International Journal of Innovative Research and Scientific Studies, 8(1) 2025, pages: 1733-1738

IJIRSS
International Journal of Innovative Research & Scientific Studies

ISSN: 2617-6548

URL: www.ijirss.com

Unlocking potential: Enhancing science learning through workbook integration

Annalene Grace E. Co

College of Teacher Education, Quirino State University, Philippines.

(*Email: annalenegrace.co@qsu.edu.ph*)

Abstract

This study investigated the effectiveness of using workbooks as supplementary instructional materials to enhance science learning among college students. A quasi-experimental pretest-posttest design was employed with two groups: an experimental group using traditional teaching methods supplemented with workbooks, and a control group receiving traditional instruction only. Data were collected from 68 freshmen students at a state university, including pre-test and post-test scores and academic performance (semi-quarterly and quarterly grades). Paired-samples t-tests and independent samples t-tests were conducted to analyze the data. The results demonstrated significantly higher post-test scores and improved academic performance in the experimental group compared to the control group. Effect size analyses indicated moderate to high practical significance for the use of workbooks in enhancing student learning. The study concludes that integrating workbooks into traditional teaching methods significantly enhances student learning outcomes in science. These findings underscore the importance of utilizing effective instructional materials. The study recommends that educational institutions prioritize the use of workbooks, ensure their effective utilization by teachers, and promote the development and evaluation of high-quality workbooks across various disciplines.

Keywords: Academic performance, Philippines, Post-test, Pre-test, State university, Workbook.

DOI: 10.53894/ijirss.v8i1.4773
Funding: This study received no specific financial support.
History: Received: 31 December 2024/**Revised:** 4 February 2025/**Accepted:** 11 February 2025/**Published:** 18 February 2025

Competing Interests: The author declares that there are no conflicts of interests regarding the publication of this paper.
Transparency: The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Publisher: Innovative Research Publishing

1. Introduction

The Philippines, like many developing nations, faces a critical challenge in improving science education to foster economic growth and address societal needs [1]. While the importance of science and technology in national development is widely recognized, the country consistently lags behind other nations in international assessments like the Trends in International Mathematics and Science Study (TIMSS) (the Philippines ranked 43rd out of 46 countries in HS II Science Trends in 2003) [2]. This underperformance underscores a significant gap in the quality of science education within the Philippine context.

Contributing factors to this gap include limited teacher training, inadequate teaching-learning processes, and a dearth of effective instructional materials [3, 4]. Research by Okpechi and Chiaka [5] highlights the shortage of good instructional materials due to insufficient teacher training and professional development. This limitation often leads to a reliance on traditional teaching methods, potentially hindering student engagement and limiting learning outcomes.

While numerous studies have demonstrated the positive impact of instructional materials on student learning across various subjects, these studies often lack specificity in identifying the most effective types of materials [6-8]. For instance, while research indicates that the use of instructional materials generally improves student performance, it rarely delves into the specific impact of particular materials like workbooks on student learning outcomes in science [9].

Furthermore, existing research on the use of instructional materials in the Philippine context often focuses on broad observations about the lack of resources, neglecting to investigate the specific challenges and opportunities presented by different types of materials[10]. For example, while research by Okpechi and Chiaka [5] highlights the shortage of good instructional materials, it does not delve into the specific challenges associated with the effective utilization of workbooks, such as teacher training on workbook integration, student engagement with workbook activities, and the availability of appropriate resources to support workbook-based instruction [11].

This study aims to address these gaps by specifically investigating the effectiveness of incorporating workbooks as supplemental instructional materials to enhance science learning among college students in the Philippines. By focusing on workbooks, this study contributes to a more nuanced understanding of the role of specific instructional materials in improving student learning outcomes in science education. Moreover, by examining the impact of workbooks within the Philippine context, this study provides valuable insights into the challenges and opportunities associated with the effective utilization of these materials in a specific educational setting.

Specifically, the study sought to answer the following questions:

1. Is there a significant difference in the pretest and posttest results of the control and experimental groups?
2. Is there a significant difference in the academic performance of the control group and experimental group (semi-quarterly and quarterly academic performance)?

2. Literature Review

The effective use of instructional materials is crucial for enhancing student learning outcomes in science education. While research consistently demonstrates the positive impact of various instructional materials [12, 13], the specific role of workbooks in improving science learning deserves closer examination. Workbooks, with their structured exercises, activities, and practice problems, offer a unique approach to engaging students and reinforcing key concepts [14].

Studies have shown that workbooks can significantly enhance student learning in various subjects. Mathews, et al. [15] observed significant improvements in student achievement in mathematics when workbooks were integrated into classroom instruction. Similarly, Leggett, et al. [16] found that workbooks with self-monitoring exercises were effective in helping students improve their academic performance. These findings suggest that the interactive nature of workbooks, which encourages active learning and provides opportunities for hands-on engagement, can be particularly beneficial in promoting deeper understanding and skill development [17].

Furthermore, workbooks can provide valuable feedback to students, allowing them to monitor their progress and identify areas for improvement [6-8]. This immediate feedback can be crucial for enhancing learning and fostering a sense of autonomy in students. By providing opportunities for self-assessment and self-correction, workbooks can empower students to take ownership of their learning and develop essential problem-solving and critical thinking skills [18].

However, the effective implementation of workbooks requires careful consideration. Research by Okpechi and Chiaka [5] highlights the shortage of good instructional materials, emphasizing the need for adequate teacher training and professional development. This suggests that the successful use of workbooks necessitates proper teacher training on how to effectively integrate them into lesson plans, guide students through workbook activities, and monitor student progress [19]. Additionally, ensuring student engagement with workbook activities and the availability of sufficient and appropriate resources to support workbook-based instruction are crucial factors for maximizing their effectiveness [20].

While workbooks offer significant potential for enhancing science learning, it is essential to address potential limitations. Some studies have raised concerns about the potential for workbooks to lead to rote learning and a narrow focus on memorization, rather than fostering deeper conceptual understanding and critical thinking skills [12, 13, 20-24]. Therefore, it is crucial to ensure that the use of workbooks is carefully integrated with other instructional strategies, such as teacher-led discussions, group work, laboratory experiments, and real-world applications, to promote a more holistic and engaging learning experience [25].

Moreover, the effectiveness of workbooks may vary depending on factors such as student characteristics, learning styles, and the specific content being taught [26]. Future research should investigate the impact of workbooks on students with diverse learning needs, including students with learning disabilities or those from underrepresented backgrounds.

In conclusion, workbooks have the potential to be a valuable tool for enhancing science learning outcomes when implemented effectively [27]. However, further research is needed to fully understand the factors that contribute to their success, including the impact of different workbook designs, the role of teacher training, and the integration of workbooks with other instructional strategies [28]. By examining the impact of workbooks, educators can optimize their use to create a more engaging and effective science learning experience for all students [10].

3. Research Methodology

3.1. Research Design

This study employed a quasi-experimental pretest-posttest nonequivalent groups design. This design is suitable when random assignment to groups is not feasible, as was the case in this study due to the existing class structures [29]. In a quasi-experiment, participants are not randomly assigned to the treatment and control groups, which can introduce potential selection bias. This design involved two groups: an experimental group and a control group. Both groups received a pre-test to assess their prior knowledge of the subject matter before the intervention. Subsequently, the experimental group received instruction using traditional methods supplemented with a workbook, while the control group received instruction through traditional methods alone. Following the intervention, both groups were administered a post-test to assess their learning outcomes. This design allowed for the comparison of post-test scores and academic performance between the two groups, providing insights into the effectiveness of the workbook intervention in enhancing student learning [30].

3.2. Participants

This study was conducted at Quirino State University Maddela Campus, following ethical guidelines and with prior approval from the Office of the Research Director of the University, with the endorsement of the Institutional Review Board (IRB). Participants were recruited from freshmen students enrolled in the GE7: Science, Technology, and Society course during the second semester of the school year 2023-2024. Two intact classes were selected for the study, resulting in a total of 68 participants (34 students in each group).

3.3. Data Collection

A standardized pre-test was administered to both groups to assess their prior knowledge of the subject matter before the intervention. The same test was administered as a post-test to both groups after the intervention to assess their learning outcomes. Student academic performance, including semi-quarterly and quarterly grades in the Science, Technology, and Society course, was collected from university records.

3.4. Data Analysis

To analyze the data, the following statistical methods were employed. A paired-samples t-test was used to compare the pre-test and post-test scores within each group (control and experimental) to determine the extent of learning within each group. An independent samples t-test was used to compare the post-test scores and academic performance (semi-quarterly and quarterly grades) between the control and experimental groups to determine if the workbook intervention had a significant impact on student learning outcomes. These statistical analyses allowed for the identification of statistically significant differences between the groups and provided quantitative evidence regarding the effectiveness of the workbook intervention [31].

4. Results and Discussion

4.1. Pretest and Posttest Results

This section presents the difference in the pretest and posttest results of the control and experimental groups.

Table 1.
Paired-sample t-test (welch test) on the pre-test and post-test results of the control and experimental group.

	N	M	SD	t	df	p-value	Cohen's d
ConPre-test	34	14.68	3.51	-10.24	33	< .001	1.8
ConPost-test	34	20.53	4.21				
ExPre-test	34	14.94	3.34	-14.28	33	< .001	2.4
ExPost-test	34	24.03	5.17				

Table 1 presents the paired-samples t-test results for the pre-test and post-test scores of the control and experimental groups. The results demonstrate a significant improvement in post-test scores for both groups, with the experimental group exhibiting a larger effect size (Cohen's d = 2.4) compared to the control group (Cohen's d = 1.8). This finding aligns with previous research by Leggett, et al. [16], who found that workbooks with self-monitoring exercises can significantly improve student academic performance.

However, it is crucial to note that while both groups showed improvement, the experimental group, which utilized workbooks, demonstrated a substantially greater improvement. This finding suggests that the incorporation of workbooks into the instructional process can significantly enhance student learning outcomes in science, surpassing the gains observed with traditional teaching methods alone. This aligns with the findings of Mathews, et al. [15], who observed that the use of workbooks in mathematics education led to significant improvements in student achievement.

Furthermore, the larger effect size observed in the experimental group provides strong evidence for the effectiveness of workbooks in enhancing learning. This finding is consistent with research by Obi and Obi [32], who emphasized the importance of active learning strategies, such as those often incorporated within workbooks, in promoting deeper understanding and improved learning outcomes.

4.2. Academic Performance

This section presents the difference in the academic performance of the control group and the experimental group (semi-quarterly and quarterly academic performance).

Table 2.
Independent sample t-test (welch-test) on the academic performance of the control and experimental group.

	Group	N	M	SD	t	df	p-value	Cohen's d
Semi-quarterly	Control group	34	81.62	7.51	-2.18	66	0.033	0.5
	Experimental group	34	85.41	6.82				
Quarterly	Control group	34	86.62	5.57	-2.04	66	0.045	0.5
	Experimental group	34	89.09	4.34				

Table 2 presents the results of the independent samples t-test comparing the academic performance of the control and experimental groups in terms of semi-quarterly and quarterly grades. The results indicate that students in the experimental group, who utilized workbooks, achieved significantly higher academic performance in both the semi-quarterly and quarterly assessments compared to the control group. These findings are consistent with studies by Wallace and Jefferson [17] and Yildirim, et al. [28], which have demonstrated the positive impact of workbooks on student academic achievement in various subject areas. The moderate effect sizes (Cohen's d = 0.5) observed in both the semi-quarterly and quarterly grades suggest that the use of workbooks had a notable and meaningful impact on student learning. These findings provide strong evidence that the integration of workbooks can effectively enhance student engagement and improve overall academic performance in science.

However, it is important to acknowledge that while this study demonstrates the positive impact of workbooks, it is crucial to consider the potential limitations of this approach. Navarro, et al. [33] have raised concerns about the potential for workbooks to lead to rote learning and a narrow focus on memorization. Therefore, it is essential to ensure that the use of workbooks is carefully integrated with other instructional strategies, such as teacher-led discussions, group work, and hands-on activities, to promote deeper understanding and critical thinking skills.

5. Discussion

The findings of this study provide compelling evidence for the effectiveness of incorporating workbooks into the teaching and learning process in science. The significant improvement in post-test scores and academic performance observed in the experimental group highlights the potential of workbooks to enhance student learning outcomes [12, 13, 20-24]. These findings align with previous research that has demonstrated the positive impact of instructional materials on student learning. However, this study contributes to the existing literature by specifically demonstrating the effectiveness of workbooks in enhancing science learning within the Philippine context.

Furthermore, the findings of this study have important implications for educational practice. The results suggest that the integration of workbooks into the teaching-learning process can be an effective strategy for improving student learning outcomes in science. This approach can be particularly beneficial in resource-constrained settings where access to a variety of instructional materials may be limited [34, 35].

However, it is crucial to acknowledge the potential limitations of this study. The use of a quasi-experimental design, with its inherent limitations in terms of controlling for selection bias, may have influenced the study's findings. Future research should consider employing randomized controlled trials to further strengthen the evidence base for the effectiveness of workbooks in enhancing science learning.

6. Conclusions and Future Works

This study provides compelling evidence for the effectiveness of incorporating workbooks as supplemental instructional materials in enhancing science learning among college students. The significant improvement in post-test scores and academic performance observed in the experimental group highlights the potential of workbooks to significantly enhance student engagement and improve learning outcomes. The findings have several important implications for educational practice, such as policy implications, teacher training, and resource allocation. Educational policymakers and curriculum developers should consider integrating the use of well-designed workbooks into science education curricula at various levels. Teacher training programs should incorporate modules on the effective use of workbooks, including strategies for selecting appropriate workbooks, integrating them into lesson plans, and effectively guiding students through workbook activities. Schools and educational institutions should prioritize the allocation of resources for the development, procurement, and effective utilization of high-quality workbooks. This study has some limitations that should be considered, such as the use of a quasi-experimental design, with its inherent limitations in terms of controlling for selection bias, which may have influenced the study's findings. Furthermore, the study focused on a specific population (freshman college students) and a specific subject (Science, Technology, and Society). The generalizability of the findings to other student populations, subjects, and educational contexts may be limited. Moreover, the study focused solely on the impact of workbooks. Future research should explore the combined effects of workbooks with other instructional strategies, such as peer tutoring, technology integration, and project-based learning. Future research should address the limitations of this study and explore the following areas: conducting randomized controlled trials to establish a stronger causal relationship between workbook use and improved learning outcomes, conducting qualitative research to investigate student perceptions and experiences with using workbooks in science learning, and conducting a longitudinal study to investigate the long-term impact of workbook use on student

learning and academic achievement. Comparative studies to investigate the effectiveness of workbooks in different cultural and educational contexts may also be pursued. Lastly, the impact of teacher training on the effective utilization of workbooks in the classroom should be investigated.

References

[1] R. Ambag, "Teaching science in the Philippines: why (and how) we can do better," FlipScience," Retrieved: https://www.flipscience.ph/news/features-news/features/teaching-science-philippines/, 2019.

[2] D. G. Guinto, "Instructional materials in science education," Sun.Star Pampanga," Retrieved: https://www.pressreader.com/similar/281732680545144, 2019.

[3] E. M. Rabino, "Poor Science education in the Philippines: causes, solutions, and suggestions," Wordpress.com," Retrieved: https://magnanamousscience.wordpress.com/2014/10/08/poor-science-education-in-the-philippines-causes-solutions-and-suggestions/, 2019.

[4] W. Rahmawati, "The importance of instructional material," Postgraduate School of English Education Program - Ahmad Dahlan University," Retrieved: http://pascapbi-3a.blogspot.com/2017/01/the-importance-of-instructional-material.html, 2019.

[5] P. Okpechi and P. Chiaka, "The teacher and teaching with instructional materials in the teaching of science subjects and the contribution of guidance and counsellors therein," *British Journal of Education*, vol. 5, no. 13, pp. 10-18, 2017.

[6] M. B. Abubakar, "Impact of instructional materials on students' academic performance in Physics," presented at the Sokoto-Nigeria. IOP Conference Series: Earth and Environmental Science. https://doi.org/10.1088/1755-1315/476/1/012071, 2020.

[7] S. A. Adalikwu and I. T. Iorkpilgh, "The influence of instructional materials on academic performance of senior secondary school students in chemistry in Cross River State," *Global Journal of Educational Research*, vol. 12, no. 1, pp. 39-46, 2013.

[8] S. Adebule and O. Ayoola, "Impact of instructional materials on students' academic performance in mathematics in secondary schools in Ekiti State, Nigeria," *Research Journal of Educational Studies and Review*, vol. 2, no. 1, pp. 1-4, 2016.

[9] L. Lum, "The consequences of poor Science education in kindergarten," The Atlantic," Retrieved: https://www.theatlantic.com/education/archive/2016/02/how-poor-science-knowledge-in-kindergarten-spells/471312/, 2019.

[10] A. Legaspi, "Lack of materials and facilities still hound K to 12 implementations," GMA News Online," Retrieved: https://www.gmanetwork.com/news/news/specialreports/363734/lack-of-materials-facilities-still-hound-k-to-12-implementation/story/, 2014.

[11] I. M. Gakii, "Developing instructional materials that address challenges facing teachers in secondary school chemistry investigative practical work: A case of Kajiado County, Kenya," Master's Thesis, Kenyatta University, 2019.

[12] B. A. Arop, F. I. Umanah, and O. E. Effiong, "Effect of instructional materials on the teaching and learning of basic science in junior secondary schools in Cross River State, Nigeria," *Global Journal of Educational Research*, vol. 14, no. 1, pp. 67-73, 2015. https://doi.org/10.4314/gjedr.v14i1.9

[13] A. R. Ajoke, "The importance of instructional materials in teaching English as a second language," *International Journal of Humanities and Social Science Invention*, vol. 6, no. 9, pp. 36-44, 2017. https://doi.org/10.18535/ijhssi/v6i9.03

[14] Ö. Ulu Kalin, "Creating interactive student workbook for primary education social studies class and researching its efficiency," *Journal of Education and Practice*, vol. 8, no. 12, pp. 33-40, 2017.

[15] C. Mathews, M. Mdluli, and V. Ramsingh, "The use of workbooks in South African grade 3 mathematics classrooms," *South African Journal of Childhood Education*, vol. 4, no. 1, pp. 80-94, 2014. https://doi.org/10.4102/sajce.v4i1.80

[16] H. Leggett, J. Sandars, and P. Burns, "Helping students to improve their academic performance: a pilot study of a workbook with self-monitoring exercises," *Medical teacher*, vol. 34, no. 9, pp. 751-753, 2012. https://doi.org/10.3109/0142159X.2012.691188

[17] E. D. Wallace and R. N. Jefferson, "Developing critical thinking skills: assessing the effectiveness of workbook exercises," *Journal of College Teaching & Learning*, vol. 12, no. 2, pp. 101-108, 2015. https://doi.org/10.19030/tlc.v12i2.9182

[18] N. M. Jalmasco, "Science education realities," The Manila Times," Retrieved: https://www.manilatimes.net/science-education-realities/100096/, 2021.

[19] B. Becker, "Math and science are the lifeblood of the future," AskIdeas," Retrieved: https://www.askideas.com/62-best-mathematics-quotes/math-and-science-are-the-lifeblood-of-the-future-bob-becker/, 2019.

[20] O. E. Effiong and C. E. Igiri, "Impact of instructional materials in teaching and learning of biology in senior secondary schools in Yakurr LG A," *International Letters of Social and Humanistic Sciences*, vol. 62, pp. 27-33, 2015. https://doi.org/10.18052/www.scipress.com/ILSHS.62.27

[21] G. Ogaga, I. Wallace, and E. Benson, "Effects of instructional materials on the teaching and learning of social studies in secondary schools in Oju local government area of Benue state," *International Journal of Current Research*, vol. 8, no. 7, pp. 33859-33863, 2016. https://doi.org/10.24941/ijcr.2016

[22] A.-R. B. Olayinka, "Effects of instructional materials on secondary schools students' academic achievement in Social Studies in Ekiti State, Nigeria," *World Journal of Education*, vol. 6, no. 1, pp. 32-39, 2016. https://doi.org/10.5430/wje.v6n1p32

[23] L. A. Quisumbing, L. J. B. Caluza, D. G. D. Funcion, M. A. Gotardo, R. L. Verecio, and J. C. Cinco, "Views and preferences in the development of instructional materials for ITS courses: The case of BEST students," *International Journal of Recent Advances in Multidisciplinary Research*, vol. 4, no. 9, pp. 2758–2765, 2017. https://doi.org/10.24327/IJRAMR

[24] J. L. Tety, "Role of instructional materials in academic performance in community secondary schools in Rombo District," Unpublished Dissertation, 2020.

[25] J. A. Akungu, "Influence of teaching and learning resources on students' performance in Kenya Certificate of secondary education in free day secondary education in Embakasi district, Kenya," Doctoral Dissertation, University of Nairobi, 2019.

[26] L. E. Ebuk and O. O. Bamijoko, "The effective management of Mathematics workbook: Sure remedy to students' performance in Mathematics," *International Journal of Advanced Multidisciplinary Research*, vol. 3, no. 4, pp. 46–53, 2021. https://doi.org/10.22192/ijamr.2021.03.04.007

[27] R. Maharaj-Sharma, "Teaching integrated science through the use of interactive worksheets," *Caribbean Curriculum*, vol. 22, pp. 85-103, 2014.

[28] N. Yildirim, K. Sevil, and A. Alipaþa, "The effect of the worksheets on students' achievement in chemical equilibrium," *Journal of Turkish Science Education*, vol. 8, no. 3, pp. 44-58, 2011.

[29] P. C. Price, R. Jhangiani, I. A. Chiang, D. C. Leighton, and C. Cuttler, "Non-equivalent group designs," Creative Commons Attribution-NonCommercial-ShareAlike," Retrieved: https://opentext.wsu.edu/carriecuttler/chapter/non-equivalent-control-group-designs/, 2019.

[30] P. T. Shivaraju, G. Manu, M. Vinaya, and M. K. Savkar, "Evaluating the effectiveness of pre-and post-test model of learning in a medical school," *National Journal of Physiology, Pharmacy and Pharmacology*, vol. 7, no. 9, pp. 947-951, 2017. https://doi.org/10.5455/njppp.2017.7.0412802052017

[31] W. Kenton, "T-test definition," Investopedia," Retrieved: https://www.investopedia.com/terms/t/t-test.asp, 2018.

[32] N. C. Obi and J. Obi, "Effect of improvised instructional materials on academic achievement of SS1 chemistry students in cross river State Nigeria," *IJAR*, vol. 5, no. 7, pp. 444-448, 2019. https://doi.org/10.22271/allresearch.2019.v5.i7f.5987

[33] J. D. Navarro, Z. Z. Garbin, E. M. Agena, and O. B. Garcia, "Maritime students' English proficiency and their feedback on instructional materials," *Asia Pacific Journal of Maritime Education*, vol. 1, no. 1, pp. 63-81, 2015.

[34] O. S. Oyelekan, E. F. Igbokwe, and A. S. Olorundare, "Science teachers' utilisation of innovative strategies for teaching senior school science in Ilorin, Nigeria," *MOJES: Malaysian Online Journal of Educational Sciences*, vol. 5, no. 2, pp. 49-65, 2018.

[35] J. Right, "The importance of learning materials in teaching," Leaf Group Ltd. / Leaf Group Education," Retrieved: https://www.theclassroom.com/importance-learning-materials-teaching-6628852.html, 2019.