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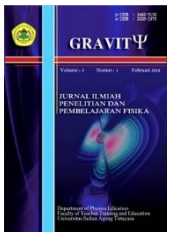

The effect of strengthening the prerequisite knowledge on student learning outcomes on the topic of values and eigenvectors

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ABSTRACT

The purpose of this study to determine the effect of strengthening prerequisite knowledge on students' achievement via and seeing students' perspectives on improving prerequisite knowledge. The research method was the Pre-Experiment, and the research sample was students of physics education on the 3rd semester in UGN Padangsidimpuan, totaling ten people. The instrument for collecting students' achievement is an essay test given to the pretest and posttest, and the device for managing students' perspectives on strengthening prerequisite knowledge is a questionnaire. Data analysis techniques for achievement were used non-parametric statistical tests with the Wilcoxon test and N-Gain, while the students' perspectives were analyzing through descriptive qualitative. This study's results indicate that there is a significant effect of strengthening the prerequisite knowledge on students' achievement, with a significance value of the Wilcoxon test count of 0.005. N-Gain obtained 0.74 in the high category. The results of the questionnaire distribution showed a positive perspective on strengthening prerequisite knowledge compared to previous learning. This medium indicates that there is an effect of enhancing prerequisite knowledge on students' achievement, an increase in achievement, and positive student perspectives on strengthening prerequisite knowledge.

Keywords: Achievement, eigenvectors, perspective, prerequisite knowledge

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INTRODUCTION

Based on observations of the assessment results of physics education students learning in the 3rd semester Universitas Graha Nusantara in the matrix course in vector space, it knows that the learning outcomes are below the value of 54. The factor that causes the low value of these students is the lack of prerequisite knowledge, such as there are still students unable to the operator of addition or subtraction with a combination of numbers with a minus (-) and positive (+) symbols. Less or not able to solve linear equations, determine the 3x3 order matrix and inverse matrix operations. It shows that the prerequisite knowledge of 3rd-semester students is not the same. Therefore it is necessary to do the prerequisite knowledge equalization by strengthening prerequisite knowledge in learning.

Prerequisite knowledge is the provision of expertise used to be able to understand the further subject matter. To recognize new material needed knowledge that supports or initial content means there is a process of constructing knowledge, which is prerequisite-

knowledge is linked to further knowledge. Example: to learn the multiplication material first has the prerequisite knowledge, which also. Matrix subjects in vector space are compulsory subjects in physics education study programs; one content is eigenvalues and eigenvectors. Prerequisites for understanding this material are quadratic equations, factoring operations with free terms and cube polynomials, determinants, matrix row operations (Anton, 2013).

Prerequisite knowledge is essential to analyze so that it can be using as material for designing learning, student errors, student learning difficulties and to support student performance, and solving problems (Purwana, 2012; Dogan-Dunlap, 2006; Adi et al., 2018; Taylor et al., 2017; Shadiq, 2007). Likewise, to make it easier to understand mathematical material at the college level, students should have mastered the underlying mathematics of high school, junior, and elementary school levels. Still, the facts in the field are not the case.

The learning method that is widely using to improve learning outcomes in the present is blended learning, namely learning that combines online and *face to face (traditional learning)*. Online learning and *face to face*; there is no difference in assessing student assignments (Smith, 2013). Therefore, in this study, choosing learning *face-to-face* emphasizes strengthening the prerequisites through a one-by-one approach to students. Face to face learning can be optimally carried out in class because the number of students is relatively small. This learning can make students work independently to solve the problems given during lectures, foster an attitude of courage to ask questions directly to the instructor so that it is expecting to increase student interest in learning. In the classroom, the teacher plays an active role in monitoring each stage of solving the questions conducted by students and can see the development of each student in answering the questions given.

The application of learning designed by the lecturer can be measured and reviewed from the perspective of students. Perspectives and responsiveness can be used to determine the impact of the implementation of learning models, characteristics, and values of effective teachers that are liked by students (Azman & Shin, 2012; Henukh & Guntara, 2020). Perception is a process of stimulus received by an individual through his senses, which is then interpreting to understand and understand the stimulus received (Maulida, 2017). Therefore this study also measures the implementation of prerequisite knowledge strengthening through student perspectives.

Based on the explanation before, the formulation of the problem in this study are: 1) Is there an effect of strengthening the prerequisite knowledge on the learning outcomes of students' grades and eigenvectors?; 2) What is the student perspective on increasing the prerequisite knowledge that has been done?. The hypotheses of this study are: 1) H_0: there is no influence of the strengthening of prerequisite knowledge on the learning outcomes of students' values and eigenvectors, and H_1: there is an influence of the strengthening of prerequisite knowledge on the learning outcomes of students' eigenvalue materials and vectors; 2) Positive student perspective (qualitative).

RESEARCH METHODS

The type of research applied was pre-experimental design with one group pretest-posttest. The experimental treatment was carried out in one class, by carrying out two procedures (without and giving reinforcement of prerequisite knowledge). In this study, researchers wanted to see if there was an effect of strengthening the prerequisite ability on student learning outcomes.

This study sample was all of the 3rd-semester students of the physics study program at Universitas Graha Nusantara, Padangsidimpuan, amounting to 10 people. Data collection instruments were essay and questionnaire tests. Essay tests are using to collect student learning outcomes data and eigenvector vectors by providing pretest and posttest. Essay tests totaled five questions, including categories C2, C3 dan C4. Simultaneously, the questionnaire was used to collect student perspective data on learning to strengthen prerequisite knowledge. The questionnaire

data obtained was increased by observing. The research steps refer to Figure 1.

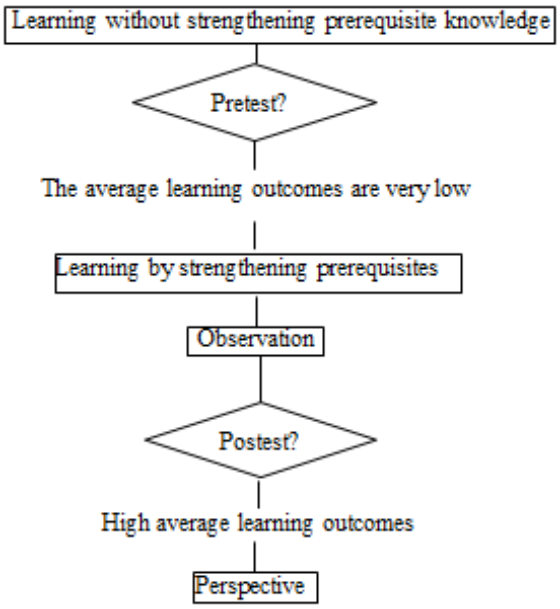

Figure 1. Stages of research

The pretest is giving to detect students' failure to work on problems, compile learning plans, and then treat them by strengthening prerequisite knowledge. The process includes: 1) explaining knowledge prerequisite materials to understand the value and eigenvectors, including quadratic equations and polynomial squares, and the determinant of the matrix carried out for two credits; 2) assignment of determining the value and eigenvector vector; 3) monitoring: see the stages of solving the questions given, help and direct students when experiencing problems. Teachers are required so that students can understand completing the given task.

Data analysis techniques used in this study were descriptive statistics and non-parametric statistics. Descriptive statistics are used to analyze data by describing or describing data that has been collected through tables, graphs, diagrams, calculation of the mean, median, mode (a measurement of central tendency), calculation of data distribution through the calculation of averages and standard deviations, calculation of percentages. Non-parametric statistics with the Wilcoxon test are used to test hypotheses. To answer the formulation of the first research problem using the Wilcoxon test, and to find out the magnitude of the increase in student learning outcomes using learning by strengthening prerequisite knowledge and without reinforcement used N-Gain developed by Hake (Siregar, 2015), shown in Table 1.

Table 1. Criteria for N-Gain scores

N-Gain	Category
$g > 0,7$	High
$0,3 \leq g \geq 0,7$	Medium
$g < 0,3$	Low

The criteria used in analyzing hypotheses is if the value of sig. < 0.05 then H_0 is rejected, and vice versa if the value of sig. > 0.05, then H_0 is accepted. This analysis was seconded using SPSS software version 21.0. Then the investigation to determine the perspective of students using descriptive analysis. In this case, what is doing is to present the results of a Likert scale questionnaire by describing the state of a phenomenon or event systematically by what it is with observations. Thus, researchers describe how the perspective of students towards strengthening the prerequisite knowledge that has been doing.

RESULTS AND DISCUSSION

Based on student learning outcomes and eigenvector vectors before and after the strengthening of prerequisite knowledge, it was founded that a significant increase in student learning outcomes is showing in Figure 2. It appears that before the prerequisite is reinforced, student learning outcomes at 100% eigenvalue and vectors, the value is below 54 with the category E predicate. In contrast, after being given a prerequisite strengthening the percentage of values A>85 by 40%, the rate of B values between 70 to 84 is 40%, the percentage of C values between 60 to 69 is 20%.

Based on the pretest given shows that the student answer sheet, none of the students completed solving the questions about eigenvalue and eigenvector, the maximum limit of completion made by students up to the determinant stage was as many as 6 people, this was influenced by determinants including discussion material in the course this. The settlement is shown in Figure 3, while 4 more peo-

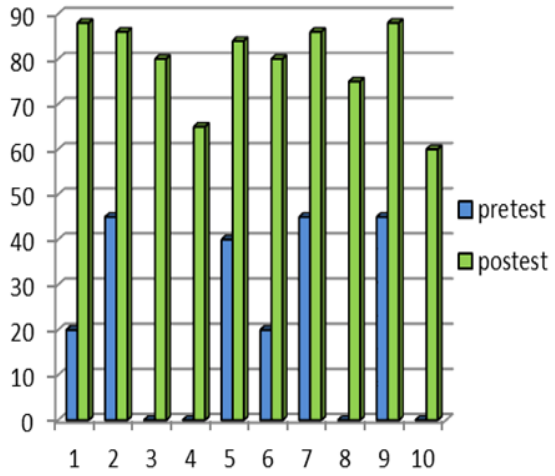

Figure 2. Student learning outcomes

ple who are not yet able to be determined are giving a strengthening of the determinant matrix operation.

The determinant process can be obtaining quadratic equations or polynomial squares so that the next stage of completion by students is to find the value of x. But none of the students managed to find the value of x, which is shown in Figure 4, and neither was the polynomial equation.

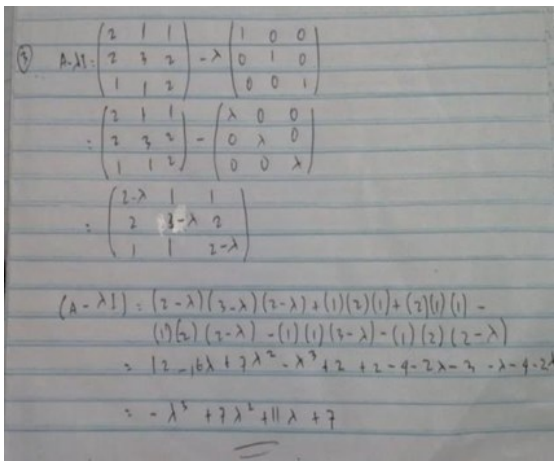

Figure 3. Completion of students to determine eigenvalues and vectors

Based on the posttest given, it can be seen from the answer sheet, and all students can finish the posttest well, that is 80% of students succeed, and 20% (2 people) get scores of 60 and 65. Students do not experience problems solving problems and eigenvectors both in solving quadratic equations, polynomial factoring, etc.

After treatment of prerequisite knowledge strengthening, learning outcomes are called pretest results, and learning outcomes after surgery of prerequisite knowledge strengthening are calling posttest results. Results Descriptive statistical analysis of these two data can be shown in the following Table 2.

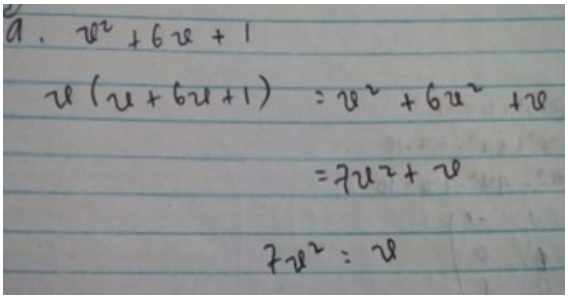

Figure 4. Completion of students to determine the value of x by factoring quadratic equations

Table 2. Description of the results of the pretest and posttest understanding of the value and eigenvector

	N	Range	Mean	Std. Deviation
Pre Test	10	45,00	21,5000	20,68950
Post Test	10	28,00	79,2000	9,77298
Valid N	10			

The difference in the results of the pretest and posttest understanding of the value and eigen vector can be seen in Figure 5, showing that the average score of the results of the pretest understanding of the value and eigenvector is much smaller than the results of this posttest also supported by the greater range of the pretest compared to the posttest contained in Table 2, which means the difference between before strengthening precondition knowledge and after, and shows that there is a change in student precondition knowledge for the better so that the results of eigen learning are also better. This difference is due to differences in the characteristics of learning systems and teaching material approaches that emphasize fundamental knowledge. The underlying mathematical concepts to the concepts of calculating eigenvalues and eigenvectors are building.

Based on non-parametric statistical tests conducted, namely the Wilcoxon test.

Obtained that there was no decrease in the score of student learning outcomes from pretest to posttest, this is showing in Table 3. the negative rank column of 0. But obtained an increase in score from pretest to posttest by 10 students (in the positive rank column). There is also no similarity in the student pretest and posttest scores in the table.

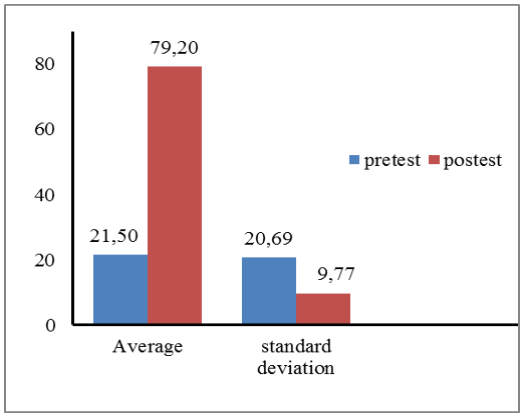

Figure 5. The mean and standard deviation of pretest and posttest understanding of values and eigenvectors

Table 3. Wilcoxon test results

Ranks

		N	Mean Rank	Sum of Ranks
postest - pretest	Negative Ranks	0[a]	.00	.00
	Positive Ranks	10[b]	5.50	55.00
	Ties	0[c]		
	Total	10		

a. postest < pretest

b. postest > pretest

c. postest = pretest

Test Statistics

	postest - pretest
Z	-2.807[b]
Asymp. Sig. (2-tailed)	.005

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Based on Table 3, the output "Asymp. Sig. (2-tailed) "above, note the Sig. is 0.005, which if related to the hypothesis analysis criteria, then the Sig. (= 0.005) < α (= 0.05) so that enough evidence to make a decision that H_0 is rejected and H_1 is accepted.

Thus it can be concluded that there is an average difference between the pretest and posttest learning outcomes, which means that there is an influence of the strengthening of prerequisite knowledge on the learning outcomes of students' eigenvalue material and vectors, the results of this study are in line with the findings made by Putri et al. between mastery of prerequisite material with learning outcomes in mathematics and students' critical thinking (Putri et al., 2014; Razak, 2017). Likewise, it can be seen from the increase in the pretest and posttest scores of students using N-gain is 0.74, which refers to Table 1 shows the high category.

The students' perspective on the learning approach given is shown in Table 4. The perspective questionnaire was made based on the experience of strengthening student requirements, with a scale of 5 (1 very negative to 5 very positive). The results of the questionnaire were founding that the average score of perception of strengthening prerequisites was 4.43 with positive interpretation.

Table 4. Student perspective results

Description	Average	%
The importance of prerequisite knowledge for understanding eigenvalues and vectors and solving cases	5	100
Motivated to do the problem independently	3,9	78
Confidence	3,8	76
This learning is more meaningful than before	4,8	96
The importance of mastering basic mathematical concepts	5	100
Motivated to relearn prerequisite knowledge on other material, and cases	4,2	84
Average	4,45	

Students provide a perspective that learning prerequisite strengthening is more meaningful than learning without reinforcement with an average value of 4.8, very positive categories, and this is the same as an increase in the average amount of student learning outcomes by 57.7. Suparno states that meaning-

ful learning is a learning process in which new information links to the understanding structure already possessed by a person (Najib & Elhefni, 2017).

Based on the results of observations, it appears that students can complete the task by solving the problem, namely the application of the concept of eigenvalues and eigenvectors in the case of physics, besides, students can find the value and eigenvectors by completing the factoring and determinant matrices first. Students know the importance of prerequisite knowledge or basic mathematical concepts to be mastered to understand new knowledge (values and eigenvectors) and solve cases with an average value of 5 with a percentage of 100%. This is similar to Siregar's finding that basic concepts or basic mathematical knowledge are essential in solving problems in science (Siregar, 2019). In general, mathematics and physics material is multilevel material in the sense that advanced material is related to the basic material. Further material can be understanding if the primary material has been owned or mastered by students.

After the students have the prerequisite knowledgeability to have an impact on learning independence and self-confidence, Table 4 shows the percentage of 76% and 78%. Learning independence and confidence gained the least relative rate compared to the component description of other students' perspectives. This could be since students were not accustoming to doing the task independently because they were not confident in their abilities. Student learning independence can be influenced by motivation and self-confidence (Mustaqiim et al., 2017), and academic system support (Douglass & Morris, 2014). Therefore it requires a great effort from the closest person (instructor) to influence students to get used to independent learning.

A series of processes experienced by students in this research activity made them motivated to master prerequisite knowledge when having difficulty understanding other material, based on the percentage of perspectives in Table 4 obtained by 84%. Based on observations made, it appears that student motivation increases during the learning process look enthusiastic about asking and completing assignments.

CONCLUSION

The treatment of strengthening prerequisite knowledge has a significant influence on student learning outcomes, which the average learning outcomes value and eigenvector 79.20 from the average value before the treatment of 21.50. At the same time, the student perspective on strengthening prerequisite knowledge is positive. This shows that increasing student learning outcomes by the N-Gain obtained positive student perspectives compared to previous learning, where the learning is more meaningful than the knowledge applied before.

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