ISA Journal of Multidisciplinary (ISAJM)

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Volume 2, Issue 4, July-August, 2025 ISSN: 3049-1851

Boosting Student Success: The Power of Strategic Intervention Material and Workbook Combined (SIM-WorC) on Academic Performance

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Received: 08.07.2025 | **Accepted:** 07.08.2025 | **Published:** 26.08.2025

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DOI: *10.5281/zenodo.16950860*

Abstract **Original Research Articles**

This study examined the effectiveness of Strategic Intervention Material and Workbook Combined (SIM-WorC) in enhancing students' academic performance in science. Using a pretest-posttest nonequivalent group design, the research involved 87 students—38 in the experimental group exposed to SIM-WorC and 49 in the control group taught through traditional methods. Statistical analyses using paired and independent sample t-tests revealed significant differences in pretest-posttest scores and gain scores, indicating that students who received SIM-WorC instruction showed marked improvement in learning outcomes compared to their peers. The findings underscore SIM-WorC's potential to boost competency mastery and academic performance, demonstrating its value as a supplementary instructional tool. In light of these results, it is recommended that science educators integrate SIM-WorC into their teaching practices to reinforce student engagement and understanding. Additionally, school administrators should encourage the creation and effective use of such materials, and consider expanding the development and testing of SIM-WorC-based resources across other disciplines within the curriculum to support broader educational impact.

Keywords: *Strategic Intervention Materials, Workbook, Pre-test, Post-test, Academic Performance.*

INTRODUCTION

Science education in the Philippines continues to grapple with structural and pedagogical challenges that hinder student achievement and conceptual mastery. Despite its pivotal role in national development—particularly in driving technological innovation and economic growth (Elkington, 2015; Ogena, Lana, & Sasota, 2011)—science remains a subject fraught with disengagement. Students often perceive it as abstract, overly theoretical, and cognitively demanding, which contributes to consistently poor performance on local and international assessments. According to the Global Competitiveness Report of the World Economic Forum, the country ranked 67th out of 140 in the quality of math and science education in 2015–2016, slipping further to 79th out of 138 in the following year (Alde, 2021). This decline reflects deep-seated gaps in educational delivery systems, including a shortage of qualified teachers, outdated instructional materials, inadequate laboratory facilities, and overcrowded classrooms (Ambag, 2018; Alboruto, 2017; Adalikwu & Lockpilgh, 2013).

As mentioned by Alair (2020) and Bonitez (2021) in their studies, these deficiencies pose significant obstacles to the implementation of inquiry-based, competency-driven instruction that science education ideally requires. Students are often denied meaningful opportunities to explore scientific concepts through experimentation and active learning, reinforcing passive reception and rote memorization. To mitigate these barriers, the present study investigates the effectiveness of Strategic Intervention Material and Workbook Combined (SIM-WorC)—an instructional innovation designed to bridge resource limitations and stimulate meaningful engagement with science content. Specifically, the study employs a pretest-posttest nonequivalent group design to evaluate whether the use of SIM-WorC leads to statistically significant improvements in academic performance and competency development in science. By analyzing differences in pretest and posttest scores, gain scores, and competency outcomes, the research aims to offer practical insights into how

SIM-WorC may serve as a scalable and effective solution to strengthen science learning in under-resourced Philippine classrooms.

Specifically, this study sought to answer the following questions:

1. Did the experimental group exhibit a statistically significant change in performance from pre-test to post-test, and how did this compare to the changes observed in the control group?
2. Was there a significant difference in the learning gains achieved by the experimental group compared to the control group?
3. Did students exposed to the Strategic Intervention Material and Workbook Combined (SIM-WorC) demonstrate a significant improvement in their competency in Earth and Space?"

METHODS

In the pursuit of the study, the researcher utilized a non-equivalent pretest and posttest control group design. The non-equivalent pretest-posttest control group design is a robust method for strengthening internal validity in experiments (Carlson & Winquist, 2011). It typically involves two groups—an experimental and a control—both of which are assessed before and after the intervention, with only the former receiving the treatment. This setup allows researchers to compare changes over time within both groups (Shuttleworth, 2009). Vockel (as cited in Villonez, 2019) further notes its utility, particularly when experimental access is restricted to a single participant group.

As Fancher (2013) notes, the pretest-posttest structure in a study is fundamentally employed to gauge changes resulting from experimental treatments and to draw comparisons between different groups. This design specifically focuses on analyzing pre- and post-intervention data for group comparisons, while also considering reliability aspects. Its suitability for this research is evident, as the study aims to assess the influence of the Strategic Intervention Material and Workbook Combined (SIM-WorC) on a particular cohort, thereby allowing for a clear observation of its effects (Alair, 2020; Dapitan & Caballes, 2019).

The study was conducted at the Quirino State University Maddela Campus. The participants of the study involved two classes of Bachelor in Technology and Livelihood Education students enrolled in the GE7-Science, Technology, and Society course. Each class was grouped heterogeneously. One class was administered with the treatment SIM-WorC, and the other class was catered to with the traditional teaching method.

Appropriate statistical tools were applied to the data gathered from the respondents. For research hypothesis 1, a paired-samples t-test was conducted to assess if a statistically significant mean difference existed between the matched pretest and posttest observations on the outcome variable. To evaluate hypothesis 2, an independent-samples t-test was utilized to determine if the mean values of the two distinct groups were statistically different.

RESULTS AND DISCUSSION

A. Difference between the pretest and posttest of the experimental group and the control group?

This section provides the statistical data on the significant difference that exists between the pretest and posttest of the experimental group and the control group.

Table 1. Paired Sample t-Test on the Pre-test and Post-test of the Control and Exp Group

	N	M	SD	t	df	p-value	Cohen's d
CONWorkPre	49	14.16	4.07	-11.63	48	< .001	1.7
CONWorkPost	49	23.61	4.38				
EXPWorkPre	38	13.24	3.18	-17.09	37	< .001	2.8
EXPWorkPost	38	30.58	4.82				

P-value: 0.05

The paired sample t-test results in Table 1 reveal statistically significant differences between the pretest and posttest scores of both the control and experimental groups. For the control group, the mean score increased from 14.16 (SD = 4.07) to 23.61 (SD = 4.38), with a t-value of -11.63 and a p-value of < .001, indicating significant improvement. The Cohen's d of 1.7 suggests a large effect size, meaning the traditional teaching method had a substantial impact on student learning. However, the experimental group showed a more dramatic improvement. Mean scores rose from 13.24 (SD = 3.18) to 30.58 (SD = 4.82), with a t-value of -17.09 and a p-value of < .001. The Cohen's d of 2.8 indicates a very large effect size, underscoring the exceptional influence of the Strategic Intervention Material and Workbook Combined (SIM-WorC) on academic performance. These results imply that while both instructional approaches led to significant gains, SIM-WorC had a more powerful impact on student learning outcomes. The notably higher posttest scores and effect size in the experimental group suggest that

integrating interactive materials and structured workbooks may enhance conceptual understanding and engagement more effectively than conventional methods (Adebayo & Adigun, 2018; Diaz & Dio, 2016). The findings suggest the need for science educators to adopt SIM-WorC or similar resource-rich strategies to boost student performance. As mentioned byu Gabucan & Sanchez (2021) and Barredo (2014) in their studies, educational institutions should consider investing in intervention tools like SIM-WorC to address systemic challenges in science education, especially in under-resourced classrooms.

B. Difference between the gain score of the experimental group and the control group?

This section provides the statistical data on the significant difference that exists between the gain scores of the experimental group and the control group.

Table 2. Independent Sample t-Test (Welch-Test) on the Gain Scores of the Control and Experimental Group

Group	N	M	SD	t	df	p-value	Cohen's d
Experimental Group	38	67.9	10.8	5.5	81.5	< .001	1.1
Control Group	49	51.3	17.3				

The results presented in Table 2 reflect a statistically significant difference in the gain scores between the control and experimental groups, as evidenced by the Welch's t-test. The experimental group, which was exposed to the Strategic Intervention Material and Workbook Combined (SIM-WorC), achieved a mean gain score of 67.9 (SD = 10.8), while the control group recorded a lower mean of 51.3 (SD = 17.3). The t-value of 5.5 with 81.5 degrees of freedom and a p-value < .001 indicates that the difference between the groups is statistically significant and not due to chance. The Cohen's d of 1.1 suggests a large effect size, indicating that SIM-WorC had a substantial impact on improving student performance compared to traditional instruction.

Similar to the study of Monding & Buniel (2021) and Anggraeni (2020), the findings from the above data underscore the effectiveness of SIM-WorC as an instructional strategy, particularly in enhancing comprehension and mastery in science subjects. Its ability to facilitate deeper learning through scaffolded materials and structured engagement is reflected in the higher gain scores and reduced variability in student outcomes. It is further implied the need for curriculum designers and science educators to adopt blended resources like SIM-WorC to enrich conventional teaching methods. The significant learning gains also support the call for policymakers and academic institutions to explore the scalable deployment of such interventions in science education, especially in contexts with limited access to laboratory facilities or updated textbooks. Ultimately, SIM-WorC offers a promising and practical solution to longstanding challenges in Philippine science education (Sinco, 2020; Aranda et al, 2019).

C. Improvement in the competency in Earth and Space among students exposed to Strategic Intervention Materials?

Based on the data from Table 2, there is a statistically significant improvement in the competency in scence among students exposed to Strategic Intervention Materials and Workbook Combined (SIM-WorC). The experimental group, composed of 38 students who received instruction using SIM-WorC, achieved a mean gain score of 67.9 with a standard deviation of 10.8. In contrast, the control group of 49 students taught through traditional methods posted a lower mean gain score of 51.3 with a higher standard deviation of 17.3. The Welch's t-test yielded a t-value of 5.5, with 81.5 degrees of freedom and a p-value less than .001, indicating that the observed difference is statistically significant. Furthermore, the Cohen's d value of 1.1 reflects a large effect size, emphasizing the substantial impact of SIM-WorC on student performance.

These results strongly suggest that SIM-WorC effectively enhanced students' learning competencies in science. The significantly higher gain scores and the lower variability within the experimental group demonstrate that structured and contextualized materials can deepen conceptual understanding and improve academic outcomes (Collado & Abado, 2021). The findings further reveal that science educators may incorporate SIM-WorC into instructional practice, especially in subjects that require abstract reasoning. The results also support broader curriculum integration of similar intervention tools to address persistent challenges in science education (Suarez & Casinillo, 2020; Dumigsi & Cabrella, 2019). At the policy level, according to Dacumos (2016), schools and institutions may consider investing in localized, learner-centered strategies like SIM-WorC to bridge resource gaps and elevate competency development across diverse educational environments.

Based on the presented findings, this study concludes that the Strategic Intervention Material and Workbook Combined (SIM-WorC) significantly improves academic performance and competency in science among students. While traditional teaching methods produced meaningful learning gains, the SIM-WorC intervention yielded markedly higher posttest scores, with a very large effect size (Cohen's d = 2.8) in the paired sample t-test and a strong gain score advantage (Cohen's d = 1.1) in the independent sample t-test. These outcomes underscore the pedagogical efficacy of SIM-WorC in fostering

conceptual understanding, supporting mastery of competencies, and narrowing performance variability across learners.

The data also suggest that SIM-WorC enables greater student engagement and content retention by combining structured guidance with interactive learning components. Its contextualized format addresses prevalent instructional gaps in Philippine science education, such as limited access to laboratories, obsolete textbooks, and insufficient learning resources. As such, SIM-WorC emerges not only as an effective classroom strategy but also as a practical solution for under-resourced educational settings.

Recommendations for future work include scaling up the use of SIM-WorC across various scientific disciplines to examine its cross-subject applicability. Researchers may consider long-term studies on retention, transfer of learning, and affective responses to SIM-WorC-based instruction. It is also advisable to explore digital versions of SIM-WorC to align with blended and remote learning environments. Curriculum developers should collaborate with science educators to localize and customize SIM-WorC materials, ensuring cultural relevance and alignment with learning standards. Additionally, institutional support is vital; policy-makers and school heads should promote capacity-building programs to train teachers in developing and utilizing intervention materials effectively. Expanding this intervention could profoundly reshape the instructional landscape and uplift science learning outcomes nationwide.

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