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Research On The Correlation Between Mathematics And Physics Of The Senior High School Students

Penelitian Tentang Hubungan Matematika Dan Fisika Siswa Sekolah Menengah Atas

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ABSTRAK

Dialeksi Materialis mengandung bahwa dunia materi secara umum terhubung, dan realizasi perhitungan, verifikasi dan tujuan lainnya yang terlibat dalam fisika memerlukan penggunaan pengetahuan matematika sebagai alat penelitian dan bahasa, dan penggunaan metode matematika dan ide matematika untuk alasan dan analisis,yang menunjukkan bahwa ada hubungan dekat antara matematika dan fisika.Analisasi pengaruh matematika pada fisika dari perspektif data membantu para guru untuk meningkatkan proses pengajaran fisika, mempromosikan kemampuan siswa untuk aplikasi matematika dan belajar fisika, dan meningkatkan kualitas pengajaran sekolah tinggi .Dalam kertas ini, melalui analisis statistik dan penelitian pertanyaan.Skor matematika dan fisika di sekolah dikumpulkan dan dianalisis oleh perangkat lunak SPSS.22.Ditemukan bahwa pencapaian matematika memiliki pengaruh yang signifikan pada pencapaian fisika.Lalu melalui survei pertanyaan apakah matematika memiliki dampak pada fisika, kita mendapatkan jawaban positif dari perspektif siswa.Kesimpulan akhir adalah seperti ini: (1) ada korelasi positif antara prestasi matematika dan prestasi fisika; (2) lebih dari setengah siswa dapat menggunakan metode matematika untuk memecahkan masalah ketika belajar fisika; (3) kebanyakan siswa berharap bahwa guru dapat mengajarkan mereka bagaimana menggunakan metode matematika dalam belajar fisika.Melalui kesimpulan ini, kita bisa tahu bahwa pencapaian matematika memiliki dampak yang sangat penting pada pencapaian fisika.Ini mengingatkan kita bahwa kita harus memperhatikan pendidikan matematika siswa.
Kata Kunci: statistik deskriptif, hasil matematika, hasil fisika, analisis korelasi.

ABSTRACT

Materialist dialectics holds that the material world is generally connected, and the realization of the calculation, verification and other goals involved in physics requires the use of mathematical knowledge as the research tool and language, and the use of mathematical methods and mathematical ideas for reasoning and analysis, which shows that there is a close relationship between mathematics and Physics. Analyzing the influence of mathematics on physics from the perspective of data is helpful for teachers to improve the teaching process of physics, promote students' ability of mathematics application and physics learning, and improve the quality of high school teaching. In this paper, through statistical analysis and questionnaire research. The scores of mathematics and physics in a school were collected and analyzed by SPSS22.0 software. It is found that mathematics achievement has a significant influence on physics achievement. Then through the questionnaire survey of whether mathematics has an impact on physics, we get a positive answer from the perspective of students. The final conclusions are as follows: (1) there is a positive correlation between mathematics achievement and physics achievement; (2) more than half of the

students can use mathematical methods to solve problems when learning physics; (3) most students hope that teachers can teach them how to use mathematical methods in physics learning. Through these conclusions, we can know that mathematics achievement has a very important impact on physics achievement. It reminds us that we should pay attention to students' mathematics education.
Keyword(s) : Descriptive statistics, Mathematics achievement, Physics achievement, Correlation analysis.

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INTRODUCTION

In the development of human history, physics and mathematics have an intense connection (Curtis 2006; Dikovic 2009; Freiman and Tassell 2018). Physics can help us understand new natural phenomena when we need to name a newly discovered physical phenomenon and show it to others (Gómez and Suárez 2020; Higgins, Moeed, and Eden 2018). It is often difficult for him to clearly express the characteristics of new things to people, or he may not be able to write anything, let alone calculate or deduce. At this time, we need to introduce a new mathematical language to describe new natural phenomena. This is the deep connection between mathematics and physics. Because of this, every major revolution in physics is marked by the introduction of new mathematics into physics.

Mathematics is a basic subject that students have been exposed to since childhood (Karp 2003; Ketelhut 2019; Vicente, Sánchez, and Verschaffel 2020). It plays an essential role in all stages of learning. Mathematics includes the key scientific basic abilities such as operation ability, calculation skills, logical thinking (Ayuningtyas, Mardiyana, and Pramudya 2019; Sumarmo et al. 2012), abstract thinking (Rosita 2018; Wijaya et al. 2020), etc., which are essential for learning other disciplines. For high school physics students, it is not very easy to learn abstract knowledge (Bernard et al. 2019; Suryanti et al. 2019; Wijaya et al. 2020). Acoustics, mechanics, optics, electricity, electromagnetism and other related knowledge in nature are reflected in physics (Escobar et al. 2016). And the learning difficulty and depth of physics knowledge are gradually increasing in high school, embodied in the physical model's abstraction and the diversity of things. These can not be obtained through experimental observation or relying on intuition. On campus, there are not many opportunities for students to operate by themselves. And through a long period of teaching experience, the students who are not solid enough in mathematics knowledge will feel very hard in physics learning (Danday and Monterola 2019; Kllogjeri and Kllogjeri 2010; Suwonjandee, Mahachok, and Asavapibhop 2018).

Mathematics and physics in high school learning stage, in the teaching materials or reference books did not directly explain the correlation between digital knowledge and physical knowledge, teachers in class on the relationship between them is not very clear, but in the specific learning, they often have the following two distinct links:

(1) Direct connection: the knowledge of geometry and trigonometric function in mathematics is often used to analyze physical problems. For example, when analyzing the force on an object, the diagrams made are often related to geometry in the analysis, and when calculating the direction of force or the path of light, they are closely related to trigonometric function. Also, the computational ability of mathematics is the most direct and frequent operation in physics With, there is also the simplification skills of mathematical operation, which can help students simplify in a lot of physical symbols, get the final expression, and then bring in specific physical values for calculation. Using mathematical operation skills to simplify calculation can help students solve physical problems and reduce a lot of calculation process in actual operation.

(2) Indirect connection: mathematical thinking and methods are more helpful to the study of physics, which is invisible. A good student of mathematics is not bad in general physics, because their way of thinking and learning methods have many similarities. Mathematics learning is helpful to improve people's thinking agility and the development of brain rational thinking. Mathematics thinking includes number and shape, transformation thinking, classification thinking, function thinking, equation thinking, etc. applying these ideas to physics learning can help students understand the relationship between physical knowledge and form rigorous logical thinking.

In most students' ideas, physics concepts and definitions are more abstract and difficult to understand than those of mathematics. Therefore, if we can improve the students' mathematics performance simultaneously, the students' physics performance can also progress together, reduce the students' pressure of learning physics, and reduce the students' worry about learning physics. This is a matter of killing two birds with one stone, which is of great significance to mathematics teaching or physics teaching.

First, after entering senior high school, the mid-term exam of senior one is their first big exam, and it is also an effective way to measure their mastery of what they have learned. In other words, their starting point is the same, not affected by too many external factors, with objectivity; second, the learning of mathematics and physics, junior high school and senior high school knowledge and requirements are not the same. Junior high school knowledge is much simpler than senior high school knowledge, not as abstract as

senior high school. Generally speaking, the difference between junior high school mathematics and physics scores is not too big. But in high school, when all the students come into contact with more complicated and knowledge points of mathematics and physics, the gap between mathematics and physics will be reflected. In this regard, we can more objectively judge the correlation between mathematics and physics. Third, from students' perspective, they can also feel the difference between junior high school learning and senior high school learning. In this process, if mathematics has an impact on physics, they will use mathematical methods to solve physics problems, so as to reduce the difficulty of learning physics and improve their physics scores.

This paper takes the mid-term examination results of grade 10 students in a high school as the research object. The school's comprehensive ranking in the local is at the middle level, and the examination is a comprehensive investigation of students' learning situation in half a semester, which has a good research significance. It turned out that there were 1806 students. Four of them were absent from one or two of the exams, so their scores in the missing subjects were 0. In order to ensure the rationality of the research, the results of the four students are excluded, so the number of research objects is 1802. In the questionnaire stage, using random sampling method, from 32 school, 15 classes were selected for the questionnaire survey, and 904 valid questionnaires were obtained.

METHOD

The research methods used in this paper are statistical analysis and questionnaire survey. The sample and population in this study were grade 1 high school students who were randomly taken from Guangxi province, China For two variables x (mathematics) and y (physics), people always want to know whether they are related. If so, how relevant are they? Is there a clear relationship? Based on this question, this paper chooses the alpha coefficient analysis method to analyze the data reliability. Then draw the scatter diagram of other subjects' scores and physics scores by statistical data software to observe whether they are linear correlation. If it is a linear correlation, then the results of mathematicshave an effect to physics results. Then analyze the person coefficient of the data to understand the relationship between mathematics and physics. Finally, through the questionnaire survey, let the students answer six questions from students' perspectives to verify the influence of mathematics performance on physics performance.

Before the reliability analysis of all the data is carried out, The researcher tested the normality and homogeneity data. The method selected in this paper is alpha coefficient analysis, and the Cronbach's alpha coefficient is 0.811. The analysis results are shown in

Table 1. According to table 2, when $0.8 \le \alpha < 0.9$ the data's credibility is very high, the selected data has research value. (If $\alpha < 0.7$ it means that the credibility of the data is not high, it needs to be reconsidered or even give up. When $0.7 \le \alpha < 0.8$ some data need to be deleted or modified. When $\alpha \ge 0.8$ the credibility of the data is high.

Table 1. Reliability analysis

Cronbach's Alpha	N
0.811	1082

As shown in Table 1, the sample data selected in this paper have high reliability and can be further studied.

Table 2. Cronbach alpha coefficient

α	**Reliability**
$\alpha < 0.5$	Give up
$0.5 \le \alpha < 0.6$	Reorganize
$0.6 \le \alpha < 0.7$	Partial modification
$0.7 \le \alpha < 0.8$	Acceptable
$0.8 \le \alpha < 0.9$	High
$\alpha \ge 0.9$	Perfect

The normality test is helpful for us to judge whether the data samples conform to the normal distribution. Table 3 shows the normality test results of math scores and physics scores.

Table 3. Normality Test Results

Model	Sig.	Decision	Conclusion
M	0.279	H_0 is not rejected	Normal
P	0.311	H_0 is not rejected	Normal

As can be seen from the results in Table 3, the mathematics scores and the physics scores follow a normal distribution.

Table 4. Homogeneity test Results

Model	Sig.	Decision	Conclusion
M&P	0.159	H_0 is not rejected	Homogeneous

According to the homogeneity test results in Table 4, it can be seen that the variance of mathematical scores and physical scores is homogeneous.

After the data shows normal and homogeneous, data processing is continued with scatter plots. we draw a scatter diagram of the math and physics scores and see whether there is a direct relationship between them by drawing. Scatter plots use data values as the lower x, y coordinates to plot these points. In the following scatter diagram (Figure1), mathematics achievement is the independent and physics achievement as the dependent variable. For example, when a student's math score is 108 and the physics score is 88, the student's score on the scatter diagram is (102, 88). Scatter plot can reveal the relationship between abscissa and ordinate of points drawn on grid. When there are many data points, scatter plot can show the overall relationship between two data values. The Scatter chart is similar to the line chart, but the line chart shows every change by connecting points or data points.

RESULTS AND DISCUSSION

Before the analysis, we first stipulate m standards for mathematics, P standards for physics. In the scatter diagram below, the red line represents the linear relationship between independent variables and dependent variables, and the colored points on the diagram are the data points composed of two grades. key ability

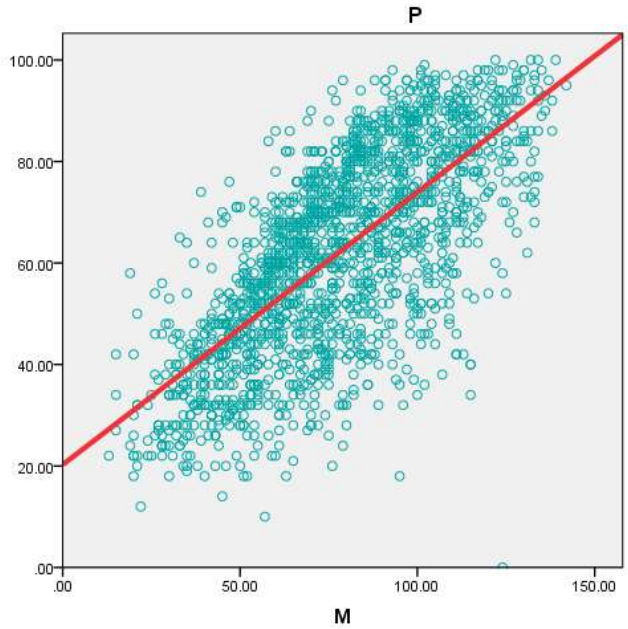

Figure 1. The relationship between physics score and mathematics score

Figure 1 is obtained by taking mathematics achievement as an independent variable and physics achievement as a dependent variable. That is to say, the better the math score,

the better the physics score. Furthermore, from the image, we can see that the relationship between mathematics and physics is very close. Most of the data points are concentrated near the regression line, indicating a strong correlation between them.

In order to further explore the relationship between mathematics achievement and physics achievement, the Pearson correlation coefficient is used for them, and the value of the coefficient is expressed by the letter R. For two independent data sets $X=\{X_1,\ X_2,,,X_n\}$、$X=\{Y_1,\ Y_2,,,Y_n\}$, The calculation formula of Pearson coefficient is as follows:

$$r_{XY}=\frac{Cov(X,Y)}{S_X S_Y}$$

and

$$Cov(X,Y)=\frac{\sum_{i=1}^{n}(X_i-\overline{X})(Y_i-\overline{Y})}{n-1} \quad (1)$$

$$S_X=\sqrt{\frac{\sum_{i=1}^{n}(X_i-\overline{X})^2}{n-1}} \quad (2)$$

$$S_Y=\sqrt{\frac{\sum_{i=1}^{n}(Y_i-\overline{Y})^2}{n-1}} \quad (3)$$

$\overline{X}$、$\overline{Y}$ represent the average of two groups of data and the number of test samples. In order to divide the correlation degree of Pearson coefficient, the division of this paper is shown in Fig. 2. Through the division of Fig. 2, the correlation degree between mathematics achievement and physics achievement is analyzed.

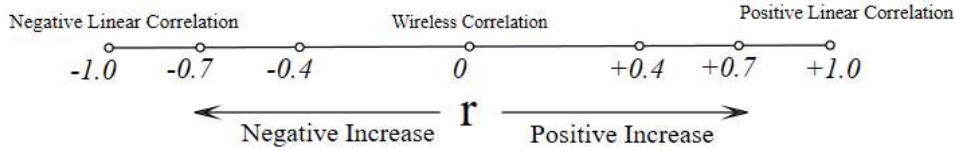

Figure 2. Variation of Pearson coefficient

Illustration of Figure 2: r describes the degree of linear correlation between two variables. The value of R is between -1 and +1. If r > 0, the two variables are positively correlated, that is, the larger the value of one variable is, the larger the value of the other will be; if r < 0, the two variables are negatively correlated, that is, the larger the value of

one variable is, the smaller the value of the other will be. The higher the absolute value of r, the stronger the correlation.

The mathematics and physics scores were analyzed by Pearson correlation coefficient using SPSS22.0, and table 5 was obtained.

Table 5. Pearson coefficient

		M	P
M	Pearson Correlation	1	.708**
	Sig.(2-tailed)		.000
	N	1802	1802
P	Pearson Correlation	.708**	1
	Sig.(2-tailed)	.000	
	N	1802	1802

**. Correlation is significant at the 0.01 level (2-tailed).

The table 5 explains that the intersection of row variables and column variables is the related calculation result of the two variables. Each group of data from top to bottom are: (1) Correlation coefficient; (2) For the hypothesis with a correlation coefficient of 0, Sig; (3) The number of observations participating in the count of correlation coefficient. On the diagonal, because the row variables and column variables are the same, the correlation coefficient is 1, and the corresponding significance probability is no longer displayed. It can be seen from the above table that the correlation coefficient between physics and mathematics is 0.708.

According to figure 2, there is a high correlation between mathematics and physics. It shows a close relationship between mathematics and physics, which also proves that the conclusion on the scatter diagram is reliable.

We conclude from the results of data analysis that mathematics has a significant impact on physics. As for students' feelings, do they think that good mathematics is helpful to physics learning? Based on this emotional orientation, we designed six questions for students to answer. This study randomly selected 15 classes from 30 classes and conducted a questionnaire survey. There were about 60 students in each class. Finally, 904 valid questionnaires were obtained. Then the 904 questionnaires were statistically summarized to get Table 6.

Table 6. Students statements about the relationship between mathematics and physics.

No	Students' statement	Students' response					
		1	2	3	4	5	Average
1	I think mathematics is helpful to study physics.			201	214	489	4.32
2	The idea of mathematics can help me solve physics problems.		54	112	231	507	4.28
3	Mathematical problems and physical problems are similar in many cases.			145	158	601	4.50
4	I will use mathematical calculation methods in physical calculation.			122	188	594	4.52
5	If my math score is good, my physics score will not be bad.			104	194	606	4.56
6	I hope the teacher will teach us how to solve physics problems with mathematics.			145	182	577	4.48
	Average						4.45

Description:

1. Strongly disagree
2. Disagree
3. So-so
4. Agree
5. Strongly agree

From the data above of Table 6, it can be found that the average score of students answering the above questions is 4.45, indicating that most students agree that mathematics is helpful to physics learning. It can be seen from the above table that more than half of the students can use mathematical thinking in the process of learning physics and mathematical calculation methods in the process of physical calculation. In most students' impression, the students who do well in Mathematics in the class often do well in physics. Because of these objective facts, they also hope to deepen their study of physics by improving their understanding of mathematics. Generally speaking, the results of this questionnaire confirm that the students highly agree with this research. Also, in the students' concept, mathematics can have a positive impact on physics learning.

CONCLUSION

Through this research, we can draw the following conclusions: (1) there is an obvious relationship between mathematics and physics; (2) we can apply mathematical thinking to physics learning, to improve the efficiency of physics learning based on enhancing mathematical understanding; (3) most students also agree that mathematics learning is of great help to physics learning. I hope teachers can help us Talk more about the relationship between the two subjects.

This enlightens us that teachers should make clear the dominant position of mathematics, strengthen mathematics teaching appropriately, and more importantly, implement the thinking mode in mathematics teaching. In teaching, we should find out more mathematical knowledge hidden in physics, or solve physical problems through mathematical methods. In this way, we can start from the knowledge itself, strengthen students' understanding of the two subjects, let students experience the internal relationship between mathematics and physics to reduce the difficulty of students learning physics. Focus on the key parts and achieve better results with limited time and energy.

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REFERENCES

Ayuningtyas, W., Mardiyana, and I. Pramudya. 2019. “Analysis of Student’s Geometry Reasoning Ability at Senior High School.” *Journal of Physics: Conference Series* 1188(1).

Bernard, M., P. Akbar, A. Ansori, and G. Filiestianto. 2019. “Improve the Ability of Understanding Mathematics and Confidence of Elementary School Students with a Contextual Approach Using VBA Learning Media for Microsoft Excel.” *Journal of Physics: Conference Series* 1318(1).

Curtis, Karena M. 2006. “Improving Student Attitudes: A Study of a Mathematics Curriculum Innovation.”

Danday, Billy A. and Sheryl Lyn C. Monterola. 2019. “Effects of Microteaching Physics Lesson Study on Pre-Service Teachers ’ Critical Thinking.” *Journal of Baltic Science Education* 18(5):692–707.

Dikovic, Ljubica. 2009. “Implementing Dynamic Mathematics Resources with Geogebra at the College Level.” *International Journal of Emerging Technologies in Learning* 4(3):51–54.

Escobar, J. H., H. Sánchez, J. R. Beltrán, J. De La Hoz, and J. D. González. 2016. “Virtual

Experimentation in Electromagnetism, Mechanics and Optics: Web-Based Learning." *Journal of Physics: Conference Series* 687(1).

Freiman, Viktor and Janet Lynne Tassell. 2018. *Leveraging Mathematics Creativity by Using Technology : Questions , Issues , Solutions , and Innovative Paths*. Springer International Publishing.

Gómez, Ricardo L. and Ana María Suárez. 2020. "Do Inquiry-Based Teaching and School Climate Influence Science Achievement and Critical Thinking? Evidence from PISA 2015." *International Journal of STEM Education* 7(1).

Higgins, Joanna, Azra Moeed, and Raewyn Eden. 2018. "Video as a Mediating Artefact of Science Learning : Cogenerated Views of What Helps Students Learn from Watching Video." *Asia-Pacific Science Education* 4(6).

Karp, Alexander. 2003. "Thirty Years after: The Lives of Former Winners of Mathematical Olympiads." *Roeper Review* 25(2):83–87.

Ketelhut, Diane Jass. 2019. "Contemporary Technologies in Education." *Contemporary Technologies in Education* 17–29.

Kllogjeri, Pellumb and Adrian Kllogjeri. 2010. "Geogebra for Solving Problems of Physics." *Communications in Computer and Information Science* 112 CCIS(PART 2):424–28.

Rosita, N. T. 2018. "Analysis of Algebraic Reasoning Ability of Cognitive Style Perspectives on Field Dependent Field Independent and Gender." *Journal of Physics: Conference Series* 983(1).

Sumarmo, Utari, Wahyu Hidayat, Rafiq Zukarnaen, Ms Hamidah, and Ratna Sariningsih. 2012. "Kemampuan Dan Disposisi Berpikir Logis, Kritis, Dan Kreatif Matematik (Eksperimen Terhadap Siswa SMA Menggunakan Pembelajaran Berbasis Masalah Dan Strategi Think-Talk-Write)." *Jurnal Pengajaran Matematika Dan Ilmu Pengetahuan Alam* 17(1):17.

Suryanti, S., Y. Arifani, I. Zawawi, and N. Fauziyah. 2019. "Student's Engagement Behaviour and Their Success in Abstract Algebra: Structural Equation Modelling Approach." *Journal of Physics: Conference Series* 1188(1).

Suwonjandee, N., T. Mahachok, and B. Asavapibhop. 2018. "Evaluation of Thai Students and Teacher's Attitudes in Physics Using Colorado Learning Attitudes about Science Survey (CLASS)." *Journal of Physics: Conference Series* 1144(1).

Vicente, Santiago, Rosario Sánchez, and Lieven Verschaffel. 2020. "Word Problem Solving Approaches in Mathematics Textbooks: A Comparison between Singapore and Spain." *European Journal of Psychology of Education* 35(3):567–87.

Wijaya, T. T., Z. Ying, S. Chotimah, M. Bernard, Zulfah, and Astuti. 2020. "Hawgent Dynamic Mathematic Software as Mathematics Learning Media for Teaching Quadratic Functions." in *Journal of Physics: Conference Series*. Vol. 1592.