Study of Numeracy Ability of Physics Education Students of Universitas Negeri Makassar Post Covid-19

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Abstract. The COVID-19 pandemic that struck the world in 2019 brought significant changes in various fields, including education. One of these changes was implementing fully online learning from 2020 to 2022. This emergency necessitated the sudden adoption of online learning without thorough planning. This study aims to analyze the numeracy skills of Physics Education students at Makassar State University from the 2021, 2022, and 2023 cohorts. The research method used is a case study with 283 student participants. The results show that the average numeracy skills scores for each cohort are 45.29 with a standard deviation of 2.43 (2021 cohort), 42.11 with a standard deviation of 2.64 (2022 cohort), and 45.45 with a standard deviation of 2.49 (2023 cohort). These results indicate that the 2022 cohort had the lowest average numeracy skills scores, while the 2023 cohort had the highest average scores. The 2022 cohort experienced the longest duration of online learning, spanning 5 semesters, which likely contributed to their greater difficulty in understanding subjects that require high mathematical and numeracy competencies, such as Thermodynamics and Programming Algorithms. Additionally, the standard deviation of numeracy scores for the 2022 cohort is higher than the 2021 and 2023 cohorts, indicating a more pronounced variation in skills within this group. This data may be due to the inconsistent quality of online learning they received. From the results of this study, the emergency learning implemented during the COVID-19 pandemic has led to significant learning gaps among student cohorts, particularly in numeracy skills.

Keywords: Numeracy Skills, Physics Education Student, Pandemic Covid.

1 Introduction

Physics is a subject that studies matter along with its interactions and the forces that govern it. It plays an important role in the development of science and technology. Natural laws or phenomena are not absolute, as physical quantities depend on location, space, and time. Physics is also one of the exact sciences, closely linked to mathematical operations such as algorithms, fractions, linear expansions, and derivatives. Therefore, numerical ability is essential in learning physics, especially in solving physics problem.

The relationship between physics and mathematics is very close, which can be seen from two main aspects: (1) mathematical methods are extensively used in physics to

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describe natural phenomena, and (2) physical concepts, as well as ways of thinking in physics, often inspire and are applied in mathematics. [1] state that mathematics provides a formal foundation for expressing the laws of physics, while physics offers a concrete context for developing mathematical methods and concepts. Thus, the reciprocal relationship between physics and mathematics must be addressed in the study of science. Both complement each other and play a significant role in developing a deeper understanding of natural phenomena and science-based technology. A good knowledge of mathematics is a prerequisite for success in the study of physics, as both simultaneously form an important foundation for other scientific disciplines. Numerical ability is one of the key aspects of mathematical calculation operations that are crucial for solving physics problems. It includes skills, accuracy, and precision in performing calculations and is generally measured through math tests and number sequences. This ability helps students understand the material, analyze various problems, and apply physics concepts in everyday life. Thus, students with good numerical skills tend to be able to handle the learning process easily.

In general, the level of numerical ability varies among students. Some students have high numerical intelligence, while others may have lower levels, and these differences can affect the learning process. Physics as a subject requires mastery of theoretical concepts and skills in calculating using relevant formulas. When students face problems requiring numerical solutions, they often experience difficulties if their numerical ability needs to be improved.

Students' numerical ability is one of the significant factors that can influence learning outcomes in physics. A good understanding of numerical skills helps students solve calculation problems and strengthens their overall mastery of physics concepts. In line with previous opinions, according to [2] numerical ability is the ability related to accuracy and speed in using basic arithmetic functions." In physics learning, the students' numerical ability greatly assists in understanding and analyzing every physics problem. Students' numerical ability enables them to avoid difficulties in learning physics, especially in aspects that require calculations. Thus, it can be concluded that numerical ability is an ability related to the use of numbers in basic arithmetic operations, such as addition, subtraction, multiplication, and division [3]. This ability is important in supporting students' understanding of physics concepts and applying formulas, often requiring good numerical skills.

According to [4] in the problem-solving process, besides mastering physics concepts, mathematical proficiency is often required because of the quantitative approach using formulas. This statement is one reason why many students struggle with solving physics problems related to mathematical aspects. In high school physics education, almost all topics involve mathematical calculations [5]. Mathematical skills are crucial for students because a good understanding of mathematical concepts will make applying physics formulas and analyzing problems easier. Students can avoid significant challenges in understanding and solving physics problems with adequate mathematical skills.

COVID-19 (Corona Virus Disease 2019) is a dangerous virus outbreak that has spread globally, with the number of confirmed positive cases increasing daily. In response to this situation, the Indonesian government took firm steps to prevent the spread

of the virus, including implementing social distancing. The impact of this distancing policy is wide-ranging, affecting various sectors, including the economy, agriculture, and education. This study aims to analyze the numeracy skills of Physics Education students at Universitas Negeri Makassar from the 2021, 2022, and 2023 cohorts.

2 Research Method

This research was an ex-post facto design [6] which is involved 283 students at the physics department at Universitas Negeri Makassar. The participant where selected base on cohort when they were fresher as the first-year student at physics department in three years cohort. The study participants comprised 96 students from the 2021 cohort, 93 from the 2022 cohort, and 94 from the 2023 cohort.

The research aimed to describe the numeracy skills of fresher students in the physics education program at Universitas Negeri Makassar post-COVID by years. Data collection was conducted using a Numeracy Skills Test instrument consisting of 25 essay test items given to the fresher students over 3 years, according to their respective cohorts. The data analysing used descriptive statistic to compare the student Numeracy skills based on their cohort in three years.

3 Research Method

The research data were collected using a numeracy skills test instrument conducted over the years 2021, 2022, and 2023. The data collected is presented in Table 1.

Tabel 1. Score of Numeracy Skill

Student Cohort	**2021**	**2022**	**2023**
Numbers of Participants	96	93	94
Ideal Maximum Score	25	25	25
Ideal Minimum Score	0	0	0
Maximum Score	18	15	18
Minimum Score	6	5	6
Average Score	45,29	42,11	45,45
Standard Deviation	2,43	2,64	2,49

The data in Table 1 show that the average numeracy skill score was lowest for the Class of 2022, at 42.11, compared to the 2021 cohort, which scored 45.29, and the 2023 cohort, which scored 45.45. The 2022 cohort experienced the longest online learning period, lasting 18 months from March 2020 until August of their third year of high school. Based on the online learning timeline during the COVID-19 pandemic, the 2023 cohort also underwent the same 18-month online learning period, while the 2021 cohort only experienced 16 months of online learning in high school. The online learning timelines for the cohorts of 2021, 2022, and 2023 are shown in Table 2.

The low scores of the 2022 cohort are suspected to be the result of the extended duration of online learning they experienced during the COVID-19 pandemic. [7] found

that online learning during the COVID-19 emergency period could only be effectively implemented for some students. Online learning was due to the need for a self-learning culture among students in Indonesia. Based on the short interview among the students, many students did not complete tasks and learn independently; instead, they involved their family such parent, sibling or taking task form the internet in term of completing their task when they were in senior high school. Most of them also did not understand the lesson topics and just stored the task when the teacher order to collect the test. In short, most of them can graduated from senior without experienced a valid examination, especially for 2021 cohort student. This result related to Namkung, et. al. that indicated student learning lower score in mathematics who learned during pandemic online learning [8].

Table 2. Online Learning Timeline during COVID-19.

Online learning During Covid-19	2020										2021							
	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
2021 cohort	11^{th} grade									12^{th} grade							Graduated	
2022 cohort	10^{th} grade									11^{th} grade							12^{th} grade	
2023 cohort	9^{th} grade									10^{th} grade							11^{th} grade	

The 2022 cohort also experienced emergency online learning during grades 10 and 11. This period is when the highest academic load occurs at the high school level. All the important topics in high school are distributed during these grades, while grade 12 is a lighter period in terms of academic burden. Grade 12 is generally focused on final school exams and college entrance preparation, so the learning process in grade 12 is lighter than in grades 10 and 11. The data also aligns with the 2021 cohort, which experienced four months of emergency learning in grade 11. The difference in duration and academic levels caused the 2022 cohort to experience more learning loss compared to the 2021 cohort, which is considered to have had regular learning during grades 10 and 11.

The problem faced the 2022 cohort after COVID-19 is the period following the government's lifting of large-scale social restrictions and the reauthorization of in-person learning in classrooms. The challenge faced by the 2022 cohort was post-COVID-19 adaptation [9]; [10] The education system needed time to transition from online to offline learning. The habit of students learning in classrooms became a new obstacle during the early stages of offline learning post-COVID-19. As a result, the 2022 cohort became the group that experienced emergency learning the longest, both during the online period and the early offline learning period.

The data analysis results from this study also show a striking difference in the maximum scores achieved by each cohort. The 2021 and 2023 cohorts had the same maximum score of 18 out of 25 and a minimum score of 6, while the 2022 cohort only managed to reach a maximum score of 15 out of 25 with a minimum score of 6. This difference further supports the assumption that the 2022 cohort experienced the most

learning loss. However, on the other hand, overall, all these cohorts only managed to achieve 72% of the maximum possible score. The cohorts are still far from 100%. Still, it is difficult to conclude whether 72% is considered high or low, specifically because there have yet to be any standardized numeracy skills required in physics learning.

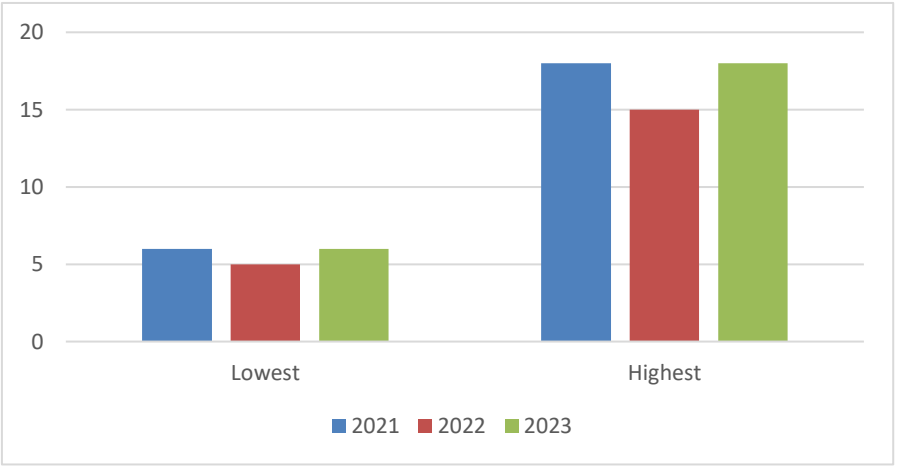

Fig 1. Graph of Lowest and Highest Score of Numeracy Ability

4 Conclusion

Analysis shows that the longer duration of online learning in 2022 contributed to a decline in students' numeracy skills, as reflected in the lower average scores and higher standard deviations. Conversely, the reduction in the duration of online learning in 2023 demonstrated improvements in learning outcomes. Therefore, it is important to balance learning methods to optimally support the development of students' numeracy skills, considering the long-term impacts of online learning.

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