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THE INFLUENCE OF PRIOR KNOWLEDGE ON PHYSICS LEARNING OUTCOMES USING STRUCTURED QUIZZES

Rakhmatul Ummah*[1], Raden Oktova[2]

[1]Program Studi Pendidikan Guru Sekolah Dasar, Sekolah Tinggi Keguruan Dan Ilmu Pendidikan Taman Siswa Bima, Indonesia

[2]Pendidikan Fisika, Universitas Ahmad Dahlan Yogyakarta, Indonesia

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ABSTRACT

Educators believe that prior knowledge plays a crucial role in facilitating students' comprehension of further material and can serve as a measure of learning success. This research aims to assess physics learning outcomes based on students' initial understanding and learning outcomes through the implementation of structured quizzes. The method employed in this study is the ex-post facto method with a pretest-posttest control group design. The analysis phase includes prerequisite evaluation, encompassing validity, reliability, discriminatory power, and instrument difficulty calculations. The impact of initial understanding on learning outcomes is measured using SPSS through t-test analysis, yielding a relative contribution of 34.62% of initial knowledge to learning outcomes, with an effective contribution reaching 51%. Therefore, it can be concluded that there is a significant influence of initial understanding on student learning outcomes.

Reseach Paper

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Keywords: Learning Outcomes, Prior knowledge, Structured quizzes.

INTRODUCTION

Prior knowledge plays a crucial role in shaping new knowledge and skills. Early knowledge assists learners in comprehending and mastering the lessons taught by teachers. Learners with limited early knowledge face difficulties in connecting knowledge concepts, thus requiring more time compared to those with adequate prior knowledge (Yaomi, 2013; Hasanudin, I. M, 2020). Early knowledge serves as the foundation learners must possess about what they are about to study. Early physics knowledge is possessed by learners and acquired from previous educational stages relevant to the upcoming physics material (Suprijono, 2013).

Prior knowledge acts as a framework for students to filter new information and derive meaning from their studies (Von Rouden et al. 2021). A critical role of early knowledge is to serve as a base that enables the acquisition of new knowledge (Alam 2022). Thus, every learning process starts from early knowledge and develops into new abilities. When connected to physics education, the term 'early physics knowledge' refers to students' knowledge before studying physics material. Physics knowledge acquired from relevant previous educational stages represents students' initial capability to learn subsequent physics material (Cai et al. 2021). Concepts within physics education are a crucial key to understanding and applying physics in daily life. These concepts allow us to connect new experiences with what we already know (Ummah, 2021).

At Taman Siswa Bima Teacher Training and Education College (STKIP), in the Elementary School Teacher Education Program, students are required to delve into basic science concepts and educational science. One of the subjects that must be mastered is the Physics topic of Electricity and Magnetism, which addresses the fundamental concepts of electricity and magnetism as well as their interrelationship. This subject involves

*Correspondance Address
E-mail: rakhmatulummah@gmail.com

vector analysis, calculus, and strong reasoning skills. Electricity and magnetism are complex fields of physics for both high school students and college students. Despite their commonality in daily life, misconceptions often arise among students and adults (Irfan, Z, 2010). These misconceptions can impact student learning outcomes due to factors like students' preconceptions, mental structure readiness, experiences, thought processes, interests, and abilities regarding early concept knowledge.

Students studying Electricity and Magnetism often encounter difficulties in remembering basic concepts and understanding them, particularly because vector analysis is involved (Hernandez 2022). This can affect their calculation abilities. Given these challenges, researchers seek ways to inspire students to maintain enthusiasm in learning and to enhance their skills, especially in the topic of Electricity and Magnetism. Therefore, the researcher proposes a teaching strategy that can influence student learning outcomes, namely implementing structured quizzes. Structured quizzes involve verification and in-depth review of the material learned by students.

These quizzes are designed by instructors to achieve specific competencies or tasks after students complete a learning module (Walangadi et al. 2023). The provision of structured quizzes is believed to enhance student learning outcomes, aligning with research by Anindita and Nursafitri, which demonstrates a positive influence on the learning process and outcomes using quiz methods at the end of lessons (Anindita et. al 2022; Nursafitri, et al. 2019).

This research employs an ex post facto methodology and uses purposive sampling to assess the influence of early knowledge on learning outcomes in the premier Physics Education class for the subject of Electricity and Magnetism, employing structured quizzes.

METHODS

The method employed in this research is ex post facto. This study is a quantitative research in which the population or sample is chosen randomly. Data collection is conducted using research instruments, and data analysis is carried out quantitatively/statistically with the aim of testing formulated hypotheses (Sugiyono, 2010). The analysis technique used involves prerequisites such as validity, reliability, discriminant power, and difficulty level. The influence between variables is assessed through t-tests with the assistance of statistical software SPSS.

This research was conducted at STKIP Taman Siswa Bima with a population of first-semester students who were studying Magnetic Electricity materials. The data collection instrument in this study is a descriptive test consisting of 35 questions. A test is a series of questions or exercises used to measure individual or group skills, knowledge, or potential. The type of test used in this research is an achievement test that measures attainment after the learning process. Additionally, a questionnaire was also used, which consists of written questions to gather information from respondents about themselves or what they know (Suharsimi, 2013).

This research applies a structured quiz design aimed at evaluating the achieved learning outcomes at the end of each program. The questionnaire is designed in two forms, namely positive and negative statements, to avoid arbitrary responses (Sukmadinata, 2013).

RESULTS AND DISCUSSION

The results of the research conducted in the first semester of the Elementary School Teacher Education Study Program, in the Basic Concepts of Science course with the subject of Electricity and Magnetism in the academic year 2022/2023, involved 28 students as research subjects. The findings of this research indicate that the utilization of structured quizzes is capable of enhancing students' learning achievements. This improvement is measured through carefully designed question sheets and also through test results that are formulated based on indicators to attain optimal learning outcomes during the learning process.

The indicators of measured learning outcomes encompass three aspects: cognitive, affective, and psychomotor. However, in this

research, the measurement focus is directed towards the cognitive aspect of students, particularly at levels C1 to C4. The attached table below illustrates the breakdown of cognitive levels for the questions related to the Electricity and Magnetism material:

Table 1 Table of Cognitive Level Distribution for Electricity and Magnetism Questions

No	Question Item	Level of Cognitif	Question Number
1	35	C1	1,2,3,4,5,6,7,8, 9,10,11,12,
		C2	13,16, 17,18, 19,20
		C3	21,22,23,24,25,26,27
		C4	28,30,31,32,33,34,35

From the table above, there are 12 items measuring the ability to recall (C1), 6 items measuring comprehension (C2), 7 items measuring application (C3), and 7 items measuring analysis (C4). Out of a total of 35 items, a validity test was conducted using the product-moment correlation at a 5% significance level. The results show that 26 items have acceptable validity, while 9 items do not meet the validity criteria. Furthermore, the test's reliability was calculated using the K-R 20 formula. The calculation result indicates an r11 value of 0.76, while the table value is 0.49 (0.76 > 0.49), indicating that this test has a reliable reliability status.

Table 2 Result of Reability Test

Cronbach's Alpha	Standardized Items	N of Items
0.766	0.633	35

For the calculation of item discrimination and difficulty level, there is 1 question that meets the criteria of "excellent," 7 questions meet the criteria of "good and satisfactory," and 15 questions meet the criteria of "poor." Meanwhile, for the difficulty level, there are 9 questions categorized as "moderate," 11 questions categorized as "difficult," and 15 questions categorized as "very difficult".

Before proceeding with further analysis, a prerequisite test is conducted first, namely the test of normality. This test aims to assess whether the data follows a normal distribution. Using the assistance of SPSS 20.0, the results indicate that the significance probability value for the initial knowledge variable is 0.593. As this significance probability value exceeds the significance level of 0.05, it can be concluded that the data in this study follows a normal distribution. Attached below are the normality graphs for each variable for further information.

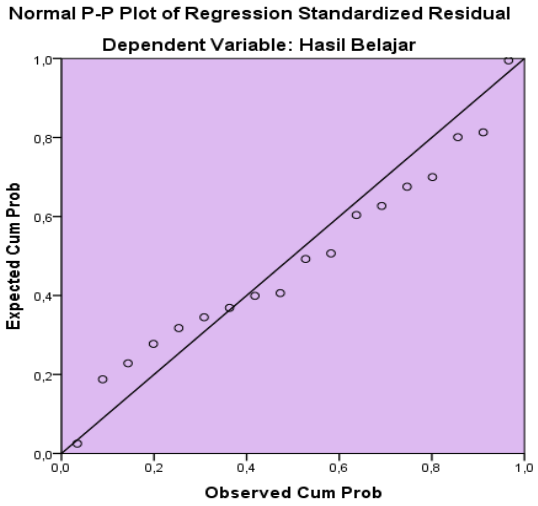

Figure 1 Graphic of the Normality Variable

The use of quizzes in this study was conducted repeatedly with a structured approach until significant results were found in improving students' learning achievements. Based on the results of the normality test, it is known that the graph shows a straight diagonal direction which indicates that this data passes the classic assumption test of normality.

This correlation test aims to determine the relationship between research variables, specifically to calculate the extent of the contribution of the learning process to comfort. The results of the calculations reveal that the learning process correlates with comfort at a magnitude of 0.714, with a significance probability of 0.000. Therefore, it can be stated that there is a significant relationship between prior knowledge and learning outcomes. Comfort exhibits a correlation of 0.863 with learning outcomes. The resulting significance probability is 0.000. This signifies that the correlation is significant at the 0.05 significance level.

Table 3 Corelation Test

Model	Prior Knowledge* Learning outcomes	Learning outcomes* Prior Knowledge
Pearson Correlation	0.714	0.863
Sig. (2-sisi)	0.000	0.000

The influence of prior knowledge on outcomes can be measured through multiple linear regression analysis. Regression analysis is conducted to understand the relationship between a dependent variable and one or more independent variables, with the aim of estimating or predicting the average value of the dependent variable based on known values of the independent variable(s). The results of the regression analysis yield coefficients for each independent variable, obtained through predicting the value of the variable using an equation.

Various aspects need to be analyzed based on the output and calculations to support hypothesis testing, including determining the coefficient of determination and conducting simultaneous significance tests (t-statistic tests), the following details the calculation of linear regression analysis:

Table 4 Calculating of Cooficient Determinent

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.763a	0.069	0.033	12.87164

The value of R represents the correlation between all independent variables and the dependent variable, with a correlation coefficient of 0.763. The value of R-squared (R^2) indicates the magnitude of the significant influence. If R^2 is substantial, then the regression is suitable for use.

Table 5 Calculating of T-Test

Model		Unstandardized Coeff.		Standardized Coeff.	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	62.972	17.676	-	30.562	0.001
	Learning process	0.365	0.262	0.263	10.391	0.176

The results of the t-test in this regression are used to determine the partial influence of each variable. The calculated t-value for the learning process, 10.391, is greater than the tabulated t-value (0.05) = 1.701, or by comparing the significance probability of 0.001 < significance level of 0.05, it can be concluded that prior knowledge significantly impacts learning outcomes. The influence provided is positive, as indicated by the positive beta value of 0.263. This means that if prior knowledge is higher, the learning process will be more optimal, which in turn affects learning

outcomes and contributes to their improvement.

This is in line with the research conducted by Sitria Side et al., which states that the use of quizzes in the learning process contributes positively and has an impact on learning outcomes (Anindita et al. 2022). This is also supported by the findings of Lianti M. Payung's study, which shows that prior knowledge, emotional intelligence, and learning motivation have a positive influence on learning outcomes in the subject of Science. Therefore, Ardhana (2010) in his research states that a knowledge-oriented approach to learning will have an impact on the process and acquisition of adequate learning (Payung et al., 2016).

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CONCLUSION

The results of this research is reveal a significant relationship between prior knowledge and physics learning outcomes. Prior knowledge significantly and positively affects comfort in the learning process, as indicated by a correlation of 0.714 with a significance probability of 0.000. This also holds true for physics learning outcomes, which exhibit a significant correlation of 0.863 with a significance probability of 0.000. Furthermore, the regression analysis shows that prior knowledge has a significant partial influence on physics learning outcomes, with a calculated t-value exceeding the tabulated t-value, and a significance probability well below the 0.05 threshold (0.001 < 0.05). Therefore, this research confirms the crucial role of prior knowledge in enhancing physics learning outcomes through its positive impact on comfort and the learning process. The implication is the importance of considering students' prior knowledge when designing effective physics learning strategies using structured quizzes.

Author's declaration

Authors' contributions and responsibilities

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

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Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare no competing interest.

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