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Needs Analysis of Implementation of The Mentoring Program for Fundamental Physics 1 Lectures to Support Student Learning Independent

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Abstract
This research uses a descriptive method and aims to analyze the need for a mentoring program in the Fundamental Physics I course. The research was conducted on 64 students (32 students had participated in the mentoring program for one semester, and 32 students did not participate in the mentoring program), 2 lecturers, and 4 tutors. Data were obtained from documents of students' final exam scores, interviews, and surveys. The results showed that (1) the final exam scores of students who participated in the mentoring program were better and significantly different from the class that did not participate in the mentoring program, (2) students who participated in the mentoring program gave a positive response to the program, and (3) students who did not participate in the mentoring program felt that they experienced many difficulties in Fundamental Physics I lectures and felt that the mentoring program was necessary.

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1. Introduction

Fundamental Physics course provides a foundation for understanding fundamental Physics concepts, ranging from Newton's basic laws, motion, and energy to electricity and magnetism. These topics are important in the context of Physics itself and relevant in various fields, such as Chemistry, Biology, Engineering, and Computer science. Success in understanding Fundamental Physics materials is crucial for academic success at the next level [1], [2]. Students with a strong understanding of fundamental physics will be better prepared to master more complex topics. Thus, the importance of fundamental Physics I as the main foundation for subsequent courses cannot be doubted. Students' investment in understanding these fundamental Physics concepts will significantly impact their future academic and professional development.

Based on the findings of past studies, many students experience difficulties in mastering essential concepts in fundamental physics. In the Fundamental Physics I course, some difficulties are, for example, in the topics of Mechanics [3]–[6], Static Fluids [7]–[9], and Dynamic Fluids [10]–[12]. In the Fundamental Physics II course, there are also many difficulties encountered, for example, on the topics of Temperature and Heat [13]–[15], Kinetic Theory of Gas [16], [17], Thermodynamics [18], [19], Static Electricity [20], [21], and Dynamic Electricity [22], [23]. Fundamental Physics III is no exception; there are also many difficulties experienced by students, for example, on the topics of Electromagnetics [24], [25], Magnetic fields [26], Alternating Current Circuits [27], [28], to Modern Physics [29], [30].

There are many aspects that cause problems in physics learning, for example, many topics must be delivered in a limited time with demands for in-depth mastery of concepts. In fundamental Physics lectures, only 2-3 meetings are usually allocated to complete one subject. This makes it difficult for lecturers to organize learning that can allow the material to be conveyed comprehensively and deeply [31]. On the other hand, the extensive Physics material with varied cases requires a long time to be learned by students [32], [33]. Therefore, students are required to be independent in learning material outside the classroom.

This demand for student independence is often not in accordance with the conditions that occur. Many students are still unused to the independent learning system outside the classroom. Many students are found to have a low level of learning independence [34], [35]. A low level of learning independence in physics can negatively impact the learning process. Some of these negative impacts include: (1) Lack of independence can lead to superficial or even incorrect understanding of the material; (2) Students with low levels of learning independence may tend to have lower grades in physics exams and assignments due to lack of in-depth understanding; (3) When students find it difficult to understand physics material due to lack of learning independence, they may lose motivation to study further or develop interest in the subject; (4) Learning independence in physics allows students to hone problem-solving, analysis, and critical thinking skills. Without sufficient independence, students may not develop these skills well; (5) Difficulty in understanding physics material due to lack of study independence may lead to increased stress and anxiety, especially ahead of exams or assignment deadlines; (6) Without sufficient independence, students may miss the opportunity to develop time management skills, self-reliance, and discipline required in the academic and professional world.

To overcome these negative impacts, it is important for students to actively seek help, develop independent learning skills, and engage in practices that strengthen their understanding of physics. Getting support from lecturers, peers, or other learning resources can also help in improving learning independence. One solution that can be implemented in lectures is a mentoring program. Mentoring is a series of activities carried out by a person or group of people in guiding, advising, directing, and training in various fields, including character building or good values to prepare mentees to be more 'valuable' [36]. So far, the mentoring program at the Universitas Negeri Malang has been implemented, but it is still not a program that is always implemented in the fundamental Physics course. The mentoring program is still implemented in the fundamental Physics I course only. In addition, not all lecturers also implement this mentoring program in their classes. On the other hand, no research has been found that explores the importance of mentoring programs in fundamental Physics I courses. In fact, this kind of research is important to reduce obstacles or problems found in lectures. Therefore, this study will explore data on the need for mentoring programs in fundamental Physics I lectures.

2. Methods

This research uses a descriptive method to describe the need for a mentoring program to support Fundamental Physics I lectures. We used several data collection techniques, such as interviews, document analysis, and surveys, to achieve this goal. Interviews were conducted with lecturers and student tutors. Interviews were conducted to provide an overview of the implementation of mentoring activities. Document analysis was conducted with the source document being the final semester exam scores of students from two classes, each of which was a class with a mentoring program and without

a mentoring program. The same lecturer taught both classes. A survey was conducted to explore student responses to the usefulness of the mentoring program.
In classes that have implemented the mentoring program, the survey was conducted to explore data on the usefulness of the program that has been carried out for one semester, while for classes that were not given, a mentoring program aimed to explore students' opinions on the program's needs. The questionnaire used in this study uses a Likert scale with a score of 5 for strongly agree (SA), 4 for agree (A), 3 for neutral (N), 2 for disagree (D), and 1 for strongly disagree (SD).

This study was conducted on 64 students (32 students from the mentoring class and 32 students from the non-mentoring class), 2 course lecturers, and 4 tutors. The context of mentoring carried out in this course is mentor mentoring activities for one semester. Mentoring is carried out during lectures in class and outside the classroom. In mentoring activities, mentors have previously been trained by the lecturer in charge of the course and have been given directions on things that must be done in mentoring activities. Mentors in this activity are students who have passed the fundamental Physics I course and are selected directly by the lecturer.

Data analysis of the end-of-semester exam scores was carried out by determining descriptive statistics to provide an overview of students' abilities after lectures in both classes. In addition, we analyzed the difference in exam results between the two classes using an independent sample t-test. Survey data were analyzed by determining the percentage of student responses for each statement item. The results of the interviews became supporting data to strengthen the findings.

3. Results and Discussion

In the results section of this study, we divide the discussion into four parts, namely (1) an overview of mentoring implementation activities, (2) the results of the final semester exam of Fundamental Physics I course, which gives an overview of the exam scores in both classes through descriptive statistics and a test of the difference in the exam scores of the two classes, (3) the response of students who were given a mentoring program for one semester to the mentoring program they have implemented, and (4) the response of students' needs to the mentoring program, for students who were not given a mentoring program in lectures.

3.1. Mentoring Activities in Fundamental Physics I Course

The mentoring activity is planned by the lecturer in charge of the course. This activity's main purpose is to help students who are struggling with the difficulties of taking Fundamental Physics I courses. Mentoring activities are assisted by mentors who are students who have taken the Fundamental Physics I course and are considered to have good academic abilities by the lecturer teaching the course. This mentoring activity is entirely a learning assistance activity for students carried out in class during lectures and outside the classroom after lectures.

Mentoring activities carried out in the classroom during lectures aim to assist students in following lectures well. The mentor's job is to pay attention to students during learning and immediately provide assistance if anyone is struggling. In addition, most students are more comfortable asking questions to student mentors than to the lecturer in charge of the course. Not only do mentor’s help students who have difficulty following lectures, but they also have an important role in helping students in discussions be more directed.

Mentoring activities outside the classroom are carried out regularly in one meeting for 100 minutes. Mentoring outside the classroom has several objectives. First, it helps students understand material or concepts that are still not understood in lectures. Second, it helps direct students in solving cases to deepen concepts. Third, it helps students plan their learning independently and motivates them.

3.2. Final Semester Examination Results of Fundamental Physics I

Based on the results of the final semester exam of fundamental Physics I, we can see how students' understanding of basic concepts is indicated by the scores obtained. We have analyzed the scores of both classes with the same lecturer. In this Physics department, the exam is conducted simultaneously with the same exam questions. Table 1 shows the descriptive statistical analysis results of the end-of-semester exam score data from the classes that received the mentoring program and those that did not. The class that received the mentoring program obtained a higher average score (75.72) than the class that did not receive the mentoring program (64.41). However, after the mentoring program, some students still scored 58.00. This score is quite low, but in this study, we did not focus on the causes of these students still getting low scores. This can be further investigated in other studies.

Based on the Skewness score, the statistical value for each class is -0.169 and 0.164. These scores are between -1 to 1. These scores indicate that the data from both classes are normally distributed. Therefore, to test the significance of the difference in the scores of the two classes, we used the independent sample t-test (Table 2).

Table 1. Descriptive Statistics of Final Semester Exam Score Data

Class	N	Minimum	Maximum	Mean	Std. Dev.	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Non-Mentoring	32	46.00	82.00	64.41	9.61	-0.169	0.414
Mentoring	32	58.00	98.00	75.72	9.73	0.164	0.414

Table 2. Analysis Results of Independent Sample t-test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Skor	Equal variances assumed	0.005	0.947	-4.68	62	0.000	-11.31	2.42	-16.14	-6.48
	Equal variances not assumed			-4.68	61.99	0.000	-10.31	2.42	-16.14	-6.48

Based on the results of the independent sample t-test analysis, the sig value was found. Levene's Test for Equality of Variances is 0.947 > 0.05, so it can be concluded that the data variance between groups of students who are given a mentoring program and those without a mentoring program is homogeneous. Based on the output on the t-test for Equality of Means, obtained $t = -4.68$; $df = 62$; and *sig.* 0.000 < 0.05. These results indicate that the two classes' average final semester exam scores are significantly different. That is, the score of the final semester exam results of students who get the mentoring program is better than that of students who do not get the mentoring program, with an average difference in the scores of the two classes of 11.31.

Based on the end-of-semester exam data from these two classes, the mentoring program positively impacts student performance in solving problems. Previous researchers have investigated this in the context of lectures in mathematics [37], [38]. In the implementation of mentoring, students are more free to ask mentors about things that have not been understood.

Mentors also provide many explanations about basic concepts that are essential for students to understand, so it is very useful for students, especially for students who still do not understand the material during lectures with lecturers.

The mentoring program that has been implemented is designed using a peer teaching strategy. Mentors in this mentoring activity are students who have passed the fundamental Physics I course. With peer teaching, students feel more comfortable asking mentors questions. This peer teaching strategy has also shown many positive results in learning [39]–[42] so it is indeed relevant to be used in the mentoring program. On the other hand, based on the interviews we conducted with lecturers, they showed positive arguments for the usefulness of the mentoring program. With the mentoring program, students are more organized in learning, lecturers are easier to manage the class, and even students tend to be more active in attending lectures.

3.3. Student Response to the Implemented Mentoring Program

In addition to analyzing the results of students' final semester exams, we analyzed students' responses to the mentoring program that had been implemented. We gave questionnaires to 32 students who had participated in the mentoring program for one full semester. The percentage of student responses for each statement is shown in Figure 1.

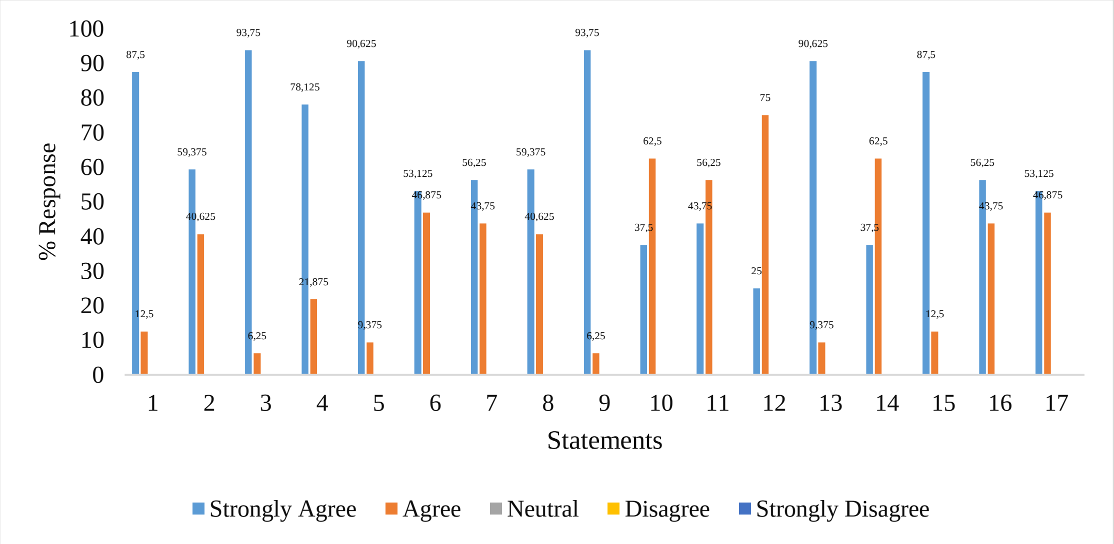

Figure 1. Student Response to The Usefulness of The Mentoring Program

Overall, the survey results show that the Fundamental Physics I mentoring program is considered very useful and effective in improving students' understanding, confidence, motivation, and academic performance. No respondents gave neutral, disagree, or strongly disagree responses to the statements, indicating a very positive acceptance of the program. In addition to impacting students' ability to solve problems, the mentoring program can also increase student motivation in learning. Based on statement item 6, 53.13% of students strongly agree, and 46.87% of students agree that they get support and motivation from mentors during the mentoring program. According to Chairiyati [43] with the mentoring program, students can try to catch up with them so that they are motivated to attend lectures better.

3.4. Difficulties in Fundamental Physics I Lectures and the Need for a Mentoring Program

Finally, the surveyed for 32 students who did not receive a mentoring program, tried to explore their opinions on the need for a mentoring program, (Figure 2).

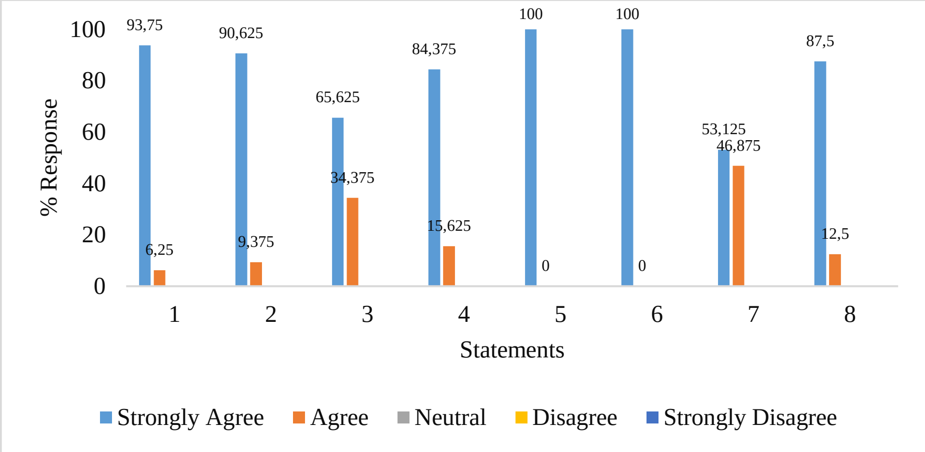

Figure 2. Student Response to Difficulties in Understanding Fundamental Physics I and the Need for a Mentoring Program

Based on the data in Figure 2, student responses generally lead to positive responses and the need for a mentoring program. In the statement about having difficulties in Fundamental Physics I, all students agreed and strongly agreed. This means that students experience many difficulties in following Fundamental Physics I lectures and have difficulty understanding the material. Moreover, all students (100%) stated that they would attend all mentoring sessions if a mentoring program was held. This shows that students need a mentoring program. The results of several previous studies show that mentoring programs are needed to overcome student difficulties in certain.

This research is limited to analyzing student needs for mentoring programs in Fundamental Physics I courses. Based on the data, we found (1) students who obtained the mentoring program had better cognitive learning outcomes than students who did not obtain the mentoring program, (2) positive responses to the usefulness of the mentoring program by students who underwent the mentoring program for one semester, and (3) difficulties experienced by students who did not undergo the mentoring program and their statements on the need for a mentoring program. We hope that the results of this study can be used as a basis for study programs to make policies on the importance of mentoring programs for students, especially for fundamental and advanced courses. In addition, we hope that there will be further research on the effectiveness of mentoring programs for certain courses, of course, to empirically test how the most effective mentoring program strategies are carried out.

Conclusion

This study has successfully shown the importance of a mentoring program in helping students in the Fundamental Physics I course. Based on the data we obtained, it can be concluded that the mentoring program positively impacts student learning outcomes, and students show a positive response to the need for mentoring programs to be provided in fundamental Physics I courses. This conclusion is based on three data sources. First, the final semester exam scores of students who were given the mentoring program were higher than those who were not given the mentoring program and were significantly different. Second, students' positive responses to the mentoring program that they have participated in for one semester. Finally, students responded positively to the difficulties they experienced in fundamental Physics I lectures and the need for a mentoring program.

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