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Improving the Ability to Analyze Kinematics Problems Through the Matriculation Program

Venty Sopacua[1]*, Fryan Sopacua[2]

[1] Physics Education Study Program, Faculty of Teacher Training and Education, Pattimura University, Indonesia.

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Corresponding Author:
Venty Sopacua
givensohilait@gmail.com

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Abstract: This study aims to describe the improvement of the ability to analyze kinematics problems through the matriculation program. The subjects of this study were 22 New Students of the 2022 Class of Physics Education Study Program, Pattimura University, Ambon. This study uses quantitative and qualitative descriptive research types. The trial design uses a one group pretest–posttest design. The instrument in this study is the Test Instrument, in this case to measure the improvement of the ability to analyze kinematics problems before and after matriculation. Data analysis in this study was carried out using quantitative descriptive analysis to describe the data as it is in the form of percentages and explain data or events with explanatory sentences qualitatively. The data analysis technique used is qualitative descriptive analysis including: kinematics problem analysis test results. The results of the study showed that 90.9% experienced an increase in their ability to analyze kinematics problems in the medium - high category, and 9.1% in the low category did not experience an increase in their ability to analyze kinematics problems, so it can be concluded that marticulation can improve the ability to analyze kinematics problems of physics education students in the Class of 2022.

Keywords: Marticulation; Kinematics problems; Ability

Introduction

In order to realize the objectives of the National Higher Education Standards, the Physics Education Study Program annually implements programs that can improve the quality of learning, one of which is the matriculation program. Matriculation is known as the annvullen or matriculation program which means fulfilling deficiencies. Matriculation is an activity carried out to fulfill deficiencies or gaps (deficiencies) in knowledge and skills that function as initial abilities needed by students to follow learning activities at a certain level well (Direktorat Pembinaan Sekolah Menengah Atas, 2014). In addition, according to KBBI (2005), the activity of matriculation is an activity to equalize the perceptions and knowledge, skills, and initial attitudes of new students related to the study program they are taking. Matriculation means registering someone at a university. The purpose of matriculation in the matriculation guidebook (Direktorat Pembinaan Sekolah Menengah Atas, 2014) is to achieve the same entry level for all students, containing the consolidation of material that should have been mastered. Matriculation is carried out at the beginning before entering the odd semester. The materials of the marticulation taught in the Physics Education Study Program include materials related to basic physics materials, one of which is kinematics (Uniform Linear Motion, Uniformly Accelerated Linear Motion, Circular Motion, and Parabolic Motion). Thus, the existence of marticulation will have an impact on the preparation of students in receiving lectures, especially on kinematics materials.

Kinematics includes one-dimensional kinematics and two-dimensional kinematics. One-dimensional kinematics is the motion of an object on a straight path where the object is considered a point object, the shape and size of the object are ignored, and the object does not rotate (Fatihah et al., 2023). One-dimensional kinematics also only uses one coordinate, the x-axis or axis. One-dimensional kinematics includes the quantities of distance and displacement, speed and velocity, and acceleration. While two-dimensional kinematics is the motion of an object on a flat plane with a specific discussion on projectile motion and circular motion. This two-dimensional kinematics studies the components of

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the motion of an object in two directions, namely the x and y axes (Fatihah et al., 2023). Learning kinematics means learning concepts and finding the relationship between one concept and another. Kinematics is very closely related to mathematics because many kinematic theories are expressed in mathematical notation. Therefore, many materials in basic physics learning are mathematical in nature, so students do not only memorize the formulas and basic concepts learned, but students must be able to analyze each kinematic concept and formula that will be used in solving kinematic problems.

In Bloom's Taxonomy, analysis is ranked fourth in this taxonomy with the cognitive process of students being able or learning to (1) remember, (2) understand, (3) apply, (4) analyze, (5) evaluate, (6) create. If students have reached the stage of analytical thinking about material or problems, students are automatically able to know, understand, and apply the material presented by the lecturer. Automatically, if students' analytical thinking skills are honed, students can improve all cognitive aspects in learning (Assegaf and Sontani, 2016). In addition, according to Anderson (Rosidatul, 2017), analytical skills involve the process of thinking skills in breaking down material into small parts and determining how the relationships between parts, between each part and the overall structure. Analytical thinking includes cognitive processes, including; (1) distinguishing, (2) organizing, and (3) giving attributes (Rosidatul, 2017). So that students have a HOTS level cognitive level (C4-C6) in solving kinematics problems.

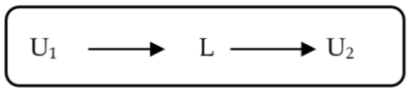
HOTS Level kinematics problem solving is one of the benchmarks for the quality of physics students in the era of the industrial revolution 4.0. Solving kinematics concepts has become a major theme in research. In addition, the ability to analyze helps students construct new information with existing information. According to Hamzah Uno (2010), the ability to solve problems is one of the basic competencies that students must master. This is a very high demand and cannot be achieved only by memorization, routine problem-solving exercises, and the usual learning process.

In order to show that students have good ability in analyzing kinematics problems, an assessment instrument is needed that can measure the ability to analyze kinematics problems. The ability to analyze kinematics problems needs to be assessed before and after matriculation so that the improvement in the ability to analyze kinematics problems can be seen. For that, students not only memorize an equation, but also can know the principles and variables related to the equation so that when given a problem, students can solve it even though it is presented in different forms.

Method

Research Design

The research conducted used quantitative and qualitative descriptive research types. The device trial was conducted using a one group pretest-posttest design trial because it used one group without a comparison group. The device trial was conducted to see the characteristics of the students. This design can be written as follows (Prabowo, 2011):



Information:

U1 is : Pretest to determine initial ability to analyze kinematics questions before taking matriculation.

U2 is : Posttest to determine the ability to analyze kinematics questions after participating in matriculation.

X is : Marticulation with Problem Solving model.

Participant

The subjects of this study were 22 new students of the 2022 Physics Education Study Program, Pattimura University, Ambon.

Research Instruments

The instrument in this study is a Test Instrument, in this case to measure the ability to analyze kinematics questions before and after matriculation.

Data Analysis Techniques

Data analysis in this study was conducted using quantitative descriptive analysis to describe the data as it is in the form of percentages and explain data or events with explanatory sentences qualitatively. Data analysis techniques used include: qualitative descriptive analysis, namely improving the ability to analyze basic physics problems (kinematics).

The increase in analytical ability was measured using normalized gain analysis adapted from Hake's (1999) normalized gain formula (Formula 1).

$$< g > = \frac{(S_{Post}) - (S_{Pre})}{\text{Skor Maksimal} - (S_{Pre})} \quad (1)$$

Information:

g is : Improvement (average normalized gain).

Spre is: Pretest Score.

Spost is: Prottest Score.

Table 1. N-Gain Score Distribution

N-Gain Value	Category
$g > 0.7$	Tall
$0.3 \leq g \leq 0.7$	Currently
$g < 0.3$	Low

Result and Discussion

In this section, the results of the initial and final tests are described before and after treatment was given using the Problem Solving learning model. The students who were the subjects of the study were 22 people who were students of the Class of 2022. The kinematics material provided included the following materials: 1) Uniform Linear Motion, (2) Uniformly Accelerated Linear Motion, (3) Circular Motion, (4) Parabolic Motion. The results of improving the analysis of kinematics problems can be seen in Figure 1 and Figure 2.

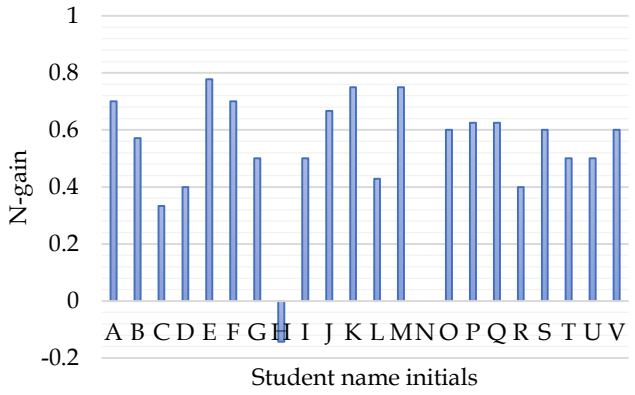


Figure 1. Results of N-Gain Marticulation of Each Student on Kinematics Material

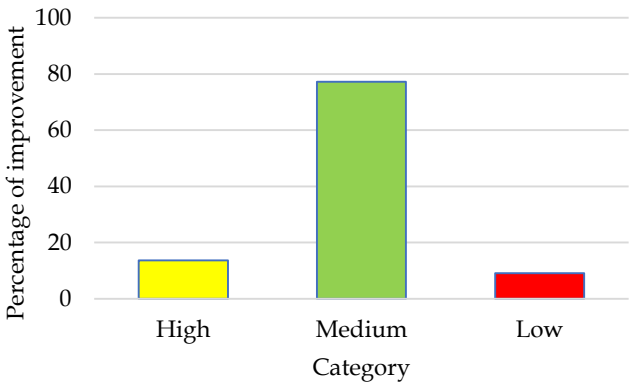


Figure 2. Results of N-Gain Marticulation on Kinematics Material

Based on Figure 3.2, overall students experienced an increase in their ability to analyze kinematics problems. More specifically, it can be seen in Figure 3.1, where there are 3 students with the initials E, K, M who experienced an increase in their ability to analyze kinematics problems classified as high category with N-Gain values of 0.78, 0.75, and 0.75. For the medium category, there are 17 students with N-Gain values of 0.33 - 0.7. For the low category, there are 2 students with N-Gain values of 0 - (-014). Thus, there are 90.9% who experienced an increase in their ability to analyze kinematics problems with medium - high categories, this is because students are able to analyze so that students are able to connect a concept to solve a problem. This is in line with Anderson's opinion (Rosidatul, 2017) who said that analytical skills involve the process of thinking skills in breaking down material into small parts and determining how the parts relate to each other, between each part and the overall structure. In addition, increasing analytical skills in students is related to supporting factors, including the model used and the way the material is delivered. Both of these things can trigger student motivation intrinsically and extrinsically.

According to Gray (Winardi, 2002) motivation is a number of processes, which are internal or external to an individual, which cause an attitude of enthusiasm and persistence, in carrying out certain activities. Meanwhile, 9.09% of students did not experience an increase in analyzing kinematics problems so that they were included in the low category because the two students did not want to try to develop their analytical skills in solving kinematics problems. These two students tend to be quiet and rely on more capable peers so that it can be said that these two students do not have the confidence to develop their abilities and are not motivated to learn. One of the can example of a question with a low percentage of answers is in the material on circular motion with a percentage of answers of 13.6%. The question reads "In uniform circular motion, if the angular velocity and radius of the rotating object are increased to 2 times, then the centripetal acceleration...". In the Circular Motion material, this question is included in the HOTS category.

According to Kusmanto et al. (2014), circular motion is a physics material that has concrete and partly abstract conceptual characteristics. The equations in circular motion are only given in theory. The learning process does not emphasize or provide direct experience to students, let alone develop competencies so that they can understand the natural environment scientifically. As a result of these difficulties, students have more difficulty in understanding the concept of circular motion that is taught. Conceptual understanding functions as a tool to explore natural phenomena that are difficult to solve by sensory experience (Dwi, et al., 2013). Second, conceptual understanding plays an important role in providing arguments in solving quite complicated physics problems (Nikat, 2021). In general, students have difficulty using concepts, principles, and verbal problems in circular motion questions. Physics

students are generally proficient in calculations but have difficulty analyzing a concept. In this question, the answer is 2 times the original acceleration students are lacking in interpreting and analyzing a problem concept, whether displayed in the form of tables, pictures or illustrations. McDermott et al (1987) said that one of the problems is that students tend to memorize formulas without properly understanding the meaning of each component in the formula. There are also those who argue that learning physics requires students not only to memorize physics concepts but also to make students understand and comprehend the concept and connect the relationship between a concept and another concept (Sadirman, 2006).

Conclusion

There were 90.9% who experienced an increase in their ability to analyze kinematics problems in the medium - high category, and 9.1% in the low category did not experience an increase in their ability to analyze kinematics problems, so it can be concluded that marticulation can improve the ability to analyze kinematics problems of physics education students in the Class of 2022.

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Conflicts of Interest
The authors declare no conflict of interest.

References

Assegaf, A., & Sontani, U.T (2016). Upaya Meningkatkan Kemampuan Berpikir Analitis Melalui Model *Problem Based Learning* (PBL). *Jurnal Pendidikan Manajemen Perkantoran*¸ 1(1). https://doi.org/10.17509/jpm.v1i1.3263

Direktorat Pembinaan Sekolah Menengah Atas, Direktorat Jenderal Pendidikan Menengah. *Panduan Matrikulasi di SMA Tahun 2014*. Jakarta: Kementerian Pendidikan dan Kebudayaan, 2014.

Dwi, I.M., Arif, H., & Sentot, K. (2013). Pengaruh Strategi Problem Based Learning Berbasis ICT Terhadap Pemahaman Konsep dan Kemampuan Pemecahan Masalah. *Jurnal Pendidikan Fisika Indonesia*, 9(1) :8-17. http://dx.doi.org/10.15294/jpfi.v9i1.2575

Hake, R.R. (1999). *Analyzing Change/Gain Scores. Dept. of Physics Indiana University*. Retrieved from http://www.physics.indiana.edu

Fatihah, N., Khomsati, N. N., & Setiaji, B. (2023). Efektivitas Game Epic Skater 2 Sebagai Media Simulasi Bermain Skateboard Menggunakan Konsep Fisika Kinematika 2 Dimensi. JFT: *Jurnal Fisika dan Terapannya*, 10(1), 47–56. https://doi.org/10.24252/jft.v10i1.34688

Hamzah Uno. (2010). *Orientasi Baru dalam Pembelajaran*. Jakarta: Bumi Aksara, hlm. 50.

KBBI. (2005). *Kamus Besar Bahasa Indonesia* (Edisi Ketiga). Jakarta: Balai Pustaka.

Kusmanto, A., Suparmi., & Surwanto. (2014). Pendekatan Learning By Doing dalam Pembelajaran Fisika dengan Media Rill dan Multimedia Interaktif Ditinjau dari Kreativitas dan Motivasi Berprestasi. *Jurnal Inkuiri*. 3(3): 65-74

McDermott, L. C., Rosenquist, M. L., & van Zee, E. H. (1987). Student Difficulties in Connecting Graphs and Physics: Examples from Kinematics, American *Journal of Physics*, 55(6), 503-513. http://dx.doi.org/10.1119/1.15104

Nikat, R. F. (2021). Exploration of Students' argumentation skill assisted format representation in solving electrical concept. *Jurnal Penidikan Sains (JPS)*, 9(1): 42-50. https://doi.org/10.26714/jps.9.1.2021.42-50

Prabowo. (2011). *Metodologi Penelitian (Sains dan Pendidikan Sains)*. Surabaya: UNESA University Press.

Rosidatul. (2017). Profil Berpikir Analitis Masalah Aljabar Siswa Ditinjau dari Gaya Kognitif Visualizer dan Verbalizer. *Jurnal Review Pembelajaran Matematika*, 2(1).

Sardiman. (2006). *Interaksi dan Motivasi Belajar-Mengajar*. Jakarta: Grafindo Persada.

Winardi. (2002). *Motivasi dan Pemotivasian dalam Manajemen*. Jakarta: Raja Grafindo Persada.ss