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Research Article

Addressing Learning Gaps in Earth and Life Science through Strategic Intervention Material

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ABSTRACT

Amidst the evolving landscape of science education, addressing persistent learning gaps requires the integration of targeted pedagogical tools tailored to diverse learner needs. Hence, this study investigated the effectiveness of a developed Strategic Intervention Material (SIM) in enhancing the academic performance of Grade 11 students in Earth and Life Science. Employing a quasi-experimental pretest-posttest design, the study involved 60 learners, randomly assigned into Control (N=30) and Experimental (N=30) groups. Findings revealed that both groups initially exhibited a lower average proficiency level, with pre-test mean scores of 7.23 and 8.23, respectively, highlighting significant learning gaps. Following the intervention, the Experimental group's performance improved substantially to a superior level, achieving a post-test mean of 21.23 (MPS = 84.93), whereas the Control group showed minimal gains (Mean = 8.13; MPS = 32.53). Furthermore, there is a significant difference between the raw scores of the respondents in the pre-test and post-test (p=0.000). The results demonstrate that the SIM effectively addressed least-mastered competencies and bridged learning gaps in Earth and Life Science more effectively than traditional approach. This study likewise underscores the value of localized intervention materials in fostering academic resiliency and mastery among secondary learners. Ultimately, these results suggest that educational policymakers should institutionalize the development of localized SIMs and integrate them into formal remedial programs to provide a scalable solution for addressing achievement gaps in science.

Keywords: *academic performance, educational intervention, Earth and Life Science, modular distance learning, quasi-experimental design, science education, strategic intervention material*

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Introduction

In the Philippines, school closures and the shift to blended and distance learning modalities resulted in learning disruptions and concerns about learning gaps, particularly among marginalized and poor-performing learners (Department of Education, 2022; Mateo, 2022). Studies revealed negative impacts of distance learning on student achievement, particularly for those who already faced difficulties (Musingafi et al., 2015; Regional Memorandum No. 5, s. 2022). Orine et al. (2024) argued that the consistently low performance of Filipino students in international assessments suggests that existing classroom resources are no longer sufficient, creating a clear demand for more effective, targeted instructional materials. Despite the fundamental importance of science education in fostering critical thinking, recent systemic disruptions in the Philippines have necessitated the use of learning gap analyses to identify student misconceptions and develop tailored interventions that strengthen scientific literacy (Cerezo et al., 2025).

In response to the pressing need for interventions, the Department of Education (DepEd) has reaffirmed its commitment to addressing learning losses and promoting educational resiliency, as articulated by Romero (2022). In light of these developments, strategic intervention materials (SIM) have emerged as a promising tool to bridge learning gaps and enhance student outcomes. Research studies of Dargo and Dimas (2021), Bonitez (2021), and Cruz (2022) have explored the effectiveness of SIM in improving academic performance and addressing specific learning needs. Furthermore, studies by Bandola (2019), Suarez & Casinillo (2020), Cordova (2019), and Arpilleda (2021) have demonstrated the positive impact of SIM across various subjects and grade levels. Furthermore, the use of intervention materials serves as a more effective alternative to traditional teaching, significantly enhancing both concept retention and overall academic performance among senior high school learners (Limbago-Bastida & Bastida, 2022; Paco & Linaugo, 2023).

Additionally, among the subjects in the Senior High School core curriculum, Earth and Life Science stands out as a particularly challenging area where students frequently encounter mastery gaps. A study mapped the most challenging topics under this SHS core subject, as perceived by first year college students (Estacio & Cornejo, 2021). Consequently, this subject has become a focal point for pedagogical innovation, leading to the development and evaluation of specialized modules (Dacayo & Calimlim, 2024), interactive flipbooks (Oronce & Manalo, 2021), and targeted e-learning materials designed specifically for struggling learners (Padugar et al., 2022). These diverse interventions highlight the urgent need for localized, high-quality resources that can effectively translate complex scientific concepts into accessible learning experiences.

Thus, this article focused on the development of a Strategic Intervention Material (SIM) and evaluates its effectiveness in improving the academic achievement of Grade 11 Earth and Life Science students after failing to achieve the Minimum Proficiency Level (MPL) during the Regional Diagnostic Assessment. The study determined the difference in learners' mastery of the least learned topic, comparing the use of SIM and traditional classroom instruction, and addressing the learning gaps effectively.

Statement of the Problem

This study aimed to determine the effectiveness of the utilization of developed Strategic Intervention Material for improving the academic performance of students in Earth and Life Science in a secondary school in Zambales, Philippines.

Specifically, it sought to answer the following questions:

1. What is the level of academic achievement of the learners before the utilization of the developed strategic intervention material?
2. What is the academic achievement of the learners after the utilization of the developed strategic intervention material?
3. Is there a significant difference between the academic achievement in science of the student- respondents before and after the implementation of the developed strategic intervention material?

Materials and Methods

Research Design

This study utilized a quasi-experimental research design (Thomas, 2022), assigning respondents randomly into experimental and control groups. This design allows for comparison of the students' academic performance in science before and after the intervention.

Research Setting and Participants

This study was conducted in a public secondary school in Zambales, Philippines. The study utilized purposive sampling which involved sixty (60) Grade 11 students who did not achieve the Minimum Proficiency Level (MPL) during the Regional Diagnostic Assessment for Earth and Life Science.

Research Instruments

To ensure the pedagogical quality and technical accuracy of the Strategic Intervention Material (SIM), the content underwent a rigorous evaluation by the School Quality Assurance Team (SQUAT). Academic achievement was measured using a researcher-developed 25-item multiple-choice assessment, specifically designed to evaluate mastery of the weathering competencies outlined in the Earth and Life Science curriculum.

To establish the content validity of the instrument, it was submitted to a panel of three subject matter experts. These evaluators appraised the test items based on their alignment with the learning objectives, clarity of language, and degree of difficulty. Their feedback was integrated into the final version of the instrument to ensure it accurately captured the intended learning outcomes and provided a reliable measure of the intervention's effectiveness.

Data Collection

The pre-test was administered to the participants in both control and experimental groups at the beginning of the lesson to measure the prior knowledge of the students before the implementation of the intervention. The developed SIM was then implemented as a remediation intervention. Finally, the post-test was administered toward the end of the study to determine the effectiveness of the instructional material in helping the students increase their academic achievement in science.

Data Analysis

The quantitative data were analyzed using descriptive and inferential statistics such as item analysis, frequency counts, percentage, weighted mean, standard deviation, and paired sample t-test. The item analysis was used to measure the frequency of error and mastery level of the students using the pre-test and post-test. Percentage, weighted mean, and standard deviation were used to scale the test scores. Paired-sample t-test was employed to determine the significance of the difference between pre-test and post-test scores. Through these tools, the academic achievement of the learners prior and after the implementation of the developed intervention material were measured for both the control and experimental groups.

Ethical Considerations

This study strictly adhered to established ethical research protocols to ensure the protection and well-being of all participants. Prior to the commencement of the intervention, informed consent was obtained from the learners, which clearly outlined the study's purpose, the nature of the activities involved, and the voluntary nature of participation, emphasizing that students could withdraw at any time without any impact on their academic standing. In compliance with the Data Privacy Act of 2012 (R.A. 10173), all personal information and academic scores were treated with the utmost confidentiality.

Result and Discussion

Level of Academic Achievement in Science Before the Intervention

The 25-item pre-test was administered to both groups to establish their baseline mastery level. As shown in Table 1, most of the learners in both the Control and Experimental groups demonstrated limited prior knowledge of the topic. In the Control Group, 70% scored between 6–10, while 23.33% scored in the lowest bracket of 0–5, and 6.67% scored 11-15. Similarly, in the Experimental Group,

56.67% fell within the 6–10 range, 20% in the 11-15 range, with 23.33% scoring between 0–5. Notably, no student in either group achieved a score above 15, indicating a significant baseline learning gap.

Table 1. Pre-Test Scores of the Learners

	Control Group		Experimental Group	
Score	Frequency	Percentage (%)	Frequency	Percentage (%)
0-5	7	23.33	7	23.33
6-10	21	70.00	17	56.67
11-15	2	6.67	6	20.00
16-20	0	0.00	0	0.00
21-25	0	0.00	0	0.00
Total	30	100	30	100
Mean Score	**7.23 (SD=2.16)**		**8.23 (SD=2.93)**	
MPS	**28.93 (lower average)**		**32.93 (lower average)**	

Furthermore, the Mean Percentage Score (MPS) for the Control Group was 28.93 (Mean = 7.23), while the Experimental Group yielded an MPS of 32.93 (Mean = 8.23). Both results are qualitatively categorized as "Lower Average" academic achievement. These findings confirm that before the intervention, both groups were at a comparable, low-performing level, which underscores the urgent need for a Strategic Intervention Material (SIM) to bridge these gaps.

These findings align with the results of the Regional Diagnostic Assessment, which highlighted that specific learning competencies in Earth and Life Science were not being met. This is consistent with the research of Lazo and De Guzman (2021), who reported that student performance is typically categorized as "Did Not Meet Expectations" before the introduction of targeted intervention materials. Similarly, the results were also similar to the findings of De Gracia (2024), particularly in having lower scores on the pre-test prior to the use of an intervention material.

Level of Academic Achievement in Science After the Intervention

Following the implementation of the SIM, a post-test containing the same items as the pre-test was administered to the student-respondents to assess the effectiveness of the developed intervention material. It can be noted in Table 2 that a majority of the students in the Experimental Group achieved high scores, with 53.0% scoring between 21–25 and 40% scoring between 16–20. Only a small fraction (7.0%) fell into the 11–15 range, and notably, no students scored below 11. This stands in sharp contrast to the Control Group, where 83.33% of the students scored 10 or below, and only 16.7% reached the 16–25 score range.

Table 2. Post-Test Scores of the Learners

	Control Group		Experimental Group	
Score	Frequency	Percentage (%)	Frequency	Percentage (%)
0-5	4	13.3	0	0.0
6-10	21	70.0	0	0.0
11-15	5	16.7	2	6.7
16-20	0	0.00	12	40.0
21-25	0	0.00	16	53.3
Total	30	100	30	100
Mean Score	**8.13 (SD=2.30)**		**21.23 (SD=3.01)**	
MPS	**32.53 (lower average)**		**84.93 (superior)**	

Furthermore, the Mean Percentage Score (MPS) of the Experimental Group reached 84.93, corresponding to a mean score of 21.23, indicating a "Superior" level of academic achievement. In comparison, the Control Group yielded an MPS of only 32.53, categorized as "Lower Average" mastery. These results provide strong evidence that the Strategic Intervention Material (SIM) was highly effective in bridging learning gaps and significantly elevating the academic performance of Grade 11 learners in Earth and Life Science.

This highlights the effectiveness of the SIM in increasing students' mastery of the least-learned topic during modular distance learning and against traditional method. Similar results were also observed in the study of Gabucan and Sanchez (2021), indicating SIM-based teaching yielded above average performance among learners in the post-test. Qualitative feedback from the experimental group participants further supported this, with learners reporting a more enriched and engaging educational experience.

Difference in the Academic Achievement in Science of the Student- Respondents before and after the Implementation of the Developed Strategic Intervention Material

The comparison of the pre-test and post-test scores for both groups reveals a notable increase in student proficiency following the intervention period. As shown in Table 4, the Experimental Group achieved a pre-test mean of 8.23 and a post-test mean of 21.23, representing a substantial gain in mastery. In contrast, the Control Group showed a much smaller increase, moving from a pre-test mean of 7.23 to a post-test mean of 8.13.

Table 3. Test on Significant Difference between the Students' Raw Scores in the Pre-test and Post-test

Group		Mean	N	Df	t-stat	p-value	Decision
Control Group	Pre-Test	7.23	30	29	-5.835	0.000	Reject Ho
	Post-Test	8.13					
Experimental Group	Pre-Test	8.23	30	29	-20.438	0.000	Reject Ho
	Post-Test	21.23					

To determine if these improvements were statistically significant, a paired-sample t-test was conducted for each group. For the Experimental Group, the results yielded a t-statistic of -20.438 with a *p*-value of 0.000. Similarly, the Control Group showed a significant difference (t = -5.835, p = 0.000). Since the *p*-value for the experimental group is less than the alpha level of significance (α=0.05), the hypothesis was rejected. Hence, there is a significant difference between the academic achievement in science of the student- respondents before and after the implementation of the developed strategic intervention material.

Even though both groups showed significant differences in the mean scores, the magnitude of the mean increase in the Experimental Group far exceeds that of the Control Group, which signifies the profound positive impact of the developed Strategic Intervention Material (SIM). Consequently, the null hypothesis for both groups is rejected, confirming that a significant difference exists in academic achievement after the intervention period. The dramatic success of the Experimental Group indicates that the SIM was highly effective in addressing the specific learning gaps identified in Earth and Life Science.

The superior performance of the Experimental Group can be attributed to the targeted design of the SIM. Unlike the traditional lecture format, the SIM provided engaging, self-paced activities and structured support that directly addressed the competencies learners struggled with during the pre-test. These findings are consistent with the research of Limbago-Bastida & Bastida (2022) and Arpilleda (2021), who also observed that groups utilizing developed SIMs achieved significantly higher mean gain scores compared to those receiving traditional instruction.

Conclusion

The study investigated the effectiveness of a Strategic Intervention Material (SIM) in addressing learning gaps in Earth and Life Science among Grade 11 students using a quasi-experimental design. The findings demonstrated that the developed SIM significantly improved student performance and mastery of required competencies compared to traditional instruction.

Initially, both the Control and Experimental groups exhibited a "lower average" level of academic achievement in their pre-test scores, indicating a uniform lack of prior mastery. However, following the intervention period, the Experimental Group—which utilized the SIM—showed a substantial increase in post-test results, reaching a "superior" level of academic achievement. In contrast, the Control Group showed only marginal improvement. Statistical analysis through a paired-sample t-test confirmed a significant difference between the pre-test and post-test scores of the Experimental Group, with a mean gain that far exceeded that of the Control Group, thereby highlighting the efficacy of the developed SIM.

The success of the developed SIM is attributed to its engaging, self-paced activities and its targeted approach to the specific learning gaps identified during the pre-test. Through the provision of a more interactive experience than standard modular distance learning, the SIM facilitated better retention and mastery of complex scientific concepts. These findings provide a significant contribution to the body of research regarding instructional interventions in the Philippines. The study concludes that the SIM is a vital pedagogical tool that can successfully bridge achievement gaps and foster educational resiliency among secondary learners.

Recommendations

The study recommends that the developed strategic intervention material may be endorsed by the school head at the district or division level for a wider scope of implementation. The schools may craft a School Learning Action Cell (SLAC) that would help teachers in designing their innovative Strategic Intervention Materials (SIM) within their learning areas. The school head may likewise initiate an activity that would give praise or incentives to the teachers for successful remediation in addressing the learning gaps. Furthermore, the teachers may help one another in crafting their Strategic Intervention Material (SIM) so that a pool of intervention material can be readily available in the school for usage of the whole school community. Lastly, researchers may conduct further studies related to the use of strategic intervention materials for validation and a wider scope of study.

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References

Arpilleda, A. (2021). Strategic intervention material: A tool in enhancing grade nine students' mathematical performance. International Journal of Research Studies in Education. 10. 10.5861/ijrse.2021.5051.

Bandola, M. (2019). Effectiveness of Strategic Intervention Materials-Collaborative Learning on the Academic Performance of Grade 8 Students in English. Ascendens Asia Journal of Multidisciplinary Research. https://ojs.aaresearchindex.com/index.php/AAJMRA/article/view/8048

Bonitez, A. (2021). Effectiveness of Science Strategic Intervention Material in Elevating the Performance Level of Grade Seven Students. International

Journal of Advanced Research in Education and Society 3 (2), 18-31. http://myjms.mohe.gov.my/index.php/ijares

Business Research Methodology (n.d.). Purposive sampling. Retrieved from https://research-methodology.net/sampling-in-primary-data-collection/purposive-sampling/

Cordova, R., Medina, J., Ramos, T., and Alejo, A. (2019). Effectiveness of Competency-Based Strategic Intervention Materials in English 7. https://www.dlsu.edu.ph/wp-content/uploads/pdf/conferences/research-congress-proceedings/2019/lli-II-019.pdf

Cerezo, J. S. B., Dagani, K. G. M., Elicano, C. D., Lapiz, M. C., Limlingan, R. B. E., Tagubar, R. B., & Taglucop, J. A. C. (2025). Learning Gap Assessment in Integrated Science 7 at Saint Paul University Surigao-New Site Campus. European Journal of Theoretical and Applied Sciences, 3(2), 274–279. https://doi.org/10.59324/ejtas.2025.3(2).22

Cruz, K (2022). DepEd addresses learning gaps as in-person classes start. Retrieved from https://www.manilatimes.net/2022/10/11/tmt-anniversary/deped-addresses-learning-gaps-as-in-person-classes-start/1861592

Dacayo, J. C., & Calimlim, A. D. Evaluation of Earth and Life Science Module for Senior High School in State University. American Research Journal of Humanities & Social Science, 7(6), 187-196.

Dargo, J. & Dimas, M. (2021). Modular Distance Learning: Its Effect in the Academic Performance of Learners in the New Normal. JETL (Journal of Education, Teaching and Learning). 6. 204. https://doi.org/10.26737/jetl.v6i2.2672.

De Gracia, M. V. R. R. (2024). ENHANCING SCIENCE LITERACY ON SELECTED TOPIC IN EARTH AND LIFE SCIENCE THROUGH ELECTRONIC STRATEGIC INTERVENTION MATERIAL (E-SIM). Ignatian International Journal for Multidisciplinary Research, 2(9), 970–979. https://doi.org/10.5281/zenodo.13855377

Estacio, R. D., & Cornejo, M. B. (2021). Challenging topics in the senior high school core curriculum subject (earth and life science) as perceived by first year college students. World Wide Journal of Multidisciplinary Research and Development, 11(7), 40-46.

Gabucan, J. R., & Sanchez, J. M. P. (2021). Strategic intervention material (SIM)-based instruction in teaching global warming concepts in 9th grade science. Formatif: Jurnal Ilmiah Pendidikan MIPA, 11(1), 15-24. http://doi.org/10.30998/formatif.v11i1.6448

Lazo, D., & de Guzman, M. (2021). Strategic Intervention Material: A Learning Approach in Teaching Economics during the Distance Education. International Journal of Computer Engineering In Research Trends (IJCERT). https://ssrn.com/abstract=3861794

Limbago-Bastida, R. A. C., & Bastida, G. L. (2022). Effectiveness of strategic intervention material on the learning outcomes of students. European Journal of Social Sciences Studies, 7(4). https://doi.org/10.46827/ejsss.v7i4.1249

Mateo, J. (2022). DepEd sets strategies to address 'learning losses'. Retrieved from https://www.philstar.com/headlines

/2022/08/11/2201847/deped-sets-strategies-address-learning-losses

Musingafi1, C., Mapuranga, B., Chiwanza, K., & Zebron, S. (2015). Experiences from Students of the Zimbabwe Open University. Journal of Education and Practice. https://files.eric.ed.gov/fulltext/EJ1079750.pdf

Orine, P. A., Casipit, J., Fontanilla, A. M., Munar, K. D., Soriano, J. M., & Ong, D. (2024). Cidade da transformação: um material de bolso de intervenção estratégica para a ciência 6. Diversitas Journal, 9(3). https://doi.org/10.48017/dj.v9i3.3066

Oronce, J. P., & Manalo, D. A. O. (2021). Development and validation of flipbook in earth and life science. IOER International Multidisciplinary Research Journal, 3(2), 111-117. https://ssrn.com/abstract=3810456

Paco, S., & Linaugo, J. D. (2023). Concept Retention among Senior High School Science, Technology, Engineering, and Mathematics (STEM) Students Exposed to a Strategic Intervention Material (SIM). Technium Social Sciences Journal, 41, 72–81. https://doi.org/10.47577/tssj.v41i1.8564

Padugar, A. R. M., Gloria, R. E., & Diongco, M. E. E. (2022). E-Learning Materials in Earth and Life Science for Struggling Learners. International Journal of Research Publications, 108(1), 236-261. https://doi.org/10.47119/IJRP1001081920223867

Romero, A. (2022). More than 11,000 teachers to address learning gap. Retrieved from https://www.philstar.com/headlines/2022/12/26/2233323/more-11000-teachers-address-learning-gap

Suarez, M., & Casinillo, L.F. (2020). Effect of Strategic Intervention Material (SIM) on Academic Performance: Evidence from Students Of Science VI. Social Science Research Network. https://doi.org/10.5281/ZENODO.4518830

Thomas, L. (2022). Quasi-Experimental Design. Retrieved from https://www.scribbr.com/methodology/quasi-experimental-design/