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Evaluating the Effectiveness of Physics Olympiad Training: A Pretest-Posttest Study among High School Students in East Kalimantan

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Abstrak

Kesempatan untuk belajar dan berprestasi adalah hak bagi semua siswa Indonesia. Namun, partisipasi dan raihan prestasi dalam Olimpiade Sains Nasional (OSN) yang diselenggarakan oleh pemerintah sebagai ajang peningkatan prestasi akademik siswa masih terbatas, terutama bagi siswa di Kalimantan Timur. Untuk mengatasi kesenjangan ini, Penelitian ini mendukung persiapan 71 siswa dari 10 kota atau wilayah di Kalimantan Timur dalam menghadapi OSN Fisika melalui kegiatan pendampingan daring selama satu minggu melalui Zoom. Analisis pemahaman siswa melalui Pre-test dan Post-test, dengan uji statistik binomial, menunjukkan peningkatan signifikan pada post-test, mengindikasikan keberhasilan dalam meningkatkan pemahaman konsep fisika. Beberapa siswa dari program ini berhasil melaju ke OSN tingkat provinsi. Untuk memaksimalkan capaian prestasi di daerah lainnya, peningkatan fasilitas dan kualitas pengajaran perlu ditingkatkan, terkhusus dari sekolah-sekolah yang berasal dari daerah terpencil. Penelitian ini diharapkan menjadi informasi penting bagi sekolah, guru, dan pembuat kebijakan untuk mendukung peningkatan sarana pendidikan dan memaksimalkan potensi siswa.

Kata kunci: Olimpiade Sains Nasional, Fisika, Pelatihan, Kalimantan Timur

Abstract

The opportunity to learn and achieve is a right for all Indonesian students.However, participation and achievement in the National Science Olympiad (NSO) organized by the government as a means of improving student academic achievement is still limited, especially for students in East Kalimantan. To address this gap, this research supports the preparation of 71 students from 10 cities or regions in East Kalimantan in facing the Physics NSO through a one-week online mentoring activity through Zoom. Analysis of student understanding through Pre-test and Post-test, with binomial statistical tests, showed a significant increase in the post-test, indicating success in improving understanding of physics concepts. Several students from this program successfully advanced to the provincial NSO. In order to maximize achievement in other areas, improved facilities and teaching quality need to be improved, especially from schools from remote areas. This research is expected to be important information for schools, teachers, and policy makers to support the improvement of educational facilities and maximize student potential.

Keywords: *National Science Olympiad, Physics, Training, East Kalimantan*

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INTRODUCTION

The results of the PISA assessment of Indonesian students for the last four years, namely 2006, 2009, 2012, and 2015 have an average achievement of low science literacy scores in the score range of 382-403 (Hidayah et al., 2019). Then in 2018, it decreased again by producing a science literacy score of 396 (Kemdikbud, 2019). The low literacy and numeracy skills of Indonesian students must be addressed immediately with a comprehensive approach. One approach to improving analytical, problem-solving, literacy, and numeracy skills is through the National Science Olympiad (NSO) program.

The National Science Olympiad (NSO) is a prestigious competition organized by the National Achievement Center as a place to improve student achievement, critical thinking, and problem-solving skills. NSO is organized starting from elementary school, junior high school, to senior high school. NSO has provided so many benefits in the world of education, especially for students who participate in it. NSO contributes to student learning motivation and improves student academic achievement (Pattipeilohy et al., 2024). Not only that, NSO also increases better career opportunities for students in the future (Falentino et al., 2024), as well as increasing motivation and self-confidence (Wirt, 2011). Unfortunately, in Indonesia, there are still disparities in participation and achievement between students in Java and outside Java (Falentino et al., 2024). Students from the Java region dominate the medal tally at the national level for high school. A previous study found that this inequality occurs due to several factors such as inadequate school facilities, expensive Olympic training fees, and lack of support from teachers and parents (Falentino et al., 2024). Therefore, this free Olympic training for children in East Kalimantan was attended to reduce this inequality. We believe that every child deserves the same learning opportunities.

Programming and algorithm training at SMAN 1 Metro has been proven to improve students' understanding and skills in preparing for the provincial NSO in Lampung (Setyawan et al., 2023). Meanwhile, math olympiad training in Samarinda showed significant differences between pre-test and post-test results, with higher post-test scores (Putri et al., 2023). Positive impacts were also seen from mentoring Olympiad preparation for high school students in Sumbawa, where they managed to master the material and solve Olympiad questions in mathematics, physics, and astronomy (Erfan et al., 2019). In Denpasar, positive results were also achieved through coaching and NSO training in high school mathematics (I Made Surat et al., 2023). In biology, NSO preparation training in Lampung improved student performance in the competition (Maulina et al., 2021). In addition, mentoring in Sabang City that focused on biology NSO mentor teachers succeeded in enriching their knowledge of syllabus, question banks, and question predictions (Asmaul Husna et al., 2022). Another Olympiad coaching in Physics, for high school students in Balikpapan, was also proven to be able to increase the average score from pre-test to post-test using Google Classroom and Google Meet platforms (Dwi Saputra et al., 2022). Of all the coaching that has been carried out, no one has specifically done research in East Kalimantan at large, especially in the field of Physics. Therefore, to support equity and provide equal learning opportunities to students in almost all areas of East Kalimantan, this research help is present as a form of concern to help students in East Kalimantan. The objective of this research is to reduce educational disparities and improve physics competencies in East Kalimantan. Through this research, it is hoped that students will be more prepared and know how to strategize and prepare themselves for the NSO. So that in the end, it is expected to improve the achievements of East Kalimantan students.

METHOD

This research used a descriptive quantitative quasi-experimental design to evaluate the impact of the Physics Olympiad training program on high school students' conceptual understanding. A pretest-posttest quasi-experimental approach was chosen to observe changes in students' physics knowledge without a control group. With the help of the East Kalimantan education office, 71 students with 21

different schools, coming from 10 cities or regions in East Kalimantan such as Samarinda, Balikpapan, Bontang, berau, Muara Wis, Tenggarong, Batu sopang, muara komam, Tanah grogot, and sangata utara. The research began with a pre-test, then continued with material exposure for the next five days, and on the last day students were asked to do a post-test. In this research, there are 5 essay pre-test questions and 5 essay post-test questions that are assessed based on whether the final results are correct or incorrect. The material taught is the material needed to face NSO questions in physics such as basic mathematics, uniform linear motion, uniformly accelerated linear motion, projectile motion, and advanced projectile motion. After the presentation of the speaker, followed by a post-test to test student understanding. Then in the evaluation, this research uses the binomial test to evaluate the change in the proportion of correct answers between the pre-test and post-test on each topic. The binomial test was chosen because the data consisted of two paired conditions (pre-test and post-test) with a fixed number of participants of 71 students. Each topic was analyzed individually, and a p-value was calculated to determine the significance of the change in proportion. A p-value lower than 0.05 indicates that the difference in proportion is statistically significant and not the result of random variation.

RESULT AND DISCUSION

RESULT

Through discussions and good planning with the research team and the East Kalimantan provincial education office, the research schedule was formulated and implemented from October 31, 2022 to November 8, 2022 (Table 1). In carrying out this research, the mentor uses the Zoom meeting platform along with Jamboard to help explain the material (Figure 1 and Figure 2).

Table 1. Research Schedule

Date	Topic	Tutor	Schedule
31/9/2022	*Pre-Test*	-	08.00-10.00
1/10/2022	Basic Mathematics	AT	08..00-10.00
2/10/2022	Uniform Linear Motion	AT	08.00-10.00
3/10/2022	Uniformly Accelerated Linear Motion	AT	08.00-10.00
4/10/2022	Projectile Motion	AT	08.00-10.00
7/10/2022	Advanced Projectile Motion	AT	08..00-10.00
8/10/2022	*Post-Test*	-	08..00-10.00

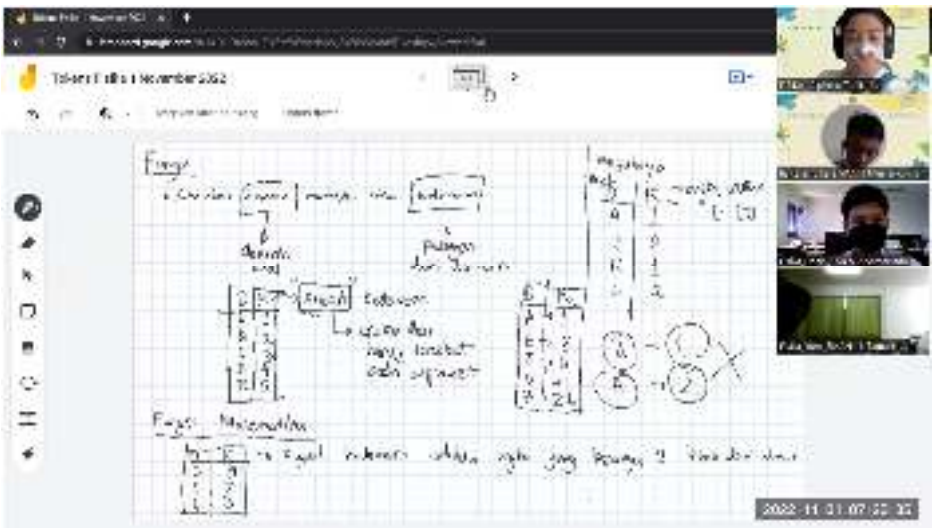

Figure 1. Day 1 Training, Basic Math

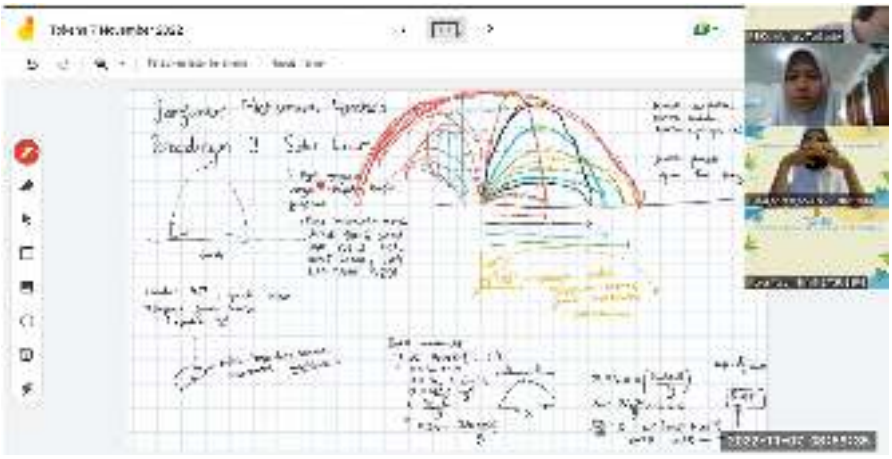

Figure 2. Training Day 6, Advanced Parabolic Motion

The pre-test and post-test results for each topic are depicted as a graph (Figure 3.) In the graph, it can be seen that there was an increase in learning outcomes in almost all subject topics except basic math (which actually showed a decrease). The results of this test were then statistically analyzed and a significant difference was found between the pre-test and post-test (Table 2).

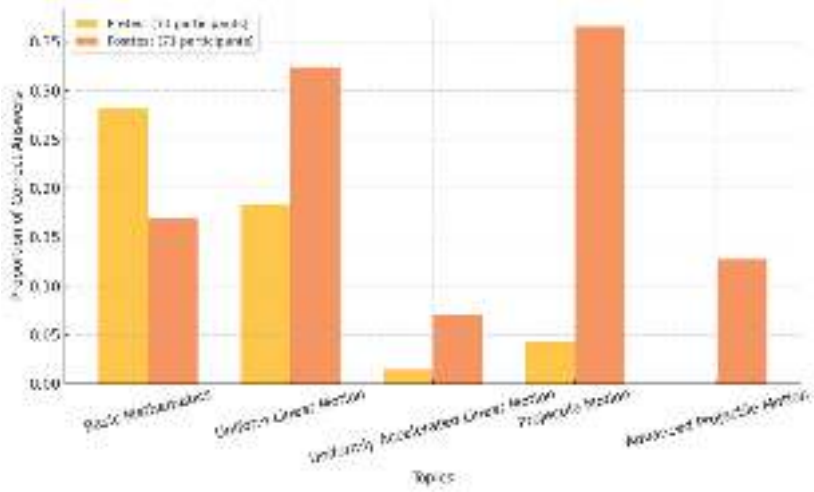

Figure 3. Correct Answer Proportions: Pretest vs Posttest Comparison (71 Participants)

Table 2. P-value (Pre-Test & Post-Test)

Topic	P-value (Pre-test & Post-test)
Basic Mathematics	0.035
Uniform Linear Motion	0.005
Uniformly Accelerated Linear Motion	0.003
Projectile Motion	0.000
Advanced Projectile Motion	0.000
All	0.000

In addition, of the 71 East Kalimantan students who participated in our research, 8 made it to the 2024 provincial NSO. Some stayed in physics, while others qualified in astronomy and earth science (which also require a good understanding of physics concepts).

Table 3. 2023 East Kalimantan Provincial Qualifiers: Schools and Fields of Study

Name	School	Subject
Alfino Mirza Pridyaning Putra	SMA Negeri 10 Samarinda	Astronomy
Denis Firman nugraha	SMA Negeri 2 Samarinda	Physics
Meilia Dwi Utami	SMA Negeri 2 Samarinda	Physics
Nicholas Noverhino Ama Payong	SMA Negeri 1 Samarinda	Physics
Nur Azizah*	SMA Negeri 5 Samarinda	Geoscience
Rachel Christanty Manullang	SMA Negeri 2 Samarinda	Astronomy
Raka Yordani	SMA Negeri 10 Samarinda	Astronomy
Sherina Nur Zahra	SMA Neger 2 Samarinda	Astronomy

*Note: When participating in this research, the student registered with the affiliation of SMA Negeri 1 Samarinda. However, when participating in the NSO, the student was affiliated with SMA Negeri 5 Samarinda.

DISCUSSION

From the results of the pre-test and post-test analysis of this research, almost all topics have increased significantly, and only the basic math topic has experienced a significant reduction. The decrease in student test scores on basic math topics can be caused by a lack of accuracy when working on basic math problems. Given that they have studied physics concepts in other topics in depth, it gives room for them to be bored and unfocused when working on basic math (which leads to inaccurate results obtained). This was also found in previous studies, where students may stop learning or ignore basic concepts that they think they have mastered, when in reality they may not have really understood them in depth (Finn & Tauber, 2015). This is relevant to the phenomenon of lack of focus on basic topics when students feel more skilled in more complex areas. Another study in statistics also found how mastery of high-level concepts in statistics can cause students to underestimate basic techniques that are considered easy, resulting in a higher risk of errors in basic material (Garfield & Ben-Zvi, 2007). As for other topics such as uniformly linear motion, uniformly accelerated linear motion, projectile motion, and advanced projectile motion, showed significantly positive improvement results.

In the long term, the research also succeeded in helping East Kalimantan students in facing the city-level NSO. Eight students participated in this research in 2022, and in 2023 they successfully advanced to the provincial NSO. This indicates that the preparation and provision of strategies to students gives them the insight to organize strategies and prepare for the NSO. This research not only exclusively supports students who want to follow Physics, but helps them to face other subject areas that require a good understanding of physics concepts, such as astronomy and geoscience.

From the NSO results at the provincial level, it can also be seen that the students who continued to the provincial level from this research all came from schools in Samarinda. This is because schools in Samarinda have good facilities and support systems for their students. So that these students can maximize the material that has been learned from this research. Whereas schools from other regions, may not have good facilities and support systems so that when students have received material from this research, they are confused and released to continue consistent independent learning. This is also supported by previous studies where facilities are the biggest factor in the NSO achievement gap in Java and outside Java (Falentino et al., 2024). Previous studies have also found that good management of facilities and infrastructure is highly correlated with student achievement in schools (Suci, Sihombing, & Fadillah, 2023). The lack of dedication of students who come from remote areas can be caused by low student learning motivation. This is also revealed by previous studies that explain how limited access to educational resources in remote areas leads to low student learning motivation (Rahmadi, 2020). In addition, the lack of qualified teachers in remote areas has a negative impact on student engagement in learning. Other studies have also highlighted the challenges in remote areas, where limited accessibility, facilities, and the number of teachers are the main barriers affecting students' motivation to learn, as they do not receive adequate support to develop their independent learning skills (Shabrina, 2022; Ulfa, 2023). Therefore, to maximize NSO dedication and training for students throughout the East Kalimantan region, it is also important to improve facilities and infrastructure as

well as the quality and quantity of teachers, especially in remote areas of the East Kalimantan region. By improving the quantity and quality of teachers and learning facilities, it is possible to increase students' motivation to learn, which in turn can improve achievement both at school and in the NSO.

CONCLUSION

This research demonstrates a significant improvement in the understanding and readiness of high school students in East Kalimantan to participate in the National Science Olympiad in physics. The pretest and posttest results indicate a substantial increase in students' grasp of key physics concepts, suggesting that the training program effectively enhances academic performance. Additionally, the success of some participants in advancing to the provincial level NSO further underscores the program's positive impact on academic preparedness in physics and related subjects, such as astronomy and geoscience. The findings also reveal a regional disparity in academic motivation and resources, with students from Samarinda outperforming those from more remote areas. This highlights a need for enhanced educational support in rural regions, particularly in terms of access to resources and motivational support. Suggestions for the next research are to provide a program that supports sustainability in learning. For example, through training also for school teachers, so that these teachers can continue to monitor the motivation and learning needs of their students. So that through this study, it can be an insight for the next research, to further maximize student achievement throughout Indonesia, especially in East Kalimantan.

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