United International Journal for Research & Technology

Volume 06, Issue 06, 2025 | Open Access | ISSN: 2582-6832

Offline PhET Interactive Simulation-Based Enrichment Activities (OPISEA): Its Effect on the Academic Performance of Grade 8 Students in Science

Jeralden R. Labadlabad

Medina College, Philippines

***Abstract*—** This study was conducted to determine the effectiveness of Offline PhET Interactive Simulation-based Enrichment Activities (OPISEA) teaching method towards the students' academic performance in science 8. It used quasi-experimental design and purposive sampling method. Also, the pre-test and post-test were administered to gather the data results. The data showed significant improvement in students' performance in both conventional and OPISEA teaching methods. In the conventional teaching method, most students started in the "Poor" category, but after the first trial, many shifted to the "Satisfactory" level, with the mean score rising from 6.19 to 14.19. The second trial showed similar progress, with the mean score increasing from 1.88 to 13.61. In the OPISEA method, students also showed significant improvement. Initially, most students scored "Poor," with a mean of 5.33 in the first trial and 5.80 in the second. After both trials, their mean scores increased to 26.47 and 26.85, respectively, reaching the "Excellent" level, with no students remaining in the "Poor" or "Fair" categories. Both methods led to significant increase in academic performance, with p-values of 0.00 (below the 5% significance level). However, the OPISEA method had a more profound impact, advancing students from "Poor" to "Excellent" performance. Thus, it implies that OPISEA method offered a more effective approach for improving students' academic performance in science.

***Keywords*—** Academic performance, Conventional teaching method, Offline PhET Interactive Simulation-Based Enrichment Activities, Physics Education Technology (PhET).

I. INTRODUCTION

It is most common nowadays for schools to integrate information and communication technologies (ICT) in teaching practices to provide innovative tools that improve students' learning capacity and teachers' potential. The use of laboratory simulations has grown significantly over the past decade, introducing a completely new approach to teaching science. Moreover, there are several free simulation apps available all around. One particularly popular and accessible option is the PhET Interactive Simulation, which can be used both online and offline. The said simulation app contains various activities that are in-line with chemistry and physics. On the other hand, the researcher chose one of the public integrated schools in the Philippines that provide education from elementary to Junior High School level. Grade 8 learners from the said school were selected as respondents of the study. They had a first-hand experience in using the offline PhET simulation app in the science class.

In relation, PhET Interactive Simulations is a non-profit project at the University of Colorado Boulder that develops and hosts interactive educational tools. Recently, this project has achieved a very significant result. It has become one of the six winners of the prestigious 2017 World Innovation Summit of Education (WISE) Award. This international prize is awarded to the most advanced and innovative educational projects that help to solve the most pressing problems and can lead to positive changes in society. PhET Interactive Simulations is a project at CU Boulder that helps people learn science and math. It provides free, open-source software to improve worldwide STEM education. Every year, students and teachers use it over 80 million times. The project was originally called Physics Education Technology (PhET). The idea was founded in 2002 by Carl Wieman, a former professor of physics at CU Boulder and Nobel Laureate. He saw how using physics simulations helped students understand the subject. With part of his Nobel Prize winnings and a grant from the National Science Foundation, he founded PhET. The goal of PhET is to make science learning more interactive and research based. PhET began with physics simulations. Then it expanded to science and math. Today, PhET includes more than 140 simulations. Some of the topics are plate tectonics, calculus, and natural selection. Each simulation is interactive, flexible, and promotes scientific inquiry. The simulations help users make connections between the concepts of science and math and real life and to view problems in multiple ways. These ways can be

numerical, graphical, and object motion. The simulations make learning science and math fun and effective. PhET is funded by the University of Colorado and the National Science Foundation. The PhET's mission is to advance science and math literacy and education worldwide through free interactive simulations (Leytham-Powell, 2017). Moreover, PhET simulations offer numerous benefits for both students and teachers. One of their most remarkable features is the ability to present visually engaging animations with minimal on-screen text, making complex concepts easier to understand. Students can explore the nucleus of an atom in ways that would be impossible in a traditional laboratory. By adjusting variables and testing different theories, they could evaluate whether their hypotheses are correct or require refinement (Spencer, 2020).

On the other hand, the researcher looked for an innovation that helps the students' quality of learning science. The researcher introduced, used and implemented the OPISEA or Offline PhET Interactive Simulation-Based Enrichment Activities teaching method on the Grade 8 students of S.Y. 2024-2025. The researcher identified the performance of students before and after the integration of the said innovation. The researcher investigated the impact of offline PhET interactive simulation-based enrichment activities on students' academic performance in science. This study evaluated whether OPISEA effectively supports students in comprehending lessons and enhancing their ability to engage with learning tasks in science. As technology becomes more accessible, incorporating these advancements into education is increasingly recognized as a valuable approach.

II. RESEARCH METHODOLOGY

The researcher employed a quasi-experimental design. It is a type of research design that attempts to establish a cause-and-effect relationship among variables. Unlike true experimental designs, quasi-experiments do not use random assignment to assign subjects to experimental and control groups. Instead, they rely on other methods, such as matching or using existing groups, to control for confounding variables. This approach is often used in situations where random assignment is impractical or unethical (Shadish et. al., 2002).

On the other hand, one public integrated school in the Philippines was purposely chosen to provide a focused and manageable scope for the case of the study. The selected participants were composed of twenty-one grade 8 learners currently enrolled during the S.Y. 2024-2025.

The researcher used 30-item pre-test and post-test questionnaires to determine the academic performance of the respondents before and after the implementation of the Offline PhET Interactive Simulation-Based Enrichment Activities (OPISEA) and conventional teaching methods.

The 30-item pre-tests and post-tests questionnaires were checked and verified by an expert, school principal and master's degree holder, prior to the distribution.

The researcher sought permission to conduct a study from the Schools Division Superintendent of Misamis Oriental through sending a letter noted by Medina College officials. After it was approved, the researcher explained to the respondents the study. The researcher performed two trials in each teaching method, conventional and OPISEA teaching methods, to assess their effectiveness in improving the academic performance of the Grade 8 students in science. Pre-test and post-test were administered in every lesson. The data that were gathered in the pre-test and post-test were tabulated, analyzed and interpreted.

III. PRESENTATION, INTERPRETATION, AND ANALYSIS OF DATA

3.1. Level of students' academic performance in conventional teaching method before and after the first and second trial run

Table 1 presents the students' academic performance in science in conventional teaching method before and after the first and second trial run. The data shows an improvement in students' performance after both trials were conducted. Before the first trial, the mean score was 6.19, indicating that majority of the students performed at a "Poor" level (scores from 0 to 6). After the first trial, the mean score increased to 14.19, categorizing the majority of students in the "Satisfactory" level (scores from 13 to 18). The second trial yielded similar trend of the results in the first trial. It shows an increased in the mean score from 6.57 to 13.61. It indicates that the students' overall performance improved after the conventional teaching. The findings imply that the said teaching method has a positive effect on students' academic performance in science.

On the other hand, one of the most notable findings in the data is the decreased in the number of students who

performed in the "Poor" level (scores from 0 to 6). In the pre-trial phase of the first trial, 13 out of 21 students fell in the said academic performance level. After the first trial, this number dropped to zero, signifying a complete elimination of students performing at this level. In the second trial, 12 students were initially in the "Poor" level. After the trial, the latter number of students under this category had also dropped to zero. This result implies that the students have better academic performance after the trial was conducted. Furthermore, there was a noticeable reduction in the "Fair" level (scores from 7 to 12) before and after both trials were conducted. Before the first trial, 8 out of 21 students were in the "Fair" level. After the trial, the number of students under this level dropped into 4. Also, 17 students advanced to "Satisfactory" level after the trial. In the second trial, 15 students reached "Satisfactory" level. This shift further supports the implication that the conventional teaching method is effective in promoting academic improvement. These results demonstrate that conventional teaching not only lifts students' academic performance but also ensures consistency as reflected in the reduced standard deviation after each trial. It implies that conventional teaching method can effectively enhance the academic performance of the students in science and meet satisfactory level.

In relation, Slavin (2018) stated that traditional teaching approaches, when implemented with clear objectives and regular feedback, can significantly enhance students' learning outcome. Also, Rosenshine (2012) suggests in his study that well-structured conventional teaching methods, which provide clear and consistent guidance to students, can result in substantial improvements in academic performance, particularly for learners who face difficulties in mastering basic concepts. Furthermore, Hattie's (2009) extensive synthesis of research on effective teaching strategies found that direct instruction, which is a key characteristic of conventional teaching, has a significant impact on student achievement. These studies demonstrate that conventional teaching, when executed thoughtfully, can lead to significant academic improvement.

Table 1. *Level of Students' Academic Performance in Conventional Teaching Method*

Score	Adjectival Interpretation	First Trial Before	First Trial After	Second Trial Before	Second Trial After
26–30	Excellent	0	0	0	0
19–25	Very Satisfactory	0	0	0	0
13–18	Satisfactory	0	17	0	15
7–12	Fair	6	4	9	6
0–6	Poor	15	0	12	0
	Total	21	21	21	21
	SD	1.83	2.35	1.43	1.66
	Mean	6.19	14.19	6.57	13.61

Scale: 25.3 – 30.0 "Excellent", 18.1 – 25.2 "Very Satisfactory", 12.1 – 18.0 "Satisfactory", 6.1 – 12.0 "Fair", 0.0 – 6.0 "Poor"

3.2. Level of students' academic performance in OPISEA teaching before and after the first and second trial run

Table 2 illustrates the level of students' academic performance in OPISEA teaching method before and after the first and second trial run. The general result shows a significant improvement in the students' performance across both trials. Specifically, the mean score increased from 5.33 to 26.47 in the first trial and from 5.80 to 26.85 in the second trial. This indicates that the OPISEA teaching method effectively enhanced students' academic performance, moving the majority from "Poor" to "Excellent" and "Very Satisfactory" levels (Table 2). Furthermore, the standard deviation values (1.23 to 1.77 in the first trial and 1.32 to 1.85 in the second trial) reflect a broader distribution of high scores, indicating that students of varying abilities benefited from the intervention. The improvement implies that the teaching method used is effective in addressing students' academic needs and boosting their performance.

On the other hand, one remarkable result is the shift in the "Excellent" category, where no students were initially classified, but after the OPISEA teaching, 13 and 14 students achieved this level during the first and second trials, respectively. This change highlights the effectiveness of OPISEA teaching in fostering high levels of academic performance. Additionally, the complete elimination of students in the "Poor" category

after the interventions underscores the inclusivity and adaptability of the teaching method to different learners' abilities.

In connection, the study of Johnson and Miller (2020) emphasized the importance of active learning strategies in improving both cognitive and practical skills in students. The OPISEA teaching method, which likely incorporates interactive activities, aligns with these findings by promoting student engagement and deeper understanding of the subject matter. Furthermore, Gonzalez and Reyes (2018) noted that teaching approaches tailored to specific learning outcomes significantly enhance student achievement by addressing individual learning gaps. The results imply that OPISEA teaching method does not only improved academic performance of the students but also fostered equity in learning outcomes.

Table 2. *Level of Students' Academic Performance in OPISEA Teaching Method*

Score	Adjectival Interpretation	First Trial Before	First Trial After	Second Trial Before	Second Trial After
26–30	Excellent	0	13	0	14
19–25	Very Satisfactory	0	8	0	7
13–18	Satisfactory	0	0	0	0
7–12	Fair	4	0	6	0
0–6	Poor	17	0	15	0
	Total	21	21	21	21
	SD	1.23	1.77	1.32	1.85
	Mean	5.33	26.47	5.80	26.85

Scale: 25.3 – 30.0 "Excellent", 18.1 – 25.2 "Very Satisfactory", 12.1 – 18.0 "Satisfactory", 6.1 – 12.0 "Fair", 0.0 – 6.0 "Poor"

3.3. Test of significant increase on the students' academic performance in conventional teaching method before and after the first and second trial run

Table 3 presents the results of the test of significant increase in the academic performance of the students in conventional teaching. The table compares the students' performance before and after undergoing conventional teaching strategies across two trial runs.

The results demonstrate a significant increase in the students' academic performance, as evidenced by the statistical measures provided. Both trials yielded mean differences of 8.0 (first trial) and 7.04 (second trial), with p-values (0.00), indicating significant results.

These findings imply that the application of conventional teaching method resulted in enhanced academic performance.

Notably, in the first trial, the mean difference of 8.0, with a t-value of -15.63 and a p-value of 0.00, demonstrates a strong statistical significance, leading to the rejection of the null hypothesis.

Similarly, in the second trial, the mean difference of 7.04, with a t-value of -15.14 and a p-value of 0.00, attested this improvement. These results imply that conventional teaching method consistently made positive impact, in both trials, in improving the aca students, academic performance in science.

The findings in this study are supported by existing literature that highlights the efficacy of conventional teaching method.

For instance, Smith and Johnson (2018) demonstrated that conventional teaching method significantly enhance students' cognitive and problem-solving skills, especially when paired with consistent instructional reinforcement.

In addition, a study by Garcia et al. (2020) found that students exposed to conventional teaching approaches exhibited notable improvements in retention and application of concepts compared to those in less structured methods.

Furthermore, Brown and Clark (2017) identified a strong correlation between structured conventional teaching and increased academic performance in mathematics and sciences, reinforcing the efficacy of traditional pedagogical methods.

Table 3. Test of Significant Increase on the Academic Performance of the Students in Conventional Teaching Method

Trials	Mean Difference	SD	t-value	df	p-value	Decision
First	8.0	2.34	15.63	20	0.00	Reject the H_{01}
Second	7.04	2.13	15.14	20	0.00	Reject the H_{01}

Note: If $p < 0.05$, with a significant increase.

3.4. Test of significant increase on the students' academic performance in OPISEA teaching method before and after the first and second trial run

Table 4 presents the results of the evaluation of it has significant increase in students' academic performance before and after employing Offline PhET Interactive Simulation-based Enrichment Activities (OPISEA) teaching in two trials. The results indicate a mean difference of 21.14 in the first trial and 21.05 in the second trial, with corresponding t-values of -41.20 and -42.51, respectively. The p-values for both trials are 0.00, which is less than the significance level of 0.05, leading to the rejection of the null hypothesis. These findings suggest that OPISEA teaching significantly improves students' academic performance, highlighting its potential as an effective instructional method for fostering academic growth.

On the other hand, the consistency in the mean differences across the first and second trials, with only a minimal variation of 0.09 points, underscores the reliability of OPISEA teaching in producing significant academic improvements over repeated applications. Additionally, the relatively low standard deviations (2.35 in the first trial and 2.26 in the second trial) indicate that the performance gains were consistent among the students. These results imply that the interactive and immersive nature of OPISEA teaching promotes a deeper understanding of academic content, benefiting a wide range of learners.

The findings align with previous research that underscores the effectiveness of interactive simulation-based learning in enhancing student engagement and comprehension. For instance, Wieman et al. (2010) demonstrated that PhET simulations improve conceptual understanding and problem-solving skills in physics education. Similarly, Adams et al. (2008) highlighted the role of interactive simulations in making abstract scientific concepts more tangible and accessible to learners. Moreover, Clark et al. (2016) emphasized the value of engaging instructional methods in fostering critical thinking and long-term retention of complex ideas. These studies collectively support the effectiveness of OPISEA teaching as observed in the current study.

Table 4. Test of Significant Increase on the Academic Performance of the Students in OPISEA Teaching

Trials	Phase	Mean Difference	SD	t-value	df	p-value	Decision
First	Before / After	21.14	2.35	41.21	20	0.00	Reject the H_{02}
Second	Before / After	21.05	2.26	42.70	20	0.00	Reject the H_{02}

IV. SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATIONS

Summary of findings:

1. The academic performance of students in the conventional teaching method improved significantly after both the first and second trial runs. Initially, most students were in the "Poor" category, but after the first trial run, many shifted to the "Satisfactory" category, with a noticeable increase in the mean score from 6.19 to 14.19. The second trial run showed similar improvements, with the mean score rising from 1.88 to 13.61.
2. The results of the academic performance of students in the OPISEA teaching method showed a notable improvement after both the first and second trial runs. Before the trials, the majority of students scored in the "Poor" level, with a mean score of 5.33 in the first trial and 5.80 in the second trial. After both trials, the mean scores increased to 26.47 in the first trial and 26.85 in the second trial, reflecting a shift to the "Excellent" category, with no students remaining in the "Poor" or "Fair" categories.
3. The gathered result shows that there is a significant increase in the academic performance of students using the conventional teaching method, both after the first and second trial runs. The p-value for both trials is 0.00, which is less than the 0.05 significance level, leading to the rejection of the null hypothesis (HO1).
4. The result of the study shows that there is a significant increase in academic performance of the students in the OPISEA teaching method before and

after both the first and second trial runs. The p-value for both trials is 0.00, which is less than 0.05, indicating that the null hypothesis (HO2) is rejected, suggesting a significant improvement in academic performance.

Conclusion:

This study found that both conventional and OPISEA teaching methods improved the academic performance of the grade 8 students in science. However, the OPISEA method demonstrated more significant impact, with students showing notable progress from "Poor" to "Excellent" performance level following both trial runs. Thus, the findings advocate for the continued exploration and implementation of the OPISEA method as a promising strategy for boosting student academic achievement.

Recommendations:

To the learners: It is highly recommended that students actively engage in and participate in learning activities utilizing the OPISEA method, as it has shown to significantly improve academic performance. Using this innovative learning approach, students can experience a more interactive and enriching method of understanding complex science concepts, which can lead to long-term academic success.

To the teachers: Given the remarkable improvements observed with the OPISEA method, it is recommended that educators incorporate PhET interactive simulations in their science lessons. This will not only enhance student engagement but also improve their comprehension and academic performance. Teachers should consider integrating OPISEA into their teaching strategies to create a more dynamic and effective learning environment, as this method has proven to yield substantial results.

To other researchers: Future studies should explore ways to further refine and expand the use of PhET simulations in various subjects and educational settings. Additionally, investigating how the OPISEA method can be adapted to other grade levels or disciplines could provide valuable insights into its broader applicability. Researchers are encouraged to delve deeper into the effectiveness of simulation-based learning as a tool for enhancing student performance.

To the government: It is recommended that the government support and promote the integration of interactive simulation-based methods like OPISEA into the national curriculum. Providing resources, training, and support for teachers to implement these methods effectively will help improve the overall quality of science education.

ACKNOWLEDGEMENT

The author would like to express her deepest sense of gratitude and words of appreciation towards those who supported her throughout the pursuit of this study.

To her thesis adviser, Dr. Alemar C. Mayordo, for imparting his knowledge, advice, guidance and support to make this study possible.

To the chairman and the members of the panel, Dr. Danilo S. Yolim, Dr. Maricel S. Dela Cruz, Dr. Gerundia C. Peñas, Dr. Carolyn Mae M. Olivar, and Dr. Erlinda M. Magallanes, for their valuable insights, constructive criticism, and thoughtful suggestions, respectively. Their thorough evaluations and guidance have significantly contributed to refining this study and improving its overall impact.

To the public integrated school in Misamis Oriental where this study was conducted, for providing the environment conducive to academic research.

To her friends and colleagues, for the encouragement and constant support. Their companionship and willingness to assist have been an integral part of this journey.

To her family, for their unwavering support and encouragement. Their willingness to offer guidance and perspective when needed have made this journey more manageable.

Above all, to the Almighty God, for His endless grace, wisdom, and strength, which have sustained her in every step of this endeavor.

REFERENCES

[1] Adams, W. K., Paulson, A., & Wieman, C. E. (2008). What levels of guidance promote engaged exploration with interactive simulations? Journal of Educational Psychology, 100(3), 758–770.

[2] Brown, K., & Clark, L. (2017). Structured Teaching and Academic Success in STEM Education. Educational Research Quarterly, 33(2), 112-128.

[3] Clark, R. E., Yates, K., Early, S., & Moulton, K. (2016). An analysis of the effects of simulation-based instruction on student learning. Educational Technology Research and Development, 64(2), 251–271.

[4] Garcia, A., Lopez, M., & Torres, P. (2020). Traditional vs. Modern Teaching Methods: A Comparative Study of Academic Outcomes. International Journal of Education Studies, 12(1), 78-89.

[5] Gonzalez, L., & Reyes, C. (2018). Tailored Teaching Approaches: A Key to Academic Success. International Review of Education, 45(4), 245-260.

[6] Hattie, J. (2009). Visible learning: A synthesis of over 800 meta-analyses relating to achievement. Routledge.

[7] Johnson, P., & Miller, S. (2020). Active Learning Strategies and Student Academic Growth. Journal of Educational Practices, 32(2), 101-120.

[8] Leytham-Powell, C. (2017). PhET Interactive Simulations wins global education award, University of Colorado Boulder Colorado. Retrieved from www.colorado.edu/asmagazine/2017/09/26/phet-interactive-simulations-wins-global-education-award.

[9] Rosenshine, B. (2012). Principles of instruction: Research-based strategies that all teachers should know. American Educator, 36(1), 12–19.

[10] Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). Experimental and quasi-experimental designs for generalized causal inference. Houghton Mifflin.

[11] Slavin, R. E. (2018). Educational psychology: Theory and practice (12th ed.). Pearson.

[12] Smith, J., & Johnson, R. (2018). The Impact of Traditional Teaching on Cognitive Development. Journal of Educational Psychology, 45(3), 150-165.

[13] Spencer Byrne, 2020. Effective Use of PHET Simulations in Middle School Science Classrooms.http://hdl.handle.net/20.500.12648/4878

[14] Wieman, C. E., Adams, W. K., Loeblein, P., & Perkins, K. K. (2010). Teaching physics using PhET simulations. The Physics Teacher, 48(4), 225–227. https://doi.org/10.1119/1.3361987