# The Effect of the Discovery Learning Model through the Aptitude Treatment Interaction (ATI) on Student Learning Outcomes on the Human Motion System Concept

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Abstract

This study aimed to determine the effect of the Discovery Learning model through the Aptitude Treatment Interaction on students' cognitive abilities in the concept of the human motion system. The method used in this research is quasi-experimental with a pretest-posttest control group design. The population in this research is all students in grade XI MIPA SMAN A Serang City in the 2021/2022 academic year. The sample of this research is class XI MIPA 1 as the experimental class and class XI MIPA 2 as the control class. The sampling technique used in this research was purposive sampling. Data collection technique used posttest to measure student cognitive abilities taken at the beginning and the end of learning. Learning outcomes showed that the average value of students' cognitive skills in experimental class is 84, an excellent category. In contrast, the average value in the control class produces a score of 74 in the superb category. To prove the hypothesis, the writer counted the significance by using a t-test (t-test) of the Independent Simple T-test, the student's cognitive learning outcomes are 0,002, so it can be concluded that there is an effect of the discovery learning model through the Aptitude Treatment Interaction (ATI) approach on student learning outcomes on the concept of motion systems in humans.

Keyword: Aptitude Treatment Interaction, Discovery Learning, Cognitive Ability, Human Motion System

## INTRODUCTION

In learning activities, the learning process is the core of learning activities. The teacher's benchmark to see the success of the learning process has been achieved or not, and the learning objectives can be seen from student learning outcomes. Learning outcomes are output values in the form of numbers or letters obtained by students after participating in learning activities and taking a series of tests or exams given by the teacher (Khusna,2013). Learning outcomes are divided into three domains: cognitive, affective, and psychomotor. The success of the learning process cannot separate from various factors such as internal and external factors of students. Students' internal factors come from within students, while external factors can come from teachers and student learning. For example, selecting the correct method or model is a success factor in transferring knowledge from teachers to students.

According to Ficha (2017), the learning model is a conceptual framework that describes a systematic procedure for organizing learning experiences to achieve specific goals. In addition to the research above, the discovery learning model is a learning model that was developed based on the constructivist view. The theory of constructivism holds that students are

responsible and active in learning and emphasize their learning outcomes while the teacher is only a guide or facilitator (Fitriyah,2017).

In the 2013 curriculum, students must be active in acquiring knowledge, skills, and attitudes in learning. However, differences in student abilities can also be internal factors that inhibit the learning process. Aptitude Treatment Interaction (ATI) is a concept or approach with some learning strategies (Mirnawati,2019) which are considered adequate for use by individuals according to their respective abilities. Based on observations in one high school in Indonesia, namely SMAN A Serang City, and interviews with biology subject teachers and 15 students of class XI MIPA, the learning carried out is conventional learning. Students only actively record the material following the direction of the teacher so that only students who have a high understanding can receive lessons well. Meanwhile, students with less experience will only follow directions from the teacher. This causes students difficulties in learning.

Based on the needs analysis, students find it challenging to materialize the motion system in humans. Students consider the motion system in humans to require students to understand various kinds of problems, while students are not allowed to explore themselves according to their abilities. According to the circular letter of the Minister of Education and Culture of Indonesia No. 4 of 2020, the implementation of education during the Covid-19 emergency is carried out with the BDR (Learning From Home) system and offline (Kemendikbud, 2020). The learning process is carried out online and face-to-face on a limited basis, following health protocols that must be strictly adhered to.

Based on the problems above, efforts to improve the learning process can facilitate, appreciate and accommodate differences in student abilities in motion system material in the era of the covid-19 pandemic, namely the discovery learning model with the Aptitude Treatment Interaction (ATI) approach through online learning. The results of Muharram's research (2017) show that the application of the ATI approach has a significant effect on learning outcomes. A similar study by Nichen (2018) showed effective results in applying the discovery learning model to learning outcomes. Therefore, based on the description above, it is crucial to research with the title "The Effect of Discovery Learning through Aptitude Treatment Interaction on Learning Outcomes in the Concept of Human Movement System".

**METHOD**

This research was conducted from September 2021–June 2022 at one of the high schools in Indonesia, SMA Negeri A Serang City, in the academic year 2021/2022 at class XI MIPA 1 and MIPA 2 odd semesters. This research used a quasi-experimental design with a quasi-experimental pretest-posttest control group design. The data collection techniques used

objective tests and observations. Meanwhile, in the analysis of the instrument test, validity, reliability, discriminatory power, level of difficulty, and level of difficulty was tested. The data processing technique is to test statistical hypotheses using the T-test. Used the appropriate method, it was suggested to describe the participant, the instrument, the data collection, and the data analysis.

## RESULTS AND DISCUSSION

This study aims to determine the effect of learning outcomes on the cognitive domain after applying the discovery learning model through the aptitude treatment interaction approach. The data obtained from this research are learning outcomes in the cognitive part. The hypothesis of this research was investigated using SPSS version 22 to prove whether or not there is an effect of the discovery learning model through the Aptitude Treatment Interaction (ATI) approach on the cognitive abilities of students in class XI MIPA on the concept of motion systems in humans at SMAN A Serang City. Before testing the hypothesis to compare the significance value (value), the authors conducted statistical tests in the form of the Kolmogorov-Smirnov normality test and the Leneve homogeneity test to test the normality and homogeneity of students' cognitive learning outcomes as a prerequisite for the independent simple T-test (T test).

The Independent simple T-Test test has prerequisites in its testing, such as the data used must be homogeneous (derived from the same variant, besides the data must be homogeneous, the data must also be analyzed for normality beforehand to find out whether the questions used to come from a population that is normally distributed or not. Data on the results of hypothesis testing using SPSS version 22.

**Table 1.** Analysis of Statistical Tests of Student Learning Outcomes in Experiment Class and Control Class

| Statistic Test | Eksperiment Class (Posttest) | Control Class (Posttest) | Description |
|---|---|---|---|
| Normalitas *Kolmogrov-Smirnov Test* | 0,007 | 0,019 | Data is normally distributed |
| Homogenitas Test | 0,550 | | Homogeneous data |
| *Independent Simple T-Test* | 0,002 | 0,002 | $H_0$ rejected |

Based on the statistical test calculations in the Table 1, the normality value in the experimental class was 0.007 and in the control class was 0.019. This indicates that the data used is normally distributed because the importance of 0.007 and 0.019 is more significant than

the significance value criteria of 0.005. Therefore, the normality test is an absolute prerequisite test for the parametric independent simple t-test. If the data is not normally distributed, the further pre-material test cannot be carried out and is replaced with a non-parametric test, namely the Man Whitney test.

In the homogeneity test table, the result is 0.550. The homogeneity test has a significance value criterion of 0.005 (Siregar, 2013). The resulting data get a value of 0.550 > 0.005, so it can be concluded that the data is homogeneous. After the test data for the level of normality and homogeneity, then the further parametric test is the independent simple t-test. Based on the T-test results in the table above, the sig (2-tailed) value is 0.002, where the count is 0.002 < ttabel 0.005. These results can be concluded that this study significantly affects student learning outcomes. Then Ho is rejected, and H1 is accepted. This study greatly influenced students who took part in discovery learning with an aptitude treatment interaction approach to online student learning outcomes.

This effect was caused by the different treatment between XI MIPA 1 class as the experimental class and the XI MIPA 2 class as the control class. Cognitive abilities of class XI MIPA 1 students whose learning applies discovery learning with aptitude treatment interaction have a higher average cognitive ability value than class XI MIPA 2. The average weight of student learning outcomes is shown in Figure 1.
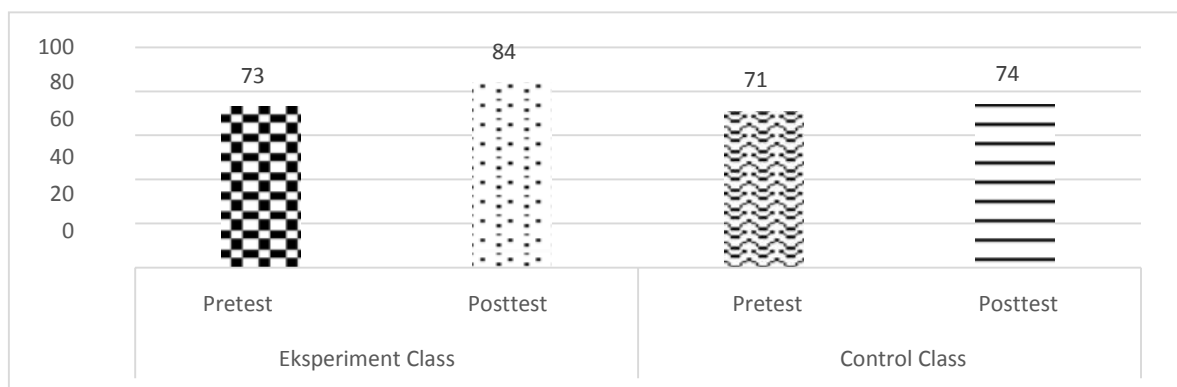


Figure 1. The average value of students' cognitive abilities in the experimental class and the control class

The average value of the experimental class students' cognitive abilities was higher than the control class due to different treatments. Students in class XI MIPA 1 were more directed and given therapy according to their level of cognitive ability. In high-ability students, the teacher is more directed to self-learning by providing a stimulus at the beginning of learning and teaching materials. Furthermore, students are given the breadth of independent learning (with a little teacher role). For example, students are directed to fill in crossword puzzles

provided by the teacher, and this is done because high-ability students are happier and more focused if they work individually.

In moderately capable students, students carry out learning activities using discovery learning syntax in general, namely stimulation, problem identification, data collection, data processing, hypothesis proofing, and concluding (Tumurun, 2014). Meanwhile, students with low abilities repeated learning, and the teacher's participation was more dominant than the groups of students with high and medium skills.

The average value of students' cognitive abilities in the experimental class was 84, with an excellent category and an increase in value from before the treatment application to after. In contrast, in the control class, it was obtained at 74. This proves that applying discovery learning through the aptitude treatment interaction approach has a positive effect. This difference in average value can also be caused by the fact that during class XI MIPA 1, students are more active in asking questions and reciprocity occurs with the teacher. This is following research conducted by Kristin (2016), where the main characteristics of discovery learning are (1) student-centered; (2) exploring and solving problems to create, relate, and generalize knowledge; (3) activities to combine new knowledge and existing knowledge.

In the control class, students tend to be silent only when the teacher asks questions, and students respond differently to the experimental category. Students in the practical class enjoy discussing more when they are divided into small groups (groups based on their abilities). This is similar to Hafidhawati's research (2016) which states that the ATI learning model says that an effective learning model is used for students who have different abilities in understanding lessons effectively, namely the ATI learning model, so that students are more comfortable with their learning. In this study, students who received different treatments based on the cognitive level of each student based on the results of the pretest can be seen in Figure 2.
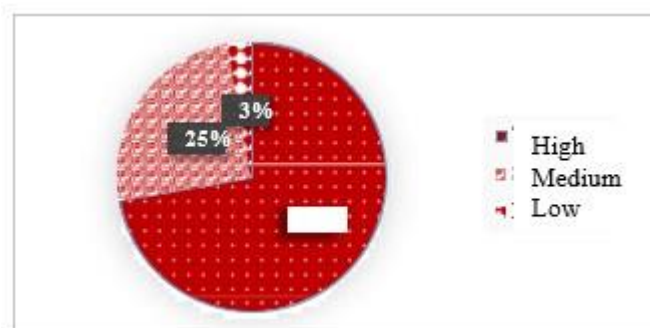


Figure 2. The average value of students' cognitive abilities in the experimental class and the control class

Figure 2 shows that as many as 16 students have high ability in the material system of motion in humans, nine students are moderately capable, and only 1 student has low ability in

the motion system in humans. After doing the initial ability test (Pre-test), students carry out learning activities with different treatments according to the results obtained. In this study, data collection was carried out in two meetings, each session discussing a different topic regarding the material for the motion system in humans.

At the first meeting of the experimental class, the first stage was the provision of a stimulus in the form of the question, "why can humans move freely while robots can't?". It is intended that students are more stimulated to participate actively in learning. In addition, it aims to make students have more focused thinking concepts. Then the teacher gives a power point containing teaching materials that will be delivered during the lesson. Finally, the teacher provides learning media in the form of crossword puzzles which means that students can collect information and evidence to support their frame of mind.

After that, students work according to their level of cognitive ability. High abilities will be directed to self-learning with the help of relevant references from the teacher. However, in practice, high-ability students remain proactive in learning. These activities include asking the teacher and discussing between peers through Whatsapp groups. Students with moderate abilities will be directed to do learning according to the discovery learning syntax. Meanwhile, for students with low abilities, treatment will be carried out in the form of repetition of material with teacher assistance and optimal use of learning aids or media (video and voice notes from the teacher).

This is following the design of the Aptitude Treatment Interaction (ATI) learning model written in Sarif Nurdin's book entitled Quantum teaching, a learning model that pays attention to the diversity of individual students in a competency-based curriculum (Nurdin, 2015).

In the control class, there is no categorization/grouping of students based on the level of cognitive ability, and this is because this study only aims to see the effect of using models, treatments, and media in each experimental class (XI MIPA 1) and control class (XI MIPA 2). The purpose of grouping students based on their ability level means that students are more effectively and optimally facilitated so that students are more motivated to study harder, and students can also express the learning styles that are adjusted to the level of students' abilities themselves. In addition to the initial value data of students, other data that support this research have a positive effect, namely the analysis of the average value of students' abilities based on the indicators of the questions discussed in the next point.

Student's cognitive abilities were measured using post-test questions that were made based on 8 learning indicators, and the 8 indicators were designed using the formulas A (Audience), B (Behavior), C (Condition), and D (Degree) (Octaviani, 2018). The 8 indicators

are: (1) describing the function of the body's skeleton; (2) distinguish the types of joints based on their shape, size, and constituent tissues and their constituent matrices in humans; (3) link the structure of the constituent tissues and functions of human bones, joints, and muscles; (4) classify the types of muscles and joints based on the system of the cells that make up the movement they cause, their location in the body, the nature and manner of their movement; (5) describe the abnormalities that occur in the bones, muscles, and joints; (6) describe the relationship between bones and the various relationships; (7) describe the mechanism of muscle contraction; (8) describes the relationship between bones, muscles, and joints in humans.

The complete calculation of the acquisition of students' cognitive abilities can be seen in the appendix (Appendix 24). The average score of students' cognitive abilities is shown in Figure 3.



5.3.1 Describe the function of the skeleton
5.3.2 Distinguish the types of joints based on their shape, size, constituent tissues, and their constituent matrix
5.3.3 Linking the structure and function of human bones, joints, and muscles
5.3.4 Classify the types of muscles and joints based on the structure of their constituent cells, the movement they cause, their location in the body, and the nature and manner of their movement
5.3.5 Describe the abnormalities that occur in muscles and joints
5.3.6 Describe the relationship between bones and the various relationships
5.3.7 Describe the mechanism of muscle contraction
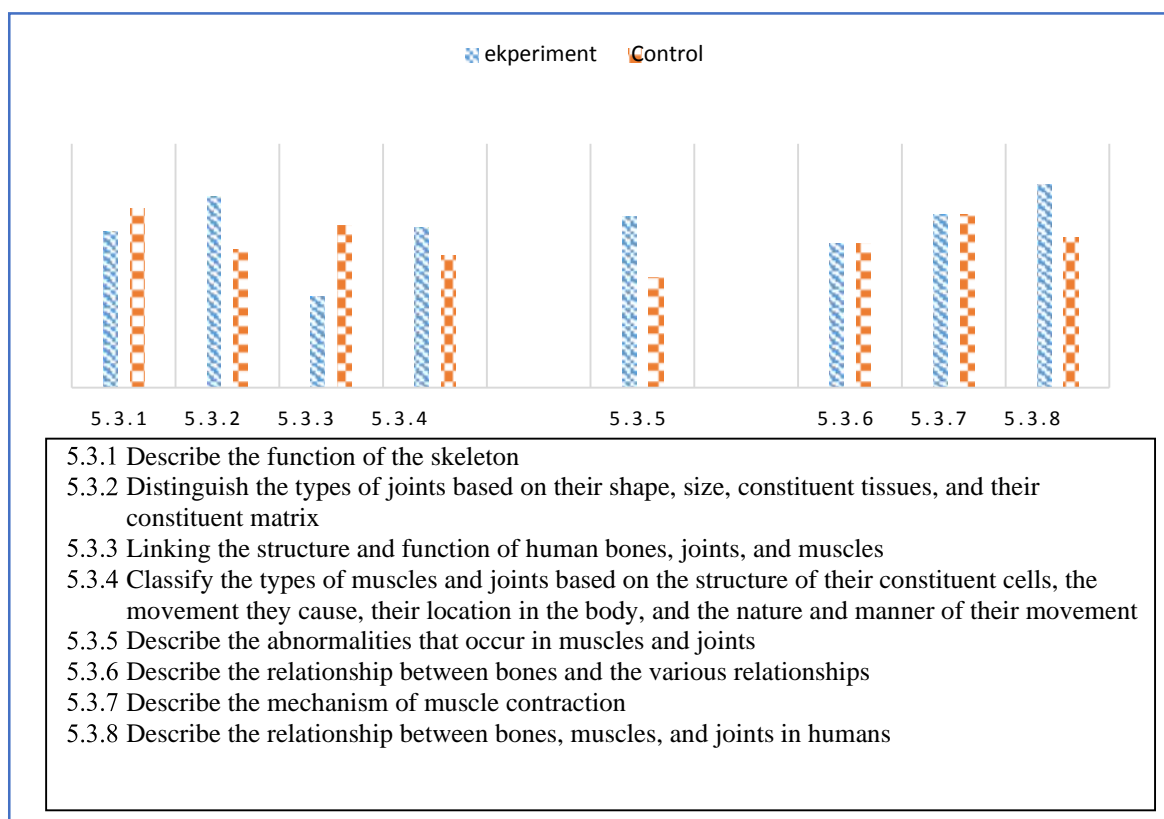5.3.8 Describe the relationship between bones, muscles, and joints in humans

Figure 3. The average value of each indicator of students' cognitive abilities

Based on Figure 3 shows that the acquisition of student scores in the experimental class is superior to the addition of cognitive abilities in the control class. The lowest score in the experimental class is in the indicator of competency achievement 3 (5.3.3), with a score of 45. While the GPA of 5.3.3 refers to item number 7, where students are presented with a brief description and asked to relate it to the function of the body's skeleton. The operational verb linking is included in the KKO at the cognitive level of level 4, namely analyzing (Riyanto, 2010). Apart from the cognitive level, based on the instrument test analysis, the items'

discriminatory power level is sufficient to outwit the students' answers (Appendix 12). Students' internal factors can also affect student learning outcomes. At the time of online learning, it is undeniable that learning feels more challenging because of the increasing number of challenges teachers and students face.

Of all indicators of competency achievement, the aspect of competency achievement indicator 8 (5.3.8) obtained the highest score compared to other indicators. Namely, the experimental class got a score of 100, whereas, in the experimental class, none of the students answered incorrectly on item 4. This is because when viewed from a cognitive level, GPA 5.3.8 refers to item number 4, wherein the question students are asked to explain the function of joints in the human body, the active verb in the question has a cognitive level of level 1 ( C1) besides that when learning takes place in class XI MIPA 1, they are more proactive when learning with the teacher, students are so enthusiastic about asking questions and giving responses during the learning syntax in the core activity, namely at the data collection stage (Appendix 24) so that the questions on number 4 is the primary material that students can easily understand and understand answer correctly.

This shows that students in the experimental class have been able to connect, display, and describe previously obtained information based on fact and concept data to obtain a high average score. This follows the statement put forward by Mubarok (2014) regarding the theory of constructivism. The most important thing is that in learning, students must get emphasis, and students must actively develop their knowledge where the use of the discovery learning model was developed based on the view of constructivism (Fitriyah, 2017). The achievement of this aspect is influenced by the discovery learning model combined with the aptitude treatment interaction approach, which focuses more on how students can achieve learning goals with the limitations of different student abilities.

The control class got the highest score on the competency achievement indicator, 5.3.1, which was worth 88, while the lowest score in the control class was a GPA of 5.3.5, with a score of 54. This was because in indicator 1 (5.3.1), students were only asked to describe the function of the skeleton in humans and obtained an average score of 88. Meanwhile, with a GPA of 5.3.5, students were asked to describe human bones and joints abnormalities. When viewed from the operative words of the two GPAs, both have different levels. Namely the GPA of 5.3.1 occupies the cognitive level of level 1 (C1). While the GPA of 5.3.5, the operative words used occupy the cognitive level 2 (C2).

Based on the table data above, not only the highest and lowest scores are in the experimental class and the control class, but there are also value gaps in the experimental class

and control class, namely the competency achievement indicator 5.3.3, where the score in the experimental class is lower than the control class. . If viewed from the cognitive level, the GPA of 5.3.3 belongs to the cognitive level 4, namely linking, students are asked to relate the structure of the constituent tissues to the bones. Based on the results of the data above, the GPA of 5.3.3 on item number 7 has a sufficient level of distinguishing power between answers, so that many students make mistakes in choosing the correct answer. The human movement system is a fairly complex material. Students are required to better understand the material carefully, especially the learning that is carried out.

Online learning has a more challenging obstacle than simply exchanging opinions. During the implementation of online learning, the author found many obstacles, such as the distance between teachers and students. This distance makes students less controlled by the teacher. Based on the results that students have done in the experimental class, nine high-ability students answered incorrectly, and 7 moderately capable students answered incorrectly. This can be caused lack of teacher participation in learning for high and medium-ability students.

High-ability and moderate-ability students are more directed by the teacher to a constructivist attitude, and there is no repetition in contrast to the case of low-ability students and the control class who apply conventional learning as the method of discussion by teachers and peers. Based on this, it turns out that the Aptitude Treatment Interaction (ATI) approach, besides having advantages, also has disadvantages such as in its implementation, such as more complex learning syntax when juxtaposed with the ATI approach, comparing students' abilities can create social jealousy between students so that students are less motivated (Wiyanto, 2010). After the treatment was given to class XI MIPA 1, namely the experimental class in the form of the application of discovery learning models through the aptitude treatment interaction approach, students' abilities experienced a positive increase, this can be seen from the value of student learning outcomes before and after the treatment is given, these results can be seen in the Figure 4.
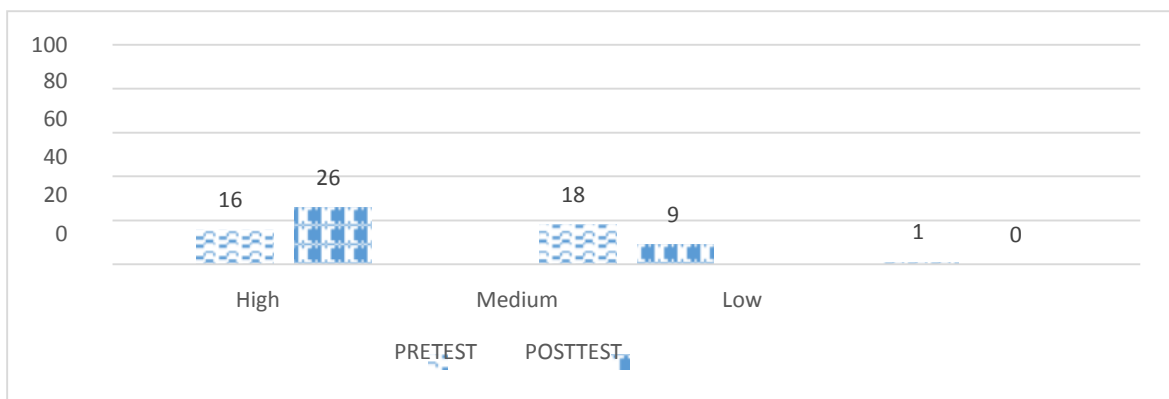


Figure 4. Comparison of Pretest-Posttest experimental class

Based on Figure 4, it is known that there is a significant increase in the ratio of students with high abilities while those with moderate and low skills have decreased. This can be caused by two factors, namely internal and external factors of students. Internal factors come from within the students themselves, such as examples of students' health conditions so that students are less concentrated in learning. External factors can be generated from outside students. Such as inaccurate learning methods or media selection, less conducive conditions during Darling's knowledge, and lack of teacher approach time.

So that the closeness of teachers with students is not well established, so students are not optimal at the time of learning. The difficulty of teaching when learning online is more challenging because teachers and students do not meet and communicate directly, which allows many external factors to interfere with the learning process.

For students with medium and low categories, getting a low percentage can happen because, during the questioning session, students who do not understand the material are embarrassed to ask directly the teacher regarding the material they do not understand. Therefore, online learning is a challenge for students and teachers. In online learning, the teacher must be more creative and create a more pleasant learning atmosphere that can condition students who are hindered by distance, conditions, and other circumstances. Meanwhile, from the student's side, students must be more active and enthusiastic, and their willingness and encouragement to learn must be improved.

In the pretest-posttest comparison data above, students with low abilities tend to get bad scores before and after the study. This difference can be caused by the number of students in the lower-level WhatsApp group being less. This condition can cause suspicion in students so that students feel less fair and different from others. This is following research conducted by Qurotul (2019) that Aptitude Treatment Interaction has shortcomings such as (1) differentiating students' abilities can make students feel unfair; (2) takes a long time for students; (3) requires special abilities, so not all teachers can do it.

In addition to the data above, which proves the data has a significant influence on student learning outcomes. Researchers also tested the effectiveness of the application of discovery learning through aptitude treatment interaction on student learning outcomes. Researchers tested it using the normalized gain test or N-Gain score, and the following data were in Table 2.

Table 2. Test results N – Gain score

| Average | Eksperiment Class | Control Class |
|---|---|---|
| | 200 | 400 |
| Minimum | -100 | -300 |
| Maximum | 100 | 400 |
| Description | Effective | effective |

Based on the N-gain score test data above, the n-gain score in the experimental class was 200 in the practical category. In the control class, the n-gain score was 400 in the practical category. This shows that the application of discovery learning through aptitude treatment interaction effectively improves student learning outcomes on the concept of motion systems in humans. Similar research was conducted by Nastiti (2012) regarding the discovery learning model that was effectively used on students' abilities.

Previous research by Noor (2014) also showed a significant effect on the application of aptitude treatment interaction on student learning outcomes. I just wrote suggesting that other learning models be used for maximum results. Therefore, this study combines the application of discovery learning through aptitude treatment interaction with learning outcomes.

**CONCLUSION**

Based on the results of the research that has been done, it can be concluded that the discovery learning model through the Aptitude Treatment Interaction (ATI) approach to student learning outcomes on the concept of the human movement system that has been implemented in class XI MIPA 1 and XI MIPA 2 at one of the high school in Indonesia, namely SMAN A Serang City has a positive effect on student learning outcomes with a significance level of $0.002 < 0.005$, with an average value of 84 in the experimental class in the outstanding category, while in the control class an average value of 74 in the excellent category. This can have an effect because there are differences in the teacher's learning syntax for each student's ability level.

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