabilities

From the pretest normality test results obtained by students L count of 0.159 with L table of 0.161 which shows that the L count is smaller than The L table, meaning that the sample is normally distributed. Whereas for The posttest obtained L count is 0.130 and L table is 0.161 then The L count is smaller than The L table, meaning that the sample is normally distributed. From the pretest and posttest homogeneity test obtained an F count of 0.944 with an F table of 1.840. This shows that the F count is smaller than the F table, meaning that the sample is homogeneous.

Table 7. Results of The Bodily-Kinesthetic Ability Normality Test Results

| Test  | L_count   | L_table | Test Decision | Conclusion |
|-------|-----------|---------|---------------|------------|
| Pretest | 0.159     | L_{(0.05;22)} = 0.161 | H_0 Be accepted | Normal Distributed |
| Postest | 0.130     | L_{(0.05;22)} = 0.161 | H_0 Be accepted | Normal Distributed |

Table 8. Homogeneity Ability Test Results Analysis of The Bodily-Kinesthetic

| F_count | F_table | Criteria | Test Decision |
|---------|---------|----------|---------------|
| 0.944   | 1.840   | F_{hitung} ≤ F_{table} | H_0 Be accepted |
|         |         |          | Homogeneous Samples |

3.2.3. T-test for Cognitive Ability

From the T-test results of students' cognitive abilities obtained T count of 24.41 with a T table of 1.697 which shows that T count is greater than T table, it means that there is an interaction/influence between the application of industrial automation media trainers by using project-based Arduino on the cognitive abilities of students.

Table 9. Results of T Cognitive Ability Test Results

| T_count | T_table   | Criteria | Test Decision |
|---------|-----------|----------|---------------|
| 24.41   | 1.697     | T_{table} ≤ T_{count} | H_0 Be accepted |

3.2.4. T-test for The Bodily-Kinesthetic Abilities

From the results of the T-test the The Bodily-Kinesthetic ability of students obtained T count of 18.33 with a T table of 1.697 which shows that the T count is greater than the T table, this means that there is an interaction/influence between the application of industrial automation media trainers and project-based Arduino on The Bodily-Kinesthetic capabilities.

Table 10. Results of T The Bodily-Kinesthetic Ability Test Results

| T_count | T_table   | Criteria | Test Decision |
|---------|-----------|----------|---------------|
| 18.33   | 1.697     | T_{table} ≤ T_{hitung} | H_0 Be accepted |
3.3. Discussion

From the results of the study and the results of data analysis showed that the T-test with a T count greater than the T table with a significance level of 5% indicates that the null hypothesis (H₀) was rejected or hypothesis one (H₁) is accepted, meaning that the application of industrial automation media trainers using the project-based Arduino system has a positive impact in improving students' cognitive abilities and The Bodily-Kinesthetic abilities. This is evident in the application of industrial automation media trainers using the project-based Arduino system that can provide new knowledge to students that we do not stop at one area of expertise but we must master at the same time three areas of expertise namely mechanics, informatics, and electronics that work together in building a media model.

This shows that students are required to be able to apply the knowledge and also must be able to innovate to create media that can stimulate active learning processes. It can also stimulate the ability to be creative, well structured and active in solving problems related to the projects given by lecturers. It can be seen that the teaching and learning process in the class shows the enthusiasm of students in participating in the teaching and learning process and the students seem to be more capable in terms of knowledge and more able to be creative in solving problems encountered, and students have the ability to develop creations well through projects that are completed.

While the media used in the teaching and learning process has a positive function so that it has an impact on improving cognitive abilities and The Bodily-Kinesthetic abilities. It can be seen that with this project-based learning, students in designing a product or making a model of learning media can improve the ability of knowledge and can automatically improve abilities related to motor movements of the brain by controlling body organs such as the ability to use the body easily and dexterously (The Bodily-Kinesthetic skill).

Apart from the results of the T-test which showed the interaction between the independent variable and the dependent variable, it was seen that the average value of the experimental class had higher cognitive abilities and The Bodily-Kinesthetic abilities compared to before treatment. This shows that the application of industrial automation media trainer by using a project-based Arduino system in improving cognitive abilities and The Bodily-Kinesthetic abilities of students works well. Therefore, the application of industrial automation media trainers using the project-based Arduino system can make students more concentrated, easier, more pleasant, and can explore combinations or interact with various scientific fields, and can develop The Bodily-Kinesthetic abilities possessed by each student through work or projects that must be completed properly. From the results of this study it can be seen that project-based learning is very influential in improving cognitive abilities and The Bodily-Kinesthetic abilities of students.

4. Conclusion

Based on the results of The research analysis shows that of the two dependent variables obtained T count > T table it means that there is a significant interaction/influence between the use of industrial automation media trainers by using a project-based Arduino system on the cognitive abilities and The Bodily-Kinesthetic abilities of students.

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