Improving the Performance of Grade 10 Learners in Science using Sole

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DOI: https://dx.doi.org/10.47772/IJRISS.2025.903SEDU0326

Received: 31 May 2025; Accepted: 09 June 2025; Published: 15 July 2025

ABSTRACT

This study investigated the effectiveness of the Self-Organized Learning Environment (SOLE) approach in improving the academic performance of Grade 10 Science learners at Bayambang National High School during the 2024–2025 school year. Utilizing a quasi-experimental research design, the study assessed the impact of SOLE on students' understanding of the coordinated functions of the nervous, endocrine, and reproductive systems. A total of 40 learners participated in the study. Pretest and posttest scores were collected and analyzed to determine changes in academic performance following the intervention.

The mean pretest score was 21%, indicated a low level of prior knowledge using the traditional method. After implementing SOLE, the mean posttest score increased to 40%, showing an average gain of 18.88 percentage points. A paired-samples t-test revealed a statistically significant improvement ($t = 27.25$, $p < 0.00001$), confirming the effectiveness of the intervention.

The findings suggested that SOLE is a powerful pedagogical tool that fosters learner engagement, critical thinking, and collaborative learning. It proved to be an effective strategy for enhancing conceptual understanding in science education. The study supported the integration of SOLE into teaching practices to achieve better learning outcomes and contribute to the advancement of learner-centered instruction in STEM education.

Keywords: effectiveness, performance, improvement, intervention

INTRODUCTION

Grade 10 Science typically focuses on deepening learners' understanding of key concepts in various branches of science, including biology, chemistry, physics, and earth sciences. The curriculum is designed to equip students with both theoretical knowledge and practical skills, preparing them for more specialized subjects in higher grades (Department of Education, 2023).

In Earth Science, learners delve into the Universe and Solar System, studying the origin and structure of the universe, including celestial bodies like stars, planets, and moons, as well as exploring theories such as the Big Bang Theory. They also investigate geological processes like volcanism and plate tectonics, examining how these dynamic Earth processes shape the planet's surface and influence both the environment and human life. Understanding these topics helps students grasp Earth's place in the universe and the natural forces that continuously reshape its surface.

In Physics, learners explore the concepts of motion and energy, focusing on Newton's Laws of Motion to understand how objects move and interact. They study the principles of work, energy, and power, including the transformation between kinetic and potential energy, and apply these concepts to solve real-world problems, such as transportation and mechanical systems. Additionally, the curriculum covers electromagnetism, where learners learn about the relationship between electricity and magnetism, the behavior of electromagnetic waves, and how these principles are utilized in everyday technologies like motors, generators, and communication devices. These lessons form the basis for understanding the physical world and its technological applications.

In Biology, learners explore key concepts in genetics, ecology, and human physiology. They learn about the principles of heredity, focusing on DNA structure, genes, and how traits are passed from one generation to the next through inheritance. In ecology, learners study ecosystems, food chains, and biodiversity, with an emphasis on how human activities impact the environment. The curriculum also delves into human physiology, where students examine the structure and functions of major body systems, including the respiratory, circulatory, and digestive systems, providing a foundation for understanding how the body maintains health and responds to environmental changes.

In Chemistry, learners study chemical bonding and reactions, focusing on the different types of bonds—ionic, covalent, and metallic—and how these bonds influence the properties of various compounds. They learn to balance chemical equations and explore different types of reactions, such as synthesis, decomposition, and others, while also grasping the mole concept to quantify substances in reactions. Additionally, students investigate the properties of gases, studying Boyle's, Charles', and the Ideal Gas Law, to understand how gases behave under varying pressure, temperature, and volume conditions. These topics provide a foundation for understanding the behavior of matter at both the molecular and macroscopic levels (Department of Education, 2023).

In the United States (U.S.), Grade 10 Science is guided by the Next Generation Science Standards (NGSS), which emphasize a hands-on, inquiry-based approach to learning. The curriculum is structured around three core dimensions: disciplinary knowledge, science and engineering practices, and crosscutting concepts. Topics typically covered in Grade 10 include biology (genetics, ecosystems), chemistry (atomic structure, chemical reactions), physics (energy, forces, motion), and Earth science (plate tectonics, climate change). The NGSS encourages students to explore real-world issues through investigation and experiment, fostering critical thinking and problem-solving skills. Resources such as Khan Academy and PhET Interactive Simulations are widely used to supplement learning and enhance engagement (Next Generation Science Standards, 2013).

In Ontario, Grade 10 Science follows a curriculum that covers biology, chemistry, physics, and Earth & Space Science, with a strong emphasis on scientific inquiry and hands-on experiments. The curriculum encourages students to investigate scientific phenomena and apply their learning to real-world contexts, such as climate change and human health. Topics like cellular biology, chemical bonding, energy conservation, and Earth's processes are central to the curriculum. Teachers in Ontario use a combination of traditional and modern teaching methods, integrating digital resources and simulations to engage students. The curriculum also emphasizes the development of critical thinking skills and the application of science to address societal issues (Ontario Ministry of Education: Science Curriculum, 2019).

In the United Kingdom, Grade 10 students typically begin studying for their GCSEs (General Certificate of Secondary Education) in science, which is divided into distinct courses for Biology, Chemistry, and Physics. The curriculum is designed to provide a strong foundation in scientific principles, with topics such as cell biology, chemical reactions, forces, energy transfer, and motion. The GCSE science exams assess both theoretical knowledge and practical skills, with students expected to perform experiments and analyze data. The teaching approach is inquiry-driven, with an emphasis on scientific literacy and real-world applications. Online platforms like BBC Bitesize provide valuable resources to help students review key concepts and prepare for assessments (AQA GCSE Science Specifications, 2016).

In Australia, Grade 10 students study science as part of the Australian Curriculum, which includes Biology, Chemistry, Physics, and Earth & Space Sciences. The curriculum places a strong emphasis on inquiry-based learning, where students engage in investigations and experiments to understand scientific concepts and their real-world applications. Topics such as ecosystems, chemical reactions, forces, energy, and human biology are commonly taught. The focus is on fostering scientific literacy, critical thinking, and problem-solving skills, while also integrating digital tools and simulations to enhance learning. Teachers use a range of resources and teaching strategies to ensure that students not only understand theoretical concepts but also can apply them in practical scenarios (Australian Curriculum: Science, 2020).

Singapore’s Grade 10 science curriculum is part of the Singapore-Cambridge GCE O-Level examinations and covers subjects like Biology, Chemistry, Physics, and Environmental Science. The curriculum is known for its rigor, with a strong emphasis on conceptual understanding and the application of science to solve real-world problems. In Grade 10, students study topics such as ecosystems, chemical bonding, forces, and atomic structure,

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue IIIS June 2025 | Special Edition on Education

while also gaining practical skills through laboratory work and investigations. The curriculum encourages critical thinking, data analysis, and a deep understanding of scientific principles. Singapore's education system integrates technology into science teaching, using tools like simulations to complement traditional hands-on experiments (Singapore Ministry of Education Science Curriculum, 2016).

In India, Grade 10 science is governed by the National Curriculum Framework (NCF) and is typically delivered under the CBSE (Central Board of Secondary Education) or ICSE (Indian Certificate of Secondary Education) systems. The curriculum covers a broad range of topics in Physics, Chemistry, Biology, and Environmental Science. Key topics include laws of motion, chemical reactions, the human nervous system, and environmental issues such as pollution and climate change. The teaching approach is a blend of theoretical lessons and practical activities, with an increasing emphasis on inquiry-based learning and experiments. Digital tools and resources like BYJU's are also integrated into the learning process to support conceptual understanding and exam preparation (Central Board of Secondary Education, 2023).

South Africa's Grade 10 science curriculum follows the Curriculum and Assessment Policy Statement (CAPS), focusing on both Physical Sciences (Physics and Chemistry) and Life Sciences (Biology). In Grade 10, students study topics such as forces and motion, chemical reactions, energy transformations, and ecosystems. Practical skills are developed through hands-on experiments and investigations, with a focus on scientific inquiry and evidence-based reasoning. Teachers encourage students to explore real-world issues like climate change and sustainability. The curriculum aims to promote critical thinking, problem-solving, and the ability to apply scientific knowledge to societal challenges. Educational platforms like Mindset Learn provide additional support for both students and educators (South African Department of Basic Education CAPS, 2012).

In New Zealand, Grade 10 students follow the National Curriculum, which includes topics in Biology, Chemistry, Physics, and Earth and Space Science. The curriculum is designed to foster an understanding of the nature of science, focusing on scientific inquiry, evidence-based reasoning, and the practical application of knowledge. In Year 10, students study topics such as genetics, chemical reactions, energy transfer, and the Earth's systems. The approach is inquiry-based, and students engage in hands-on investigations to develop their scientific skills. New Zealand's science curriculum also emphasizes sustainability and environmental issues, encouraging students to apply scientific knowledge to address real-world challenges. Digital tools like Science Learning Hub support interactive learning and research (New Zealand Ministry of Education: Science Curriculum, 2020).

In the Philippines, the DepEd's K to 12 Science curriculum outlines specific learning competencies for Grade 10 students, ensuring they achieve a comprehensive understanding of key scientific concepts by the end of the school year. Students are expected to explain the formation of the universe by studying various theories, such as the Big Bang Theory, and describe the mechanisms of inheritance and genetic variation, including how traits are passed down through generations. They also learn to understand the behavior of gases, studying factors like pressure, temperature, and volume, and their effects on chemical reactions. Additionally, learners apply Newton's laws of motion and principles of energy conservation to analyze and solve real-life situations, such as understanding forces in everyday movements or energy efficiency in machines. These competencies aim to build a solid foundation in scientific thinking and application (DepEd K to 12 Curriculum Guide, 2016).

While teaching science can indeed be fun and rewarding, challenges like motivating and engaging learners remain significant hurdles for educators. Engaging learners in science can be particularly challenging because many students perceive the subject as abstract, difficult, or disconnected from their everyday lives. Complex concepts like genetics, chemical reactions, or electromagnetism can be difficult for students to grasp without concrete examples or hands-on experiences. This lack of tangible connection often leads to reduced motivation and interest in learning science.

To counter this, teachers must employ contextualized teaching methods—relating lessons to real-world applications, such as explaining genetics through heredity in family traits or demonstrating Newton's Laws with practical activities like sports physics. However, limited resources in many schools, particularly in underfunded areas, make it difficult to implement engaging, hands-on activities like laboratory experiments or interactive demonstrations. As a result, lessons may rely heavily on textbooks and theoretical discussion, which further alienate students from the subject matter.

Teachers also face challenges in developing inquiry-based and problem-solving activities that cater to the diverse interests of students, especially when working with large classes and limited access to technology. Innovative teaching strategies, such as integrating technology, games, and project-based learning, have been shown to boost student interest, but they require significant resources and training, which are often lacking (Barrett 2021).

To tackle the challenges of engagement and motivation among Grade 10 science learners, the researcher intends to implement Self-Organized Learning Environments (SOLE) as a transformative approach. By fostering an environment where learners can take charge of their learning, SOLEs encourage learners to pursue their interests and engage in collaborative inquiry. This method empowers learners to explore scientific concepts in a meaningful way, promoting deeper understanding and retention.

The use of SOLEs aims to create a dynamic and interactive classroom atmosphere that stimulates curiosity and enhances motivation. Through collaborative group work, learners will engage in discussions, share ideas, and collectively solve problems, leading to the development of critical thinking and communication skills. By prioritizing student autonomy and inquiry-based learning, this approach seeks to cultivate a more enthusiastic and motivated group of science learners, ultimately improving their academic performance and fostering a lifelong love for science (Laguador, 2020).

Innovation, Intervention, and Strategy A Self-Organized Learning Environment (SOLE) is a program designed to support self-directed education. Sugata Mitra, an education scientist, first popularized the term in 1999, referring to an approach he developed following his Hole in the Wall experiments. Mitra's experiments demonstrated that groups of kids could learn to navigate computers and the internet by themselves, and "research since then has continued to support his startling conclusion that groups of children, with access to the Internet, can learn almost anything by themselves." Starting in 2014, he's worked with and through the School in the Cloud project to support the development of SOLEs around the world, adding "Granny" mentors and Big Questions as key components of such programs.

Mitra has also served as the inspiration for StartSOLE.org, a platform used by classroom educators to drive inquiry-based learning. In 2022, Mitra was recognized with the Brock Prize in Education Innovation for his transformational work in rethinking the way children learn.

One of the things that was learned through the program is that children are often smarter than given credit for. Rather than providing lectures or spoon-feeding information to the students, it is better to ask "engaging, provocative questions" and let them work out the answers. It was also determined to be good to let the students self-direct in the areas that are of interest to them, with the idea that students will then often stretch to comprehend information that might have otherwise been too difficult for them.

Other findings were that the educational experience is enhanced through collaboration and teamwork, that speech-to-text software is an effective tool for learning to speak a new language, and that tests asking students to solve real-life problems are more effective at prompting students to apply and demonstrate their learning than standard tests.

The first student in India to use the program was Gouri Chindarkar (born about 1996) from Sangli in Maharashtra. She learned about the program through a mentor, an American woman named Ann Thomas, who met with her at 6:30 in the morning. She used a computer for the first time, and her schoolwork delivered in English; her native language is Marathi. Gouri Chindarkar has since studied Computing Engineering at the Kankavali campus of Mumbai University, and she was selected as one of the BBC's 100 Women in 2016.

Project SOLE begun in 10 locations in Hyderabad, Andhra Pradesh, with an 11th one in Sindhudurg rural area of Maharashtra over a period of 2 years, 2008 to 2009. It is not clear to what extent the learning is effective over the long-term (https://startsole.org).

SOLE refer to the adaptation of a school space to facilitate Enquiry Based Learning. A teacher encourages their class to work as a community to answer questions using computers with internet access. The process is designed to foster autonomy and student-driven learning by creating a collaborative environment that promotes innovation, discovery, and lifelong apprenticeship (Christian Educators Association International. 2023).

A SOLE classroom consists of a set of laptop computers, and a teacher eager to try out a new teaching approach. The class work around a guiding set of rules as seen in Figure 1) students are divided into groups, four students in each group; 2) students are free to choose their group; 3) they can change the group at any time; 4) they interact with other groups and bring back some information to their group. A task is given to students and a computer with internet is provided to them to solve the task-related issue independently. But they can also take the views of their fellows to solve the problem. The role of the teacher is passive in this learning.

Role of teacher in SOLE classroom. The biggest role a teacher plays is of a facilitator, rather than a leader, of the classroom. SOLEs are very student-driven, and teachers often take a step back- monitoring, but letting students succeed. SOLE can't function without a teacher– the teacher might just be in a little different role than normal.

How to run your sole. In the SOLE learning approach, there are 3 phases a) Question Phase b) Investigation Phase c) Review Phase. A structured timetable is established to ensure that students have designated time intervals for each phase of their learning journey. This time allocation is crucial for maintaining a well-organized and efficient learning environment. Each phase is carefully planned to optimize student engagement and achievement, promoting a balanced and effective learning experience.

Structured SOLE Implementation Plan – Grade 10 Science, 3rd Quarter

To begin the third quarter Grade 10 Science unit, the teacher established clear learning goals focused on the interaction between the endocrine, nervous, and reproductive systems. Emphasis was placed on hormonal regulation and the brain's role in coordinating these systems. Learners paraphrased the outcomes in their own words, writing them on index cards that were then displayed on a "goal wall" to build a shared sense of purpose and direction.

Next, the Self-Organized Learning Environment (SOLE) framework was introduced to encourage learner-led inquiry. The teacher shared a video about Sugata Mitra's "Hole in the Wall" experiment to illustrate how curiosity-driven learning can thrive without direct instruction. To support learners in managing this autonomy, a "SOLE Checklist" was provided, outlining expectations and responsibilities throughout the process.

Learners were then placed into small groups of four to five members, either randomly or based on shared interests identified through surveys. As an engaging icebreaker, each group participated in a "Draw a Body" activity where they sketched and labeled key organs and connections within the reproductive, endocrine, and nervous systems. This encouraged teamwork and helped activate prior knowledge.

With groups formed, the class tackled open-ended guiding questions such as "How do hormones, the brain, and reproductive organs work together?" Using the "Think-Pair-Share" strategy, learners discussed their interpretations before collectively choosing one question per group to explore in depth. This activity encouraged critical thinking and gave learners ownership of their inquiry.

Learners then entered the research phase, using diverse resources such as textbooks, MELCs (Most Essential Learning Competencies), Khan Academy, and the Mayo Clinic website. They recorded their findings in science journals or digital note pads. This phase allowed learners to dive deeply into content, evaluate sources, and collect evidence to answer their inquiry questions.

Throughout the research period, the teacher acted as a facilitator, moving from group to group to pose probing questions and offer guidance without directly giving answers. Group roles were assigned to ensure active participation: a Facilitator to keep the group on track, a Recorder for documentation, a Tech Handler for managing digital tools, and a Presenter to prepare the group's final output.

To synthesize their findings, learners selected a project format—infographics, skits, or 3D models—to creatively demonstrate their understanding. These were presented through a "Gallery Walk," allowing peers to interact with each project, ask questions, and provide real-time feedback. This approach promoted active engagement and allowed for diverse modes of expression.

After presentations, learners reflected on their experiences by answering prompts such as "What surprised me?" and "What would I do differently?" Using "Glow and Grow" sticky notes, peers gave feedback highlighting strengths and areas for improvement. This step fostered metacognition and built a supportive classroom community.

Assessment involved both performance-based and traditional methods. Projects were graded using a rubric that focused on scientific accuracy, creativity, and collaboration. Short quizzes with diagram-based and scenario-based questions assessed individual understanding. Groups also completed a self-assessment form to evaluate their teamwork and process.

Finally, learners were given time to revise their projects based on feedback. Some opted to enhance their work digitally, creating Canva posters or simple video presentations. The final outputs were displayed in a dedicated classroom science corner or featured in a virtual science fair, showcasing learner growth and celebrating inquiry-driven learning.

Action Research Questions

This study determined the performance of Grade 10 learners in Science at Bayambang National High School using the SOLE.

This study particularly answered the following sub-problems:

1. What is the performance of Grade 10 learners before the implementation of the strategy?
2. What is the performance of Grade 10 learners after the implementation of the strategy?
3. What significant difference exists between the performance of Grade 10 learners before and after the implementation of the strategy?

METHODOLOGY

This study utilized quasi-experimental research design. Quasi-experimental research design is a methodological approach that investigates the causal effects of an intervention or treatment without the use of random assignment to groups. This design is particularly useful in real-world settings where randomization may be impractical or unethical, such as in educational interventions or public health studies. Quasi-experimental designs often involve comparison between an experimental group, which receives the intervention, and a control group, which does not, though the groups are not formed through random assignment. This lack of randomization can lead to potential biases and confounding variables that researchers must account for when interpreting results. Common types of quasi-experimental designs include non-equivalent control group designs, interrupted time series designs, and regression discontinuity designs, each of which allows for different methods of analyzing the effects of interventions (Shadish et al., 2022).

Participants and/or Other Sources of Data and Information

The participants in this study were Grade 10 science learners enrolled at Bayambang National High School during the 2024–2025 school year. This diverse group of students provided valuable insights into their understanding and experiences in science education, particularly in the context of Self-Organized Learning Environments (SOLE).

Grade 10 science learners were chosen as participants for this study because the third quarter of the Grade 10 science curriculum focuses on the Coordinated Functions of the Nervous, Endocrine, and Reproductive Systems—a topic that is integrative, complex, and well-suited for student-centered learning approaches such as Self-Organized Learning Environments (SOLE). At this stage, learners are developmentally prepared to engage in critical thinking, self-directed inquiry, and collaborative problem-solving, which are essential for understanding how these biological systems interact. Moreover, Grade 10 is a crucial point in junior high school, where learners are transitioning to more advanced scientific concepts, making it an ideal time to introduce innovative teaching strategies to deepen their comprehension. This selection also supports national goals to enhance STEM education and was logistically practical within the context of Bayambang National High School.

Data Gathering Methods

This study utilized a quasi-experimental research design focused on Grade 10 science learners enrolled at Bayambang National High School during the 2024–2025 school year, specifically in the 3rd quarter Force, Motion, and Energy curriculum. The following data gathering methods were employed:

A pre-test was administered to the group prior to the intervention to assess learners' baseline knowledge of the key concepts related to the coordinated functions of the nervous, endocrine, and reproductive systems. Following the implementation of the Self-Organized Learning Environment (SOLE) strategy, a post-test was given to evaluate changes in learners' understanding and retention of the material. The comparison of pre-test and post-test results provided quantitative data on the effectiveness of the SOLE approach.

Once the data were gathered, they were tabulated, analyzed, and interpreted to provide answers to the study's research questions. Descriptive statistics were used to treat the data.

To address sub-problem 1, which focused on the mean score of Grade 10 learners before the implementation of the SOLE strategy, the mean score from the pre-test was computed. Individual pre-test scores were collected, each with a maximum of 50 points. The total score of all participants was summed and divided by the number of participants to determine the pre-test mean score.

To address sub-problem 2, which aimed to determine the mean score of learners after the implementation of the SOLE strategy, the same process was followed using the post-test scores. The total post-test scores were summed and divided by the number of participants to calculate the post-test mean score.

To address sub-problem 3, which examined the significant difference between the pre-test and post-test scores, a Dependent Samples T-test (Paired Samples T-test) was conducted. The difference between each participant's post-test and pre-test score was calculated to generate a set of difference scores (D). The mean and standard deviation of these difference scores were computed, and the t-statistic was calculated. The computed t-value was compared to the critical value from the t-distribution table at the 0.05 significance level to determine whether the observed difference in scores was statistically significant.

RESULTS AND DISCUSSIONS

Pretest and Posttest Scores before and after the implementation of SOLE to Improve the Academic Performance of Grade 10 Learners in Science

The findings presented in Table 1, demonstrated a significant improvement in the academic performance of Grade 10 learners in Science after the implementation of the Self-Organized Learning Environment (SOLE). Prior to the intervention, using the traditional method, the learners' pretest percentage scores ranged from 15% to 27%, with a computed mean score of 21%. This indicated a generally low level of understanding of the subject matter before the SOLE-based approach was utilized.

Following the use of SOLE, the posttest scores showed a marked increase, ranging from 34% to 46%, with a mean percentage score of 40%. This reflects a substantial gain of 19 percentage points on average, underscoring the effectiveness of SOLE in enhancing student engagement and comprehension in Science.

Table 1 Pretest and Posttest Scores before and after the Implementation of SOLE

Learners	Pretest Percentage Score before the use of SOLE	Posttest Percentage Score after the use of SOLE
1	21	34
2	23	40
3	26	42
4	24	39

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue IIIS June 2025 | Special Edition on Education

5	22	38
6	21	35
7	18	40
8	19	38
9	21	40
10	18	35
11	17	42
12	16	38
13	17	41
14	17	40
15	18	38
16	21	45
17	19	35
18	22	40
19	20	42
20	25	45
21	26	38
22	27	39
23	26	41
24	26	42
25	23	35
26	24	40
27	22	38
28	25	35
29	26	41
30	22	40
31	21	42
32	20	44
33	18	46
34	18	42
35	16	41
36	17	38
37	15	37
38	21	42
39	22	43
40	20	44
Mean Score	**21**	**40**

The data suggested that all learners demonstrated an improvement in their scores, with some showing an increase of more than 20 percentage points. Such consistent upward trends imply that the SOLE approach catered effectively to diverse learning needs and encouraged independent, inquiry-based learning.

In reflection, the application of SOLE likely contributed to fostering critical thinking and collaborative problem-solving among the learners. By allowing them to explore scientific concepts in a more student-centered and self-directed manner, SOLE appeared to promote deeper understanding and long-term retention of knowledge. These results aligned with previous educational research supporting the benefits of inquiry-driven learning environments.

Overall, the study provided strong evidence that the integration of SOLE into Science instruction positively impacted student performance, justifying its continued use and further exploration in broader educational contexts.

Difference between Pretest and Posttest Scores before and after the implementation of SOLE to Improve the Performance of Grade 10 Learners in Science

Based on the statistical analysis of the pretest and posttest mean scores of 40 Grade 10 Science learners as seen in Table 2, a significant improvement was observed after the implementation of the Self-Organized Learning Environment (SOLE). The mean difference between the pretest and

Table 2 Difference between Pretest and Posttest Scores before and after the implementation of SOLE to Improve the Performance of Grade 10 Learners in Science

Step	Symbol/Formula	Value/Calculation	Result
Sample Mean	M	—	18.88
Population Mean (null)	μ	—	0
Sum of Squares	SS	—	748.38
Degrees of Freedom	df	N - 1 = 40 - 1	39
Sample Variance	$S^2 = SS / df$	748.38 / 39	19.19
Variance of the Mean	$S^2M = S^2 / N$	19.19 / 40	0.48
Standard Error of the Mean	$SM = \sqrt{S^2M}$	$\sqrt{0.48}$	0.69
T-value	$t = (M - \mu) / SM$	(18.88 - 0) / 0.69	27.25

posttest scores was 18.88 percentage points, indicating a strong positive shift in academic performance.

To further analyze this difference, a paired-samples t-test was conducted. The t-value was calculated as 27.25, with a p-value $< .00001$, which is well below the commonly accepted significance level of 0.05. This means the result is statistically significant, and the likelihood that this improvement happened by chance is extremely low.

The high t-value and low p-value confirm that the use of SOLE had a meaningful impact on students' learning outcomes. These findings support the hypothesis that student performance in Science improved significantly after being exposed to a SOLE-based instructional approach.

In conclusion, the difference between the pretest and posttest scores was not only notable in terms of numerical gains but also statistically significant. This provides strong evidence that SOLE is an effective method for improving academic performance in Science among Grade 10 learners. The results suggest that continued use and further integration of SOLE in classroom instruction could yield lasting educational benefits.

Action Plan

The action plan was developed to improve the performance of Grade 10 Science learners through the implementation of the Self-Organized Learning Environment (SOLE). It began with an orientation conducted for both teachers and students to ensure awareness and readiness for the new instructional strategy. SOLE-based lesson plans were then integrated into regular Science classes, allowing students to engage in collaborative and inquiry-based learning. Pretests and posttests were administered to monitor progress, and data were analyzed to assess the impact of the intervention. Feedback sessions with both students and teachers provided valuable insights into the effectiveness of the strategy. Based on the results, an action plan and final report were prepared and presented to school stakeholders, aiming to institutionalize effective practices and encourage broader adoption of SOLE in future instruction.

Objectives	Actions Taken	Persons Responsible	Time Frame	Budget	Expected Outcome
1. To introduce SOLE as an instructional strategy	Conduct orientation for teachers and students on SOLE	Researcher, Science Teachers	Week 5	₱2,000 (materials, printing)	Awareness and readiness to implement SOLE effectively
2. To integrate SOLE into regular Science classes	Design and implement SOLE-based lesson plans	Science Teachers	Weeks 6–10	₱3,000 (resources, devices)	Enhanced student engagement and participation
3. To monitor and assess student progress	Administer pretest and posttest; collect and analyze performance data	Researcher	Weeks 6–12	₱1,500 (test materials)	Measured improvement in student academic performance
4. To reflect on the effectiveness of SOLE	Evaluate test results; conduct feedback sessions with students and teachers	Researcher, Science Teachers	Week 13	₱500 (feedback tools)	Insight into the strengths and limitations of the SOLE implementation
5. To institutionalize effective strategies	Develop and present an action plan and final report	Researcher	Weeks 14–16	₱1,000 (report printing)	Concrete recommendations for future teaching strategies
6. To disseminate findings	Present research results to stakeholders (school head, faculty, etc.)	Researcher, School Head	Week 17	₱1,000 (presentation materials)	Awareness and potential adoption of SOLE at a broader level

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