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Exploring the Educational Landscape: The Impact of Post-Covid Online Learning on Physics Education Undergraduates' Academic Engagement and Achievement

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Abstract

Covid-19 is a pandemic that can change the culture of the learning process, which Covid-19 pandemic brought transformation and new habits, and these new habits had to be adjusted based on the rules and regulations that apply in the country. Globally, Covid-19 made educators have to quickly adapt to new teaching methods, and students faced difficulties with internet access, digital literacy, and maintaining motivation in a remote environment. However, around 2021, in quartile 3 to be precise, in Indonesia changes have occurred again to adapt to new habits, namely the post-Covid-19 recovery period, where the education system has again transformed from online learning habits to offline learning. This study aims to find out how interest in studying and learning outcomes affect undergraduate students of physics education in the post-COVID-19 era. The research method is carried out quantitatively, which consists of filling out a questionnaire for interest in studying which consists of five aspects; (1) Exploration; (2) Curiosity; (3) Boredom; (4) Attention; and (5) Enjoyment. This study used two groups namely pre covid-19 and post covid-19 with a total of 67 samples used, then processing of learning outcomes data prerequisite tests such as normality and homogeneity tests were carried out then hypothesis testing using independent sample t-test and Cohen's D Effect Size to know the how big the difference between two groups, then a deep interview is conducted to know deeply. This research found results in which undergraduate physics education students in the post-COVID-19 era experienced low interest in studying and learning outcomes due to the shock culture and the influence of student organizations which they thought were more interesting than academic activities.

Keywords: education landscape, academic engagement, academic achievement, post covid online learning

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1. Introduction

COVID-19 is a pandemic that can change many human activities, including social activities, as well as educational activities in learning at the college/university level. Learning during COVID-19 was characterized by online learning, as is the case in Indonesia based on regulations that regulate that learning must be carried out online, as well as reducing study time. But the reduction in study time, of course, goes hand in hand with the flexibility of time for learning. Online learning, during COVID-19, was felt to be very effective and efficient in improving

various skills, as well as learning outcomes. Research conducted by Pustika (2020) stated that online learning during the COVID-19 pandemic was felt to be effective in increasing students' thinking skills due to the unlimited use of technology. In addition, in terms of learning outcomes, students in online learning during COVID-19 get good learning outcomes because of the efficiency of learning time that exists during online learning periods (Mseleku, 2020). In the use of technology in the education sector during the Covid-19 pandemic it was felt very rapidly, with the evidence that many developments of teaching materials could be accessed online (Yusuf, 2021). Thus, special implementation is needed for online learning during the Covid-19 pandemic.

In its implementation, online learning activities during Covid-19 had many innovations in the use of appropriate technology, to the development of new learning models. Focusing on innovation, various innovations to facilitate online learning have been carried out, such as using the WhatsApp application to facilitate the learning process (Susilawati & Supriyatno, 2020), using interactive LMS applications such as LabXChange for laboratory activities (Listiawati et al., 2022), up to developing e-books as teaching materials for the Covid-19 pandemic (Malaquias et al., 2021). Focusing on developing learning models, there is one learning model that was born in the Covid-19 era, namely the Sophisticated Thinking Blended Laboratory (Agustina & Putra, 2022) where the model combines two real and real laboratory activities, and the implementation of real laboratory activities can be designed to work remotely (remote laboratory). The implementations of new learning activities create new challenges for students. These will certainly have a certain impact on learning habits or culture during the COVID-19 or post-COVID-19 times.

The pandemic has forced the education sector to adapt quickly to new challenges, such as remote learning and hybrid models. Studying the effects allows us to understand how educational institutions have innovated to overcome obstacles and whether these innovations can be sustained for long-term benefits. The transition to online learning or hybrid learning requires changes in teaching methodologies, so studying the effects helps educators and institutions understand the effectiveness of these changes, enabling them to refine and optimize pedagogical approaches for better student engagement and learning outcomes.

Due to many achievements and innovations made during the distance learning period in the COVID-19 era, one often wonders what happened after the COVID-19 pandemic, as from various narratives, many have made plans in post-Covid-19 pandemic education policies (Murphy, 2020; Ratih et al, 2021). So that an in-depth study is needed to deal with education after the Covid-19 pandemic to overcome various problems that come up such as shock culture, or knowing what to do in the first steps after the Covid-19 pandemic (Singh et al., 2021). It is very important to know the initial steps after COVID-19 because this will reveal the advantages and disadvantages of the decision to use the model in learning. Knowing the initial steps in learning after the COVID-19 pandemic is needed because this will determine the appropriate learning model or use of media when learning is carried out post-COVID-19.

Indonesia has entered the post-COVID-19 era, requiring students from all levels to carry out learning activities offline, so research is needed to determine the effect of post-COVID-19 pandemic education to pro-

vide an overview of what happened in the post-COVID pandemic era. -19. In this study, researchers took initial data for a preliminary study, where researchers obtained initial data in the form of low interest in learning after the COVID-19 pandemic, so this research needs to be conducted and studied more deeply. Based on research conducted by Pahrudin (2021) who expressed his concern for the education sector in the post-COVID-19 era, it is feared that a shock culture will occur which will cause students' low interest in learning. Low interest in learning is very important to investigate because this will determine the learning output results.

The importance of this study is based on knowing how post-COVID-19 education affects an interest in studying and learning outcomes, as well as providing an initial overview for following up learning in the post-COVID-19 era, especially for physics education study programs. The results of this study are expected to be the main source of data for follow-up on post-Covid-19 education so that decisions taken by policymakers are sourced and appropriate for future steps.

Based on the explanations from the various studies conducted in the introduction, this study aims to find out interest in studying, along with learning outcomes for undergraduate physics education students in the post-COVID-19 pandemic.

2. Method

This research focuses on finding out the results of students' interest in learning after the COVID-19 pandemic quantitatively by comparing survey results between students after the COVID-19 pandemic and students before the COVID-19 pandemic. The population used in this study used two populations, namely Post-Covid-19 pandemic physics education un-graduate students (PoC19S), and Pre-Covid-19 pandemic physics education undergraduate students (PrC19S). The PoC19S population used is a population of 35 samples from physics education undergraduate students for the 2021 academic year, and the PrC19S population used is a population of 32 samples from physics education undergraduate students for the 2019 academic year. Where, class of 2021 is students who have attended the online learning period from before they started college, until after this research was completed, but the class of 2019 is students who have participated in the offline learning period from before they started college until the Covid-19 pandemic emerged. In full, a description of the participants in this study can be seen in Table 1.

Table 1. Participant Description

Population	Sample	Gender	
		Male	Female
PoC19S	35	12	23
PrC19S	32	11	21

Questionnaires in the form of in-depth questions are used to find out the interest in studying each population, where the interest in studying aspect uses questions with five aspects that have been developed by Rotgans (2015) which include; (1) Exploration; (2) Curiosity; (3) Boredom; (4) Attention; (5) Enjoyment. For details, the number of questions and sample questions from the five aspects of Interest in studying can be seen in Table 2.

Table 2. Questionnaire Aspect and Its Examples

Aspects	Questions	Component of Questions	Question Example
Exploration	4	1, 2, 3, 4	"I prefer to explore, and deeply analyze the subject matters that I study"
Curiosity	5	5, 6, 7, 8, 9	"I will ask more deeply about the subject matters I am studying if I want to explore it further"
Boredom	5	10, 11, 12, 13, 14	"I will not feel sleepy when listening to lecturers giving lectures"
Attention	4	15, 16, 17, 18	"I pay more attention to lecturers when delivering lectures because I think it's interesting"
Enjoyment	5	19, 20, 21, 22, 23	"I am very happy with the lectures because I am interested in the lectures"

In its aspect, the exploration aspect is focused on knowing the subject's interest in studying as they carry out exploration based on their interests, because according to previous researchers who stated that students will appear to have an interest when studying when these students can do exploration well by paying attention to scientific principles (Japahuge & Zeng, 2018). Exploration allows us to assess how students adapt to changes in the learning environment (Zulfikar et al., 2019). So, it can reveal students' adaptability, resilience, and the impact of such changes on their attitudes towards learning. Exploring students' experiences during this shift can reveal their adaptability, resilience, and the impact of such changes on their attitudes toward learning.

The curiosity aspect is focused on knowing how these students feel challenged and have a curiosity that can come because of differences in understanding between students and lecturers, or curiosity because they are curious about science so that students are able to ask critical questions, where this will show an interest in studying (Murayama et al., 2019). Curiosity is associated with a growth mindset—the belief that abilities can be developed through dedication and hard work. Students with a growth mindset tend to approach challenges with enthusiasm and resilience (Prayogi & Asy'ari, 2021). Investigating the student's curiosity can provide insights into how these attitudes collectively contribute to a positive learning experience.

The boredom aspect will show interest in studying the subject if students do not feel bored with lectures, where boredom will arise because students do not have interest in lectures which comes from various factors (Awaludin et al, 2023; Tze et al., 2016). Boredom may be linked to a lack of motivation, so exploring when students report feeling bored can help uncover underlying motivational factors, such as a perceived lack of challenge or a disconnect between personal interests and the lectures (Pawlak et al., 2020). Addressing these boredom aspects can positively impact attitudes towards learning.

The attention aspect will show an interest in studying when the student needs recognition or a desire to master lectures, with this in mind, high attention is enough to show good interest in studying (Hauser & Schwarz, 2016). Some students may thrive in interactive, hands-on activities, while others may prefer a more traditional classroom setting (Hebebci et al., 2020). Investigating attention allows us to identify the conditions that foster optimal learning experiences, shaping positive attitudes

The enjoyment aspect will show an interest in studying the subject if students go through lectures without any pressure at all, even students will forget all the pressure they feel when carrying out lectures (Frenzel et al., 2018). Exploring how students respond to tasks that are appropriately challenging provides insights into the balance between difficulty and enjoyment (Muñoz-Carril et al., 2021). This knowledge guides educators in designing learning activities that are intellectually stimulating and enjoyable.

All questionnaires were tested first by conducting a product moment validity test, and the reliability test before the questionnaire could be used in research, where the product moment validity test results were carried out by looking for the Pearson correlation value, and the reliability test was carried out by a reliability scale test, where All of these tests were carried out with the help of the IBM SPSS 18 application. In testing validity and reliability, a pre-study sample of 60 subjects was used outside the research subject to avoid data redundancy, and validity and reliability were measured objectively.

The validity of the questionnaire is carried out using product moment with Pearson correlation by comparing $r_{\text{critical value}}$ and $r_{\text{calculated}}$, where the conditions for a valid questionnaire are indicated by $r_{\text{calculated}} > r_{\text{critical value}}$ where the $r_{\text{critical value}}$ used for 60 subjects is 0.254. The reliability of the questionnaire is carried out using Cronbach's alpha test by comparing the Cronbach's alpha results > 0.600. Following, the results of the validity test using the product moment, and the reliability value can be seen in Table 3.

Table 3. Questionnaire Aspect and Its Example

Number of Question	Validity	Reliability
1	0.358	
2	0.447	
3	0.277	
4	0.582	
5	0.625	
6	0.411	
7	0.453	
8	0.289	
9	0.381	
10	0.610	
11	0.472	
12	0.486	0.787
13	0.361	
14	0.338	
15	0.364	
16	0.627	
17	0.476	
18	0.483	
19	0.344	
20	0.627	
21	0.777	
22	0.262	
23	0.333	

Table 3 shows that all $r_{calculated}$ values produced yield values> 0.254, which means the questionnaire used is valid for use. Meanwhile, in terms of reliability, it is known that the reliability results obtained are equal to 0.787, with the $r_{calculated}$ obtained which is equal to 0.787, it can be seen that the questionnaire used is reliable because Chronbach's alpha > 0.600.

To get PrC19S and Po19S physics education undergraduate students' learning outcomes, this research uses an inquiry-based learning model, where students are given real-world problems so that students have to solve real-world problems by combining theory with laboratory activities to get answers to real-world problems, then students fill out the questions that have been tested for validity and reliability beforehand after the lesson ends. The use of the inquiry-based learning model in PrC19S and Po19S is due to equalizing the treatment given so that there is no research bias in the form of differences in treatment between the two groups.

Giving questionnaires to subjects, the first time the questionnaire was administered, and the results of interest in studying were obtained in the 2019 class, where the implementation time was carried out in March 2020, and then for the 2021 class they were given and the results of interest in studying were obtained in March 2021. Then for study results, the entire series of inquiry-based learning is carried out and assessed based on an assessment rubric that has been designed beforehand, and the assessment is carried out the same for the PrC19S population, or PoC19S.

According to Glewwe (2021) in carrying out treatments in comparing results originating from different populations in the time range, the same treatment should be used, even as much as possible, and the number of samples used must be the same in order to avoid data validity due to differences in treatment. So to find out more deeply, this study conducted an analysis based on learning outcomes between PoC19S and PrC19S by comparing the learning outcomes of the two populations, where the two populations were given the same treatment and assessment techniques and the data used in this research, for both PrC19S and Po19S, uses the same learning materials, so that the research carried out will be feasible for both populations even though they have different timescales.

This study will fulfill the prerequisite test by carrying out a normality test using the Liliefors (KSL) and Shapiro-Wilk (SW) tests because this research uses subjects with a total of under one hundred subjects, so the two tests are considered suitable because the two tests it will be more accurate in knowing the normality of the data if the research has subjects under one hundred (Chen & Liu, 2020). The normality test pays attention to the significance value of the two hypotheses to be taken, namely; (1) If the p-value > α (0.05) then accept Ha, or in other words, the data is normally distributed; and (2) If the p-value < α (0.05) then it fails to accept Ha, or in other words, the data is not normally distributed

The second prerequisite test is to carry out a homogeneity test which aims to determine the equality of the data used, considering that the population used uses different subjects in terms of quantity and period, this homogeneity test is needed in this study because according to Ahn & Kang (2018), this homogeneity test should be done before testing the hypothesis because to find out whether the data used when using different populations and data sources have the same variance or not so that the hypothesis decision making in the independent sample t-test makes decisions that are assumed, not those that

are not assumed (Mishra et al., 2019) so that the homogeneity test that is considered appropriate in this study is to use the Levene's test because of its characteristics which focus on two populations that have different subjects in terms of quantity and time of data collection (Kim & Cribbie, 2018). The homogeneity test pays attention to the significance value of the two hypotheses to be taken, namely; (1) If the p-value > α (0.05) then accept Ha, or in other words the data is homogenous; and (2) If the p-value < α (0.05) then it fails to accept Ha, or in other words the data is not homogenous.

Then further data analysis was carried out to find out the results of the hypothesis testing and at the same time answer the objectives of the two studies, namely to find out how the influence of online learning during COVID-19 on physics education undergraduate student learning outcomes by conducting an independent sample t-test, where the independent sample t-test will find out how an event can affect a variable based on its average value (Nayak & Singh, 2021). The hypothesis testing using an independent sample t-test test pays attention to the significance value of the two hypotheses to be taken, namely; (1) If the p-value > α (0.05) then it fails to accept Ha, or in other words there is no difference in the average learning outcomes between PrC19S and PoC19S; and (2) If the p-value < α (0.05) then accept Ha, or in other words there is a difference in the average learning outcomes between PrC19S and PoC19S

To detail the results of the hypothesis testing using the independent sample t-test, an effect size test is used using Cohen's D Effect Size because this effect size test can provide a level interpretation of the differences that occur from data because according to Gignac & Szodorai (2016) states that the independent sample t-test is not enough to provide an overview of changes in an average, there must be a test that provides an interpretation of the level of the difference, namely using Cohen's D Effect Size which is felt to be very accurate. The mathematical calculation in the Cohen's D Effect Size test for the independent sample t-test uses the equation which can be seen in equation 1.

$$ES = \frac{Mean_{group1} - Mean_{group2}}{SD_{Pooled}} \quad (1)$$

To find the SD_{Pooled} value, you can use the equation which can be seen in equation 2.

$$SD_{Pooled} = \sqrt{\frac{(SD_1^2 + SD_2^2)}{2}} \quad (2)$$

Where the interpretation used in the Cohen's D Effect Size test is guided by the interpretation described by previous researchers, where the value of 0.00 – 0.20 indicates an interpretation that has no effect, 0.2 – 0.50 indicates a small effect interpretation, 0.50 – 0.80 indicates a medium effect interpretation, 0.80 – 1.30 indicates a high effect interpretation, and >1.30 indicates a very high effect interpretation (Juandi et al., 2021).

Then, the final stage of this study was to conduct in-depth interviews with the population using random sampling from the population used by the researcher. The in-depth interviews focused on the five aspects as shown in Table 2. Then the researcher took an outline of what the subject felt based on the aspects and discussed it in detail later.

3. Result and Discussion

This study found findings in the form of interest in studying results based on the results of filling out the forms for the students and learning outcomes based on the acquisition of grades from the entire learning series.

The findings will then be discussed on each subject so that after showing the findings, they will be discussed later.

Interest in studying was obtained from two populations namely PrC19S and PoC19S, where PrC19S filled out a questionnaire first which was followed by PoC19S, there are five aspects that have been described in the methodology sub-discussion of the instrument, where the percentage results of interest in studying are reviewed from the five aspects in both the population is presented in Table 4.

Table 4. Overall Frequencies, and Descriptive Data of the Interest in Studying Survey

Aspect	Percentages (%)		Descriptive Data			
	PrC19S	PoC19S	PrC19S		PoC19S	
			Mean	SD	Mean	SD
Exploration	77.65	61.14	15.53	1.39	12.23	2.80
Curiosity	80.75	62.51	20.22	1.82	15.63	2.96
Boredom	77.37	61.25	19.34	3.11	15.31	3.19
Attention	81.40	60.28	16.28	1.55	12.06	2.67
Enjoyment	76.87	65.48	19.22	2.47	16.37	3.06
Percentage Overall	78.80	62.13				

Based on Table 4, shows that the highest score in the exploration aspect is in the PrC19S group with a percentage of 77.65%. The highest score in the Curiosity aspect was in the PrC19S group with a percentage of 80.75%. The highest score in the Boredom aspect was in the PrC19S group with a percentage of 77.37%. The highest score in the Attention aspect was in the PrC19S group with a percentage of 81.40%. The highest score in the Enjoyment aspect was in the PrC19S group with a percentage of 76.87%. In terms of average percentage, the PrC19S group got the highest average percentage value with an average percentage of 78.80%. Of course, by knowing the descriptive data, researchers can find out what the condition of each aspect is in each group so that this can help to discuss the impact of interest for studying and its learning outcomes on physics education undergraduate students in the PrC19S and PoC19S.

Then, to fulfill the prerequisite tests before carrying out the hypothesis test, a normality test and homogeneity test are carried out on the results of learning outcomes in both populations. The following normality test results can be seen in Table 5.

Table 5. Normality Test of Learning Outcomes in Two Populations

Population	KSL			SW		
	Statistic	df	Sig.	Statistic	df	Sig
PrC19S	.135	32	.144	.955	32	.195
PoC19S	.125	32	.200	.938	32	.067

Based on Table 5 shows that the value of Sig. for KSL from PrC19S, the result is 0.144, and the value of Sig. for SW of PrC19S gets a result of 0.195. Then the results of Sig. for KSL from PoC19S get a result of 0.200, and the value of Sig. for the SW of PoC19S get a result of 0.067, where with a confidence level (α) 0.05, then all normality results from the data used are to get an interpretation of Sig. > α, which indicates that all data are normal so that the data used can absolutely be tested for the hypothesis using the independent sample t-test, but before doing the hypothesis test, a

homogeneity test was carried out, even though Listiawati (2022) states that the homogeneity test is not an absolute requirement, but this study uses two populations with different numbers of subjects and different timeframes, so a homogeneity test should be carried out because it ensures the validity of the data used (Nam, 2017). Following are the results of the homogeneity test using the Levene Test which can be seen in Table 6.

Table 6. Homogeneity Test of Learning Outcomes in Two Populations

	Levene Statistic	df1	df2	Sig.
Learning Outcomes	4.590	1	65	0.621

Based on Table 6 shows that the results of the homogeneity of the two data from the population show the value of Sig. 0.621, with the value of α used that is 0.05, then the data used is homogeneous with the Sig interpretation. > α.

After the results obtained based on the prerequisite tests were normal and homogeneous, to find out how the statistical average was compared between PrC19S and PoC19S, a hypothesis test was carried out using the independent sample t-test with the formulation of the hypothesis H_0 hypothesis to show that there is no difference in mean learning outcomes between PrC19S and PoC19S, and H_a is a hypothesis to show that there is a difference in average learning outcomes between PrC19S and PoC19S. The following are the results of hypothesis testing using an independent sample t-test which can be seen in Table 7.

Table 7. Independent Sample t-test Results for Hypothesis Decision

	Equal Variances	Levene's Test for Equality of Variances		t-test for Equality Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff	Std. Error Diff	95% Confidence Interval of the Diff	
									Lower	Upper
Learning Outcomes	Assumed	4.590	.621	6.265	65	.000	13.91	2.642	8.634	19.187
	Not Asummed			6.328	63.092	.000	13.91	2.611	8.694	19.128

Based on Table 7 shows that the results of hypothesis testing using an independent sample t-test get Sig. (2-tailed) is 0.000, this is according to Al-Emran (2016) states that if the Significance value in 2-tailed obtains a value below 0.05 (Sig. (2-tailed) < 0.05) then the decision that must be taken is that there is a difference from the value obtained, therefore based on the acquisition of Sig. (2-tailed) Table 7, shows the hypothesis taken, namely Ha, or in other words, there is a difference in the average learning outcomes between PrC19S and PoC19S.

Descriptively it can be explained that the average difference can be seen in the Mean Diff value, but this cannot provide a definite interpretation, further tests are required to determine the interpretation of the average

change (Lakens, 2017). One of the statistical tests to get an interpretation of the mean difference can be done by carrying out the Cohen's D Effect Size test because, in Cohen's D Effect Size, the results of the interpretation of changes will be obtained based on the mean value, standard deviation, and the number of subjects from two groups or populations (Hummel & Maedche, 2019). Following are the results of the Cohen's D Effect Size test which can be seen in Table 8.

Table 8. Cohen's D Effect Size Result on Learning Outcomes

	PrC19S			PoC19S			Effect Size	Interpretation
	N	Mean	Std. Deviation	N	Mean	Std. Deviation		
Learning Outcomes	32	80.63	9.224	35	66.71	12.063	1.28	High

Based on the results of the Cohen's D Effect Size test obtained from Table 8, the result is 1.28. Based on the interpretation described earlier, the interpretation obtained from the difference in the average learning outcomes between PrC19S and PoC19S is a high difference. It can be seen from the results that the average value of PrC19S is higher than PoC19S with a difference of 13.92 points.

As the results of in-depth interviews conducted by researchers with several subjects from the two samples, an outline of the effects of the transition was obtained, where the outline of the results of in-depth interviews can be seen in Table 9.

Table 9. Results Outline of In-Depth Interviews with Multiple Subjects in Both Populations

Population	Aspect	Outline of In-Depth Interviews
PrC19S	Exploration	The population feels that exploration in lectures is not given enough when carrying out online lectures
	Curiosity	The population feels low curiosity when carrying out online learning because lectures are only one way
	Boredom	The population feels bored quickly and gets sleepy easily when carrying out online lectures
	Attention	The population feels that there is no concern from the lecturer when carrying out online lectures
	Enjoyment	The population feels that online lectures are fun because they can save time and maximize the use of technology
PoC19S	Exploration	The population feels that lectures are too pressing to explore when carrying out offline lectures after the pandemic
	Curiosity	The population does not know their curiosity because the population does not know what the lecturer means when giving lectures
	Boredom	The population feels bored quickly and wants to quickly end lectures when carrying out post-pandemic offline lectures
	Attention	The population feels awkward when being noticed by lecturers or friends during lectures
	Enjoyment	The population feels less happy when carrying out academic activities because the population feels more comfortable carrying out student organization activities

As stated in the previous presentation, PrC19S are students who carry out learning before the Covid-19 pandemic, so the acquisition of an interest in studying data is obtained when they are still learning offline, and PoC19S are students who carry out learning when the Covid-19 pandemic occurs the acquisition of an interest in studying data is obtained when they do online learning. Based on the acquisition of the data presented in Table 4, the overall percentage of interest in studying PrC19S is to get a yield of 78.80%, while for PoC19S is to get a yield of 62.13%. Based on the narrative from research conducted by Pei & Wu (2019) which revealed that offline learning is felt to make undergraduate students more enthusiastic, compared to online learning activities, this is because when carrying out offline learning activities, undergraduate students tend to be interested because they have good social interaction. unlimited is also in line with statements from other researchers who revealed that offline learning activities make undergraduate students more often interact in class so that offline learning activities will get an experience that undergraduate students really feel (Agarwal et al., 2020).

Meanwhile, the low interest in studying at PoC19S is due to them being used to online situations, where there is a lack of social interaction, and tend to have their activities outside of lectures, according to the statements of several researchers who stated that learning activities carried out online will make undergraduate students tend to underestimate the course of lectures, so online students tend to have a low interest in learning (Dhawan, 2020; Dumford & Miller, 2018). In addition, students who carry out lecture activities offline tend to prioritize the outside world, compared to their academics, this is indicated by an interest in making money that is higher than the interest in studying when online learning is enforced due to regulations to limit learning activities (Mukhtar et al., 2020).

Based on the results of hypothesis testing and effect size testing, it was found that PrC19S received a higher learning outcomes score than PoC19S, which is based on statements from previous researchers who revealed that offline learning activities tend to be more productive in terms of learning, so learning outcomes will have maximum results (Hart et al., 2019). In addition, Kent et al (2019) revealed that offline learning activities have tight interactions, so students tend to be more active in carrying out learning.

Bahasoan (2020) said that online learning tends to only have effectiveness in terms of time and effort, but when talking about learning outcomes it is felt to be superior to offline learning. Liguori & Winker (2020) speculates that students who are used to carrying out learning activities online and then immediately carrying out offline learning will feel enormous pressure because offline learning activities in their implementation require more time, effort, and effort compared to learning activities. by online. Of course, the recovery from the COVID-19 pandemic requires undergraduate students and lecturers to determine the best strategy for giving new habits to post-COVID-19 undergraduate students so as to produce better learning outcomes compared to pre-COVID-19.

Based on the findings from the results of interest in studying, and learning outcomes in the PrC19S and PoC19S populations, in-depth interviews were then conducted to find out more about the various transitions experienced by the two populations, where PrC19S experienced the transition from offline to online, and PoC19S experienced the transition from online to offline. This in-depth interview involved several subjects

from both populations by random sampling with the main target being at least one and a half of the population where PrC19S was interviewed first, then followed by PoC19S.

Based on the narrative of in-depth interviews, in terms of exploration, PrC19S felt that the exploration given during online lectures was not given enough by lecturers in their lectures, this was stated by the majority of the population when conducting interviews where the population stated that lecturers prioritized time and only prioritized giving material so that sometimes it seemed like the lecturer was being chased time because they want to do other activities. Previous research revealed that online learning during the Covid-19 pandemic made the productivity of lecture activities decrease, even though productivity increased at the beginning, it decreased over time due to boredom and lack of experience, making undergraduate students feel less exploratory in lectures (Agustina & Cheng, 2020). In line with the opinion of Dube (2020) who states that the exploration of undergraduate students is a little hampered when learning online because they are at a disadvantage in exploring, where sometimes explanations in lectures are not detailed enough. In the PoC19S population, they feels pressured when carrying out post-online lectures because the population's habits in online learning are not so dense, as most of the population stated in interviews that they feel more chased by deadlines and feel they don't have time to indulge themselves such as taking breaks and or just doing activities social outside of academia. It can be seen from the exploration results in Table 4 that undergraduate students get low scores on exploration compared to the PrC19S population, where previous researchers stated that the learning transition during the Covid-19 pandemic made undergraduate students mentally more vulnerable than students who were used to offline learning (Haiyudi & Art-In, 2021; Irawan et al., 2020). The psychological pressure which plays the main role in the exploration for interest in studying undergraduate students is lower because undergraduate students who have good psychology will make exploration in lectures better than undergraduate students who have psychological pressure due to the transition from online to offline (Chaturvedi et al., 2021).

Furthermore, the narrative of in-depth interviews in terms of curiosity PrC19S felt low curiosity because the population felt that online lectures were focused on the teacher center, so there was no two-way action towards undergraduate students, such as the narrative of several subjects who stated that the lecturer only gave teaching materials, then the lecturer explains it by reading it again without any issues being discussed, which according to Emaliana (2017) explains that the teacher center will make students' curiosity low because everything is focused on what the educator gives, so there is no deep freedom for the students. learners. In addition, Serin (2018) said that students' curiosity should be formed by educators by providing further in-depth study to students so that educators do not only provide teaching materials and then explain in lectures. The PoC19S population feels ignorant of their curiosity, as stated by several subjects who stated that they were not used to giving a problem, they were only used to listening to what the lecturer said, and doing what was ordered. According to previous researchers, students who are used to online lectures will not be used to deeper reasoning, because when lectures are offline, undergraduate students have to build their curiosity deeper (Lowrey et al., 2018).

In the in-depth interviews, boredom and attention were felt to have the same

connection, where the PrC19S population felt bored and sleepy more quickly when carrying out lectures, and also felt that there was no concern from lecturers to students when carrying out lectures, where this was said by several subjects who stated that boredom and drowsiness more often come when lectures are online because undergraduate students only listen without any interaction, so there is no deeper attention from lecturers in their lectures. According to Baber (2020) which states that lectures conducted online will make students quickly bored due to the lack of social interaction between students and other students, as well as computer screens that often make them sleepy quickly, Baber's statement is in line statement with Nashir & Laili (2021) where students often look at computer screens starting from lectures to doing assignments will cause sleeping hours to shift, so that students get sleepy quickly during lectures, besides that the lack of attention from educators makes students feel ignored. The PoC19S population feels the same way as the PrC19S population when carrying out offline lectures after a long time of carrying out online lectures, this population feels bored quickly and wants to end lectures quickly, however, PoC19S feels awkward when being watched by lecturers and other friends, as narratives from several subjects who stated that they were awkward and a little embarrassed when their lecturers or friends paid attention to them because they were not used to direct social interaction in class. The social interaction transition affects their learning outcomes, in which students will feel insecure about showing themselves (Van Herpen et al., 2020).

The last in-depth interview focused on the enjoyment aspect, where the PrC19S population felt happy when carrying out online lectures, where time efficiency, flexibility, and the use of technology were felt to be very beneficial, as stated by several subjects who stated that they felt happy because they could manage schedules. lectures without having to interfere with other activities between the lecturers or undergraduate students, and also the use of technology that they just find useful. Efficiency and time flexibility in online lectures are felt to be very high because lecturers or students in implementing their online lectures can manage their time by mutual agreement (Hamid et al., 2020), besides that the use of technology in online lectures is felt to have a positive impact on undergraduate students who carry out online lectures, where many undergraduate students experience the use of new technology (Putra et al., 2021). In contrast, the PoC19S population, where they do not feel happy when carrying out lectures offline because they are used to online lectures which are felt to be effective and time efficient, so they can spend more time outside of lectures, as statements from various subjects stated that they are more interested in student organization activities than lecture activities, and not a few of them ask for offline lectures to be online because they want to carry out student organization activities offline. It is felt that there is a deviation of interest, where undergraduate students show their main orientation in organizational activities, not in academic activities, according to the narrative of Quaye (2019) which states that when students are too deep in student organizations, it is felt that it will reduce learning output, and sometimes they do not understand academic activities because they always prioritize student activities (Bowman et al., 2015).

This research certainly has limitations, including that the sample size used does not cover a large area and allows research bias to

occur because the data between the groups used has a long time difference. So, due to the limitations of this research, it is recommended to conduct research on a larger scale and use samples with a relatively small time difference between groups.

4. Conclusion

Based on the research results, there was a shift in habits among pre-covid undergraduate students, where the shift in habits in question was from initially taking lectures offline, then online. Likewise, with post-covid students, the shift in habits in question is from initially conducting lectures online, and then offline. Of course, this shift in new habits will cause undergraduate students to experience culture shock in learning, which will result in a decrease in their interest in studying and learning outcomes because they have to apply the new culture again. After the COVID-19 pandemic, students experienced low interest in studying and their learning outcomes, which happened because their habits of efficient and effective online lectures became strict offline lectures, the social interaction habits that they rarely experienced where their individualistic attitudes had to be changed. become a collaborative habit. Apart from that, there are findings that post-COVID-19 students are more interested in participating in student organization activities than academic activities, which of course has an impact on their interest in learning. Based on the results obtained, the effect size shows a value of 1.28, so the interpretation of the difference between the PrC19S and Po19S values is high, where the results obtained in line with culture learning theory, where students who experience culture shock will focus on applying themselves to a new culture so that students do not focus on learning. Of course, with the limitations of this research, it does not describe on a large scale, so this research can be used as a reference or initial research to find out the effects of the interest for studying and its learning outcomes on physics education undergraduate students.

Undergraduate students after the COVID-19 pandemic must be able to adapt to new habits to keep up with the times, besides that the campus or education providers must prepare more carefully for policies and steps in the lecture process so that they can form post-Covid-19 pandemic students who collaborate and has a high interest in studying so as to produce good learning output as well. In addition, student organizations must prioritize the pillars of higher education, as applicable in Indonesia, namely the "*Tridharma Perguruan Tinggi* (Three Missions of Universities)" so that they are in line with the functions and objectives of the student organizations, and always invite collaboration with campuses or study programs. So, with collaboration between policymakers, lecturers, and the role of student organizations, a good academic culture will be formed.

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