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DIFFERENCES IN FORMATIVE ASSESSMENT RESULTS OF BASIC PHYSICS 2 STUDENTS IN OFFLINE AND ONLINE LECTURES ON SPECIAL RELATIVITY THEORY MATERIAL

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Abstract :
The research was motivated by the Galodo disaster that occurred in Tanah Datar district. This disaster has an impact on the implementation of basic physics 2 lectures at UIN Mahmud Yunus Batusangkar which must be carried out online using the Zoom application. The research was conducted on two different campuses, namely 2nd semester students at UIN Mahmud Yunus Batusangkar and UIN Imam Bonjol Padang. This study aims to determine whether there are differences in the results of formative assessments of students who conduct online and offline lectures by chatting with lecturers, teaching methods, and teaching media. This research was analyzed using a quantitative approach with a control group posttest only design. The instrument used is a formative question on special relativity material in essay form. The results of the study were analyzed using an independent sample t test which resulted in a 2 tailed sig value (0.269) > 0.05 which indicates that there is no difference in the results of students' basic physics formative assessment between students who conduct online and offline lectures on special relativity theory material. The average formative score of students is also not much different in both samples. The use of appropriate lecture methods, strategies, and media needs to be improved in basic physics 2 lectures.

Keywords: Offline, Online, Special Relativity Theory

INTRODUCTION

Learning is a process of interaction between students, educators and learning resources in a learning environment (Triwahyuni, 2022; Maulia et al., 2023; Jusmaniar et al., 2024). This process aims to develop the potential of students so that they can achieve the expected competencies (Jami, 2022; Whudian et al., 2023; Tiastiti et al., 2024). Learning does not only involve the transfer of knowledge, but also involves the development of skills, attitudes, and values that are relevant to everyday life (Angelia et al., 2023; Herlo et al., 2023; Refliana & Pertiwi, 2023). Thus, learning becomes the

foundation for the formation of character and individual competencies that are ready to face challenges in the future.

Physics learning at the college level has a crucial role in equipping students with a deep understanding of the basic concepts of the universe, physical phenomena, and their applications in technology (Asis et al., 2023; Mirawati & Sikarni, 2023; Andriani et al., 2024). At this level, physics learning is not just about understanding theory, but also involves experiments, data analysis, and complex problem solving. With a more applied and research-based approach, students are expected to be able to connect physics theory with its application in various fields of life, so that they are ready to contribute to innovation and the development of science (Restiani & Sariniwati, 2022; Nikmah et al., 2023; Madyan et al., 2024).

Basic physics 2 is one of the compulsory courses in the Tadris Physics Study Program at UIN Imam Bonjol and at UIN Mahmud Yunus Batusangkar. In this basic physics 2 course, students discuss electrostatistics, electrodynamics, magnetism, induction and alternating current, harmonic vibrations, wave symptoms, general properties of waves, geometric optics and optical devices, special relativity theory, and wave particle dualism. Many materials are obtained by students in this course.

This 2 credits course is taught through a different system. This is due to the Galodo disaster that occurred on May 11, 2024 in Tanah Datar district which caused obstruction of road access to the UIN Mahmud Yunus Batusangkar campus. This Galodo forced the implementation of the online lecture process in all courses, including basic physics 2. This certainly makes students complain about this disaster. Basic physics that should be taught offline or face-to-face must be carried out online.

The physics material taught during the Galodo period is the material on the theory of special relativity. The sub-materials taught in this special relaitivity theory material are the concept of ether hypothesis, Galileo's principle of relativity, Einstein's principle of relativity, velocity transformation, and the concept of momentum and relativistic energy. Special relativity emphasizes that only the laws of physics and the speed of light are absolute. Space and time are relative (Sanusi & Haryadi., 2022; Nabela et al., 2024). The theory of special relativity finds different frames of reference so that it is relative to the concept of space and time.

Lectures on this material still use discussion and question and answer methods both on the campus of UIN Imam Bonjol Padang which is held offline and online which is held at UIN Mahmud Yunus Batusangkar. At UIN Imam Bonjol Padang, students use the blackboard as a medium to help convey information, while physics students at UIN Mahmud Yunus Batusangkar also use writing tools in the zoom application to explain to their friends. If students have difficulty in explaining occasionally students use their notebooks alone in explaining to peers by facing the camera towards the writing to be explained. Examples of problems given by lecturers are equalized so that there is no significant difference between the implementation of learning on these two campuses. The basic difference in the methods of these two campuses is only the condition of online and offline learning. The teaching methods used are the same and the lecturers are also the same.

Online learning is learning that is carried out not by meeting face-to-face but by using platforms that can help in the process of implementing lectures (Sutarno, 2021; Manik & Nurhayati, 2023; Nwune et al., 2024). Many easy platforms can be used by lecturers, one of which is the zoom application. It is different with offline learning. Offline learning is learning that is carried out face-to-face in the classroom in delivering lecture information (Ekantini et al., 2020; Ikhsan, 2024).

The advantage of online learning is the increasing innovation in the field of technology in delivering information while the disadvantage of online learning is the lack of educator assistance in guiding students who have difficulty in understanding physics concepts. In addition, the advantages of offline learning are the direct interaction between educators and students, the provision of direct motivation to students with all students hearing it, and educators can properly monitor the implementation of the lecture process in the classroom. Meanwhile, the weaknesses in lectures conducted online are the lack of discipline of students in collecting assignments and the lack of interest in technology in the lecture process (Badriyah et al., 2021; Monita et al., 2024).

Research on formative assessment in online learning conducted by Adinda et al., (2021) found that formative assessment aims to determine the development of students' mastery of the competencies being studied. The results of formative assessment are usually used to determine the basis for improvement in the learning process. Research conducted by Anggraini et al., (2024) on the

effectiveness of formative assessment found that formative evaluation can improve students' ability to learn. Teachers can use the results of formative assessment by first adjusting learning strategies and media, providing assistance to students who are having difficulties, or providing motivation to students. Therefore, formative assessment is important to do, and this study will compare formative assessment in online and offline learning. This study fills the gap in the literature by examining the effect of emergency conditions, such as the Galodo disaster, on online and offline learning outcomes in the Basic Physics 2 course, especially on the special theory of relativity material, which has not been widely discussed before. The novelty of this study lies in the application of the control group posttest only design in the context of physics education, which shows that even though online and offline learning methods are used, learning outcomes do not differ significantly if the same media and teaching strategies are applied. This study also makes a practical contribution by suggesting improvements in learning strategies and media in emergency situations, as well as offering new insights into optimizing physics learning under unusual conditions, such as natural disasters.

The difference in learning implementation conditions on these two campuses makes the author interested in comparing the results of student formative assessments in the material of the special theory of relativity as a consideration for improving the lecture process in the future. This study aims to determine whether there are differences in student physics formative learning outcomes between the implementation of online and offline learning at UIN Mahmud Yunus Batusangkar and UIN Imam Bonjol Padang campuses. The physics material that was tested formatively was the special theory of relativity material because when this material was to be taught there was a Galodo disaster in Batusangkar.

RESEARCH METHOD

Types of research

This research uses a quantitative approach with a quasy experimental method. The design used was control group postest only design. Both groups were given formative tests using different treatments in terms of lecture implementation using online and offline lectures. With this design, the study aims to measure whether there is a significant difference in the learning outcomes of students who take online lectures compared to those who take offline lectures, using formative tests as the main measuring tool. The control group posttest only design helps in isolating the effects of different treatments to evaluate the effectiveness of the teaching methods used.

Population and Research Sample

This study involved students from two campuses, namely UIN Mahmud Yunus Batusangkar and UIN Imam Bonjol Padang, with a total sample of 40 students, divided evenly into two groups: 20 students taking online lectures and 20 students taking offline lectures. The sampling technique is total sampling. This is because the population in this study is limited. The variables in this study are online learning, offline learning, and formative assessment. Formative assessment was chosen because this assessment is only carried out on one material, the ethics of students have completed one course outcome. The null hypothesis used in this study is that there is no difference in the results of students' physics formative assessment between students who carry out offline and online lectures on special relativity theory material.

Research Instrument

The instrument used in this study is a formative question in the form of an essay related to the material of the theory of special relativity. The outline of the essay question instrument is shown in table 1.

Table 1. Grid of essay question instruments for special theory of relativity material

No	Concept of the question	Number of questions
1	Length Contraction	1
2	Relativistic Velocity Addition	1
3	Time Dilation	1

4	Relativistic Momentum	1
5	Relativistic Energy and Mass	1
Number of questions		5

Data Analysis

Data were analyzed using an independent sample t test with two-way hypothesis testing. Data analysis using the independent sample t-test is one of the statistical methods used to compare the average of two different groups (Permatasari, 2023; Puspita et al., 2023; Cahyani et al., 2024). This method is suitable for use when we want to know whether there is a significant difference between two groups of samples that are not related to each other. In the context of two-tailed hypothesis testing, the null hypothesis usually states that there is no difference in means between the two groups, while the alternative hypothesis states that there is a difference in means. This two-tailed t-test is conducted taking into account that the hypothesized difference can occur in either direction, either higher or lower.

RESULTS AND DISCUSSION

The research was conducted in May 2024 on two different campuses, namely on the campus of UIN Imam Bonjol Padang and the campus of UIN Mahmud Yunus Batusangkar. This research was conducted to answer the problem formulation set out in the introduction, namely to see the differences in student formative assessment results for the two different campuses by equalizing educators, methods, and teaching media. The results of the formative assessment for both samples are shown in the table below.Research results are presented in the form of graphs, tables, or descriptive. Analysis and interpretation of these results is necessary before they are discussed.

Table 2. Average Formative Assessment Results of Students in both Research Groups

No.	Research Group	Sample Amount	Mean
1	Group A (UIN IB)	20	57.5
2	Group B (UIN MY)	20	53.5

From Table 1 above, it can be seen that the number of research samples used was 20 physics students in semester 2. The number of students who take courses at UIN Mahmud Yunus Batusangkar is not that many actually. Students increase due to the senior students who repeat the basic physics 2 course in this junior class. If we look at the average value of the two samples, we get an average difference of 4 points which makes the difference in student formative grades not so different. However, we need to know the difference further by using statistical tests displayed in table 3 below.

Table 3. Results of Independent Sample t test Statistical Test of Physics Student Formative Grades

Result of Independent Sample t test	t	df	Sig. (2-tailed)	Mean Difference
Equal variances assumed	1.122	38	0.269	4.0

From table 3, it can be seen that testing has been carried out using an independent sample t test for both samples. To see the results of whether or not there is a difference in student formative assessment between the two samples, it can be seen from the 2 tailed sig value. The 2 tailed sig value is 0.269. This sig2 tailed value is greater than the significance level value of 0.05, so Ho is accepted with the result that there is no significant difference in the results of the formative assessment of physics students between students who use offline learning and online learning in the special theory of relativity material.

Special relativity material contains abstract material that can be visualized in the media. The presence of media is important in achieving good formative results on this material. Learning media is used as a supporting tool in presenting interesting material, to activate the learning atmosphere, and can be used to improve the quality of the learning process so that good understanding is obtained in students (Puspitarini & Hanif, 2019; Nabila et al., 2021; Rosadi & Utara, 2023). in this study, researchers did not use abstract media to explain the concept of relativity theory which had an impact on formative assessments that were still relatively low. The presence of media in the online and offline learning

process is equally important because it can be used in overcoming limitations in the lecture process in achieving lecture objectives (Prasongko, 2021; Limin & Kundiman, 2023; Qurrotaini et al., n.d.).

In lectures, the emphasis is more on how students can solve problems related to the special theory of relativity. The discussion of problems is carried out consistently with the same proportion. Problem solving in physics is very important in students (Rahmah, 2021; Sutarno et al., 2021). Students need to be trained in the habit of answering questions in the form of essays to see how their skills and abilities in answering physics questions. The selection of essay questions is appropriate because essay questions can stimulate the development of student thinking. Essay questions are better at monitoring the quality of problem solving by students than multiple choice questions (Rosmiati et al., 2020; Pemecahan et al., 2022).

The implementation of offline lectures is better implemented in basic physics 2 courses even though the material is abstract. This can be seen from the average formative score of students who are offline better than online. After conducting interviews with students who carry out online lectures, several reasons were obtained that resulted in low formative scores. Some of the reasons put forward are:

1. Network constraints, when listening to the exposure of peers and lecturers suddenly the network is lost
2. The limitation of the camera resolution of each student which has an impact on the lack of clarity of explanation in the form of writing
3. Lack of student attention because students can do other activities besides listening to material through the zoom application
4. The absence of a strong supervision system in the online learning process by lecturers
5. Tired of carrying out online lectures that previously also carried out online lectures

These five reasons cause a lack of student understanding in basic physics 2 lectures if carried out online. this is also supported by Resnandari endah et al (2021) which explains the weaknesses of online learning in higher education are the lack of adequate network availability, lack of student enthusiasm in online lectures, lack of student mastery in using online learning applications, students find it difficult to communicate online, and limited supporting devices in carrying out online lectures.

In addition to online lectures, students who conducted offline lectures also obtained low average formative scores. This is due to several reasons, namely:

1. Lack of challenge during lectures so that only friends who perform will need to understand better.
2. Lack of number of questions that are discussed together in class
3. Exposure to discussions that are too long needs to be given a clear time duration
4. The need to provide a lot of practice so that students are trained in solving problems.

These four reasons are the focus that must be considered by lecturers in improving the quality of lectures. The implications of this study suggest that although there is no significant difference in formative assessment results between online and offline lectures when the same teaching methods and tools are used, there is an urgent need to develop more effective teaching methods or strategies to improve students' ability to solve physics problems, especially on complex concepts such as the special theory of relativity. This means that educators should focus more on innovations in learning media and pedagogical approaches that can be applied in both online and offline learning situations, so that students' understanding of abstract materials can be improved. Thus, educational institutions need to consider integrating more interactive technology and media as well as adaptive teaching strategies into the physics curriculum, to ensure that the quality of learning remains optimal, regardless of the lecture format used.

CONCLUSION

This study concludes that there is no significant difference in student formative assessment results between students who carry out offline and online lectures if they use the same learning methods and teaching tools. The improvement in this lecture both online and offline is the need for a more appropriate method or strategy in delivering information to students so that students' ability to solve physics problems can increase. In addition to a good lecture strategy or method, lecture media is also needed that can support student understanding of the concept of special relativity theory. From the

results of this study, it is recommended that educational institutions develop and implement more effective teaching methods and interactive learning media to improve students' understanding of complex physics materials, both in online and offline lectures.

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