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The Correlation Between Partial Differential Mastering and Learning Thermodynamics of Physics

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Abstract
This study aims to determine the correlation degree of partial differential mastery contribution to study the thermodynamics of physics of students of the Physics Education Study Program, Universitas Muslim Nusantara Al Washliyah. In collecting data in this study, students were given tests of partial differential equations and thermodynamic physics materials. This test was administered to find the correlation between the students' ability in mastering the two materials. Data analysis revealed that there was a significant correlation between the mastery of partial differential and studying physical thermodynamics. The hypothesis testing showed a positive value. The correlation coefficient, the value of rXY = 0.76 is obtained and continued with the significance test of the correlation coefficient and the value of t = 9.92 (t count) is obtained, while the t table value for the significance level is 0.05 = 1.70. The calculation of the coefficient of termination obtained the price of r2XY = 0.5772. It found that 57.72%; the data shows that there is a significant contribution to the mastery of partial differentials in studying thermodynamic physics.

Keywords: partial differential material, physical thermodynamics

Introduction

Physics as one of the basic sciences of science plays a very important role in determining human life. The mission carried out by physics is not merely to explain the symptoms of physics, but physics also plays a role in the development of technology for the convenience and comfort of human life. It is known that Physics deals with energy and matter and their interactions. It may refer to the tools, instruments, gauges and related knowledge. It contributes greatly to the production of instruments and devices; all products have the tremendous benefits to sciences (Holbrook & Rannikmae, 2007). Thus, Physics may help several scientific fields and professions such as engineering, manufacturing, mining and construction industries. Additionally, the knowledge of Physics is significant in the development of sciences (Abraham & Reis, 2012). Advanced technology needs the Physics contributrion for the electronics and superconductors. The knowledge of nuclear is developed based on Physics in the preparation and processing of fuel for utilization of nuclear power, development of nuclear weapons e.t.c. (Fereidoon et al, 2011)

Physics should have not been overemphasized; it shapes the basis for the technological advancement (Abubakar, 2012). Physics takes a vital role in the development of any society in many ways, for example; in electronics for developing transistors, diodes and integrated circuits (ICs) which allowed the development of radio transmitters and receivers, televisions, radio tapes players and also modern machines for health services machines (Aliyu, 2011). Furthermore, the solar energy is developed from the knowledge of Physics applied in the preservation, storage and utilization of sunlight for preservation and processing of food and generating of electricity e.t.c. Besides Physics, there is a field of Mathematics which is a branch of science whose existence is very strategic compared to other branches of science. In this case, mathematics is not a separate branch of science. But mathematics can be applied to other branches of science as an application of mathematics itself.

The partial differential is part of the courses contained in the applicable curriculum at the Physics Education Study Program of UMN Al Washliyah. The differential equation

(Mechee & Al-Juaifri, 2017) is applied to theromodynamics course. The motion of objects, Fluid and heat flow, bending and cracking of materials, vibrations, chemical reactions and nuclear reactions are all modelled by systems of differential equations. This partial differential material has many applications in physical thermodynamics. Thermodynamics is an experimental science so laws are developed based on observations and experimental facts. One of the things that cannot be avoided, namely studying the thermodynamics of physics cannot be separated from the skills of calculating partial differentials.

A differential equation has two derivatives. Firts, if an equation contains a single independent variable, the derivative is an ordinary derivative and the equation is called an ordinary differential equation. Second, if an equation contains two or more independent variables, the derivative is a partial derivative and the equation is called a partial differential equation.

One of the subtopics of Physics is thermodynamics. It correlates the heat, mechanical work and other aspects of energy transfer that takes place in devices such as refrigerators, heat pumps, internal combustion engines (Wanjala, 2015). Thus, thermodynamics is based upon the general laws of nature. It governs the conversion of heat into mechanical work and vice-versa (Brij et al, 2008). Thus, thermodynamics is a part of classical mechanics; it is a branch of physics where we study the behaviour of a system by considering only the large-scale response (macroscopic properties) or the bulk properties (such as density, volume, pressure etc.) of the system that we can observe and measure in experiments. Thermodynamics deals with macroscopic properties and does not describe the structure of an object in detail. The laws formulated in thermodynamics are based on long-term observation of experimental facts. The quantities that affect the properties or state of the system are called thermodynamic coordinates or system coordinates.

Thermodynamic coordinates affect and determine the properties and state of the system; hence the thermodynamic coordinates are also called system state variables, namely extensive variables and intensive variables. In thermodynamics, we often find the equation of a function that has more than one independent variable, for example, the equation of state for an ideal gas pV = nRT. This equation of state has more than two variables, namely pressure p, volume V and temperature T. Then the derivative function which has more than one independent variable is calculated by the concept of a partial differential equation whose derivative function is to one of the independent variables by making the other independent variables a fixed number.

Furthermore, based on observations, it can be seen that there is a relationship between partial differential mastery and student learning outcomes in physical thermodynamics. Based on the description above, the purpose of this research is to find out how big the contribution of partial differential mastery in studying the thermodynamics of physics to students of the Physics Education Study Program of UMN Al Washliyah.

Methods

This research applied a corelational design (Dahlani et al, 2020; Mavragani & Ochoa, 2019). This research was conducted at the Physics Education Study Program, Universitas Muslim Nusantara Al Washliyah. In this study, as many as 32 students were taken as a simple random sample. The variables in this study were student mastery in partial differential material and student learning outcomes in thermodynamic physics. While the indicators for the variables above are student test scores after following the two materials above. In collecting data, tests were used for each material, namely partial differential material and physical thermodynamics material. In this study, the data taken are in the form of numbers which are the results of tests of partial differential material and physical thermodynamics material. The data analysis technique followed the steps:

1) From the results of student tests in the material of partial differential and thermodynamics, the standard deviation was determined.

2) Calculate the correlation coefficient using the formula r_{xy}

$$= \frac{n\varepsilon XY - (\varepsilon X)(\varepsilon Y)}{\sqrt{[n\varepsilon X^2 - (\varepsilon X)^2][n\varepsilon Y^2 - (\varepsilon Y)^2]}}.$$

3) Calculating the correlation significance test using the t formula

$$= \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}.$$

4) Calculating the termination coefficient using the formula

$$r^2XY = \frac{b[n\varepsilon XY - (\varepsilon X)(\varepsilon Y)]}{n\varepsilon Y^2 - (\varepsilon Y)^2},$$

from the calculation of the termination coefficient, it is determined how much variable X can explain variable Y.

Research Results and Discussion

The following is the frequency distribution of the partial differential material test scores and the thermodynamics material.

Table 1: Frequency Distribution of Partial Differential Material Test Score

Score	fi	xi	xi^2	fixi	fi xi^2
14-15	4	14,5	210,25	58,0	841,00
16-17	3	16,5	272,25	49,5	816,75
18-19	5	18,5	342,25	92,5	1711,25
20-21	9	20,5	420,25	184,5	3782,25
22-23	8	22,5	506,25	180,5	4050,00
24-25	3	24,5	600,25	73,35	1800,75
Total	**32**	-	-	**638,0**	**13002,75**

Table 2: Frequency Distribution of Physics Thermodynamics Test Scores

Score	fi	xi	xi^2	fixi	fi xi^2
12-13	5	12,5	156,25	62,5	781,21
14-15	4	14,5	210,25	58,0	841,00
16-17	8	16,5	272,25	132,0	2178,00
18-19	7	18,5	342,25	129.0	2395,75
20-21	5	20,5	420,25	102,5	2101,25
22-23	3	22,5	506,25	67,5	1518,75
Total	**32**	-	-	**552,0**	**9816,00**

From table 1, the average student test score in the partial differential material is 19.94 and the standard deviation is 3.02. While table 2 the average student test score in the thermodynamic physics material is 17.25 and the standard deviation is 3.08.

Discussion of the research steps carried out are normality test, regression linearity test, correlation coefficient significance test, calculate the correlation coefficient and calculate termination coefficient.

For the normality test of partial differential material, it is obtained that x_2 count = 5.0852, while x_2 table = 7.81. Because the calculated x_2 is smaller than the table x_2, the data shows that the sample is normally distributed. Normality test of thermodynamic physics material obtained x_2 count = 2.8397, while x2 table = 7.81. Because the calculated x_2 is smaller than the table x2, the data shows that the sample is normally distributed. To determine the effect of variable X with variable Y, the Pearson Product Moment coefficient formula is used, is: $r_{XY} = \frac{n\varepsilon XY-(\varepsilon X)(\varepsilon Y)}{\sqrt{[n\varepsilon X^2-(\varepsilon X)^2][n\varepsilon Y^2-(\varepsilon Y)^2]}}$ = 0,76. Test the significance of the correlation coefficient $t = \frac{r\sqrt{n}-2}{\sqrt{1-r^2}}$ = 9,92 data shows a significant correlation. To calculate the termination coefficient $r^2XY = \frac{b[n\varepsilon XY-(\varepsilon X)(\varepsilon Y)]}{n\varepsilon Y^2-(\varepsilon Y)^2}$ = 0,5772. This means that the percentage of variable X explaining variable Y is 57.72 %. The data shows that there is a significant contribution to the mastery of partial differentials in studying physical thermodynamics. Based on the results of data analysis and hypothesis testing, it shows that the higher the partial differential mastery, the higher the student's ability in thermodynamic physics material. This illustrates that between the variable X and variable Y there is a real influence in the sense of having a positive role. Although it has been seen that between the two variables there is a positive and significant contribution, this contribution still needs to be studied more selectively. There may be many other factors that also affect the ability of students to study thermodynamic physics.

Conclusion

Based on the research results obtained, it can be concluded as follows: 1). The data shows that students' ability in thermodynamics material has a relationship with students' mastery in partial differential material. 2). the effect of mastery of partial differential in studying thermodynamic physics is 57.72%.

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