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SCIENCE SPIRAL PROGRESSION CHALLENGES: CAN THE CAROUSEL STRATEGY IMPROVE PHILIPPINE K-12 STUDENT PERFORMANCE?

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Abstract

Filipino students' declining science performance necessitates exploring novel instructional methods. This study examines the carousel strategy's effectiveness as a cooperative learning technique for Grade 8 public school students who struggle with the spiral science curriculum owing to time constraints and poor knowledge recall. This study was conducted in the 2019–2020 academic year and involved 60 Grade 8 students from Opol National Secondary Technical School, selected through convenience sampling. A non-equivalent control group pretest-posttest design and focus group discussions were conducted using a mixed-method approach with a quasi-experimental research design. The results indicated significant improvements in the experimental group's post-test scores (17.37 to 26.30) using the carousel strategy compared with the control group's lecture method (17.67 to 23.20). Six themes emerged from the thematic analysis: collaboration, confidence building, engagement, enjoyment, and improved learning outcomes. Furthermore, two novel benefits were identified: enhanced knowledge retention and efficient instructional time use. The findings provide significant insights into the effectiveness of the carousel teaching method in science education, showing its potential to improve learning and retention despite classroom time limitations. This study thus contributes meaningfully to advancing pedagogical practices in science education.

Keywords: Science Spiral Progression, Carousel Teaching Strategy, Quasi-Experimental Design.

INTRODUCTION

The urgency to enhance science teaching methods in Philippine classrooms emerged owing to declining student performance in science in both international and national assessments from elementary to high school, as noted by De La Cruz (2022), Sarsale & Langub (2023), and Villanueva (2022). According to previous studies, Filipino students' performance in the 2018 Program for International Student Assessment (PISA) fell short of global benchmarks, with an average science literacy score of 357. This score was notably lower than the average of 489 points, which the Organization for Economic Cooperation and Development (OECD) countries recorded based on various reports (OECD, 2018; Palines & Cruz, 2021). Likewise, the results of the national assessments in the country, like the National Achievement Test (NAT) in Grades

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6, 10, and 12, have recorded a steady decline in science subjects, falling to “low mastery” or “low proficiency” levels, below the Department of Education’s (DepEd) standard of 75% (Mirasol et al.,2021; Basco, 2020). "Locally, the four divisions in the Department of Education, namely those in Cagayan de Oro City, Gingoog City, El Salvador City, and Misamis Oriental, reported that students’ NAT scores in the four subjects, Filipino and History were the highest, while mathematics and science scores were the lowest " (Namoco et al., 2022). Previous studies attributed Filipino students’ poor science performance to teacher quality, teaching-learning process, school curriculum, instructional resources, and administrative support (SEI-DOST & UP NISMED, 2011). In response to these challenges, the Department of Education (DepEd) implemented a revised K-12 science curriculum that employs a student-focused spiral progression approach, aiming to tackle the nation's educational issues (Barrot, 2023; Gerondio et al., 2023; Tesorio & Canizares, 2018). The spiral curriculum repeats key concepts as the curriculum progresses, increasing complexity and practical application until mastery is achieved (Dunton & Co, 2019; Johnston, 2012). Snider (2004) reported that this approach keeps students on track, aligns with their cognitive stages, and reinforces concepts through reviews and applications. Despite these benefits, empirical studies identified some drawbacks. One major issue is the insufficient time allocated for science subjects in the K-12 curricula, which was reduced to four hours per week compared with the 2002 Basic Education Curriculum’s six hours per week (Tirol, 2022). Resurreccion & Adanza (2015) found that teachers in selected Cavite high schools spend less than 30 minutes annually on 70% of the topics. This limited time hinders students’ understanding and retention owing to teachers being forced to rush through the material, which restricts students’ depth of understanding. Consequently, teachers may revert to traditional methods, such as lecture methods, to cover the curriculum, regardless of students’ mastery (Limueco & Prudente, 2018). The lecture method, a conventional teaching strategy, is often termed a teacher-centered approach (Precious & Feyisetan, 2020; White & Kern, 2018). Such an approach significantly contributes to the declining education quality in Southeast Asian countries such as the Philippines, Cambodia, Thailand, and Vietnam (del Valle, 2023; Newman & Gentile, 2020). Moreover, teachers often struggle to recall students' prior knowledge, which is vital for connecting new, complex lessons, particularly under the K-12 spiral science curriculum (Boladola, 2018). These challenges, including limited instructional time and retrieving prior knowledge, were emphasized in various studies and have also been observed in Grade 8 science classes in public high schools in Misamis Oriental, including Opol National Secondary Technical School, which also uses spiral progression in science education. Therefore, strategies to improve science education in the Philippines are needed, given that teaching quality greatly affects student performance (Guerrero & Bautista, 2023). Cooperative learning, supported during the K–12 reform discussions in the Philippine Congress, is a proven method to boost academic achievement by actively engaging students. Learner-centered pedagogical methods such as cooperative learning, self-regulated learning, and differentiated instruction originate from learner-centered teaching (SEAMEO-INNOTECH, 2012). In cooperative learning, teachers divide students into small groups to work together, promoting interaction and mutual support to understand the material and achieve common goals. Theoretically, this collaborative effort should enhance academic performance, retention, and other crucial educational outcomes (Ramadhanti &

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Yanda, 2018; Simesso et al., 2024; Sugano and Nabua, 2020). In a specific cooperative learning strategy, the carousel teaching strategy or carousel brainstorming, students collaborate in groups at various workstations. Each group begins at a designated station, works together on the activities, and rotates to the next station after a set time. Before the lesson ends, all tasks should be completed by students through active involvement and cooperation (Hunter et al., 2017; Owen & Thomas, 2021). The strategy of a carousel has numerous benefits. It makes foreign language instruction more interactive and student-centered so that learners can participate in using the language work with other students and be responsible for their learning. This method not only develops language skills but also nurtures motivation and self-assurance — which are primary contributors to effective language attainment (Owen & Thomas, 2021). Similar findings in this strategy approach yield better results for students' reading abilities than small group discussions (Andriani & Jufrizal, 2018). Additionally, the carousel strategy necessitates students moving from one station to another, encountering other students' ideas. Thus, it strengthens their existing knowledge by attaching it to new information, providing different perspectives, collaborating, and actively participating in such activities to improve recall (Burhanuddin, 2015). Despite its proven advantages, limited research has examined the carousel strategy in science education, particularly in the Philippines, with only one study examining elementary-level students. Rufon & Forlales (2022) utilized such a strategy among Grade 6 students taking up Earth and Space Sciences in Romblon, Luzon, and found that this strategy outperformed traditional methods. The present study examined the efficacy of the carousel method among Grade 8 students from Opol National Secondary Technical School, aiming to bridge the gap in the empirical examination of this strategy in a high school setting. This study also aimed to assess how different approaches to teaching, such as the carousel strategies, affect academic performance in science subject content areas among Grade 8 students due to lack of time for instruction and difficulty retrieving previous knowledge based on the spiral progression curriculum for science compared with traditional methods. Specifically, this study aimed to: [1]Determine the significant difference between students' pre-test and post-test scores in science when exposed to the carousel strategy and lecture method.

[2] Identify themes that emerge from students' experiences of the carousel strategy among Grade 8 students in science classes through focus group discussions.

METHODOLOGY

A combination of qualitative and quantitative methods was used in this research (Molina-Azorin, 2016). The study evaluated the effectiveness of the carousel strategy to improve science achievement among eighth-grade students at Opol National Secondary Technical School by using pre- and post-tests in the fourth quarter of Biology Science lessons that obtained data quantitatively. Qualitative data on various student responses to the carousel teaching approach were collected through focus group discussions (FGD) during a semi-structured interview conducted in Cebuano, which is a local dialect, then translated into the English language; adopted from Mantey et al. (2022) and Badeo & Koc (2021). A quasi-experimental design with a non-equivalent control group pretest-posttest method was employed (Noviani et al., 2023; Eshaq, 2024). According to Siedlecki (2020), this design is

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preferred due to its cost-effectiveness and minimal resource requirements over true experimental designs.

The researchers utilized convenience sampling. This approach is cheap and easy because it involves using readily available subjects (Etikan et al., 2016; Yeboah et al., 2019). The respondents were eighth-grade students from Opol National Secondary Technical School, Misamis Oriental, Northern Mindanao, during the school year 2019-2020. Two sections comprised 60 students and were involved for four weeks within the fourth quarter of Biology Science classes held between February and March 2020. Before data collection, a formal consent letter was prepared and delivered to the principal's office at Opol National Secondary Technical School. Permission to carry out the study was requested, and the study's research goals and objectives were discussed. Subsequently, consent forms were distributed to the respondents' parents before data collection, following DepEd order no—16 series, 2017, and the Data Privacy Act of 2012 to maintain ethical standards. After securing the consent forms from the respondents, the researchers began gathering the data.

DATA COLLECTION

The research procedure was divided into the following stages:

1. Pre-test: Before implementing the carousel teaching strategy, 30 respondents from the experimental group and the control group, 30 respondents for each section completed a 50-item multiple-choice test on fourth-quarter biology lessons adapted from Genovia et al. (2018) and Galceran & Mugot (2019). The questionnaires adhered to DepEd's guidelines for grade eight science competencies.
2. Intervention: The experimental group received carousel teaching strategy-based instruction for one hour and four meetings in one week, totaling four hours per week, which was adapted and modified from the studies of Bartlett (2015) and Owen & Thomas (2021). In contrast, the control group received traditional lecture-based instruction for one hour per meeting for the entire week, amounting to four hours of teaching. The intervention lasted for the same duration as the control group.
3. Post-test: After implementing the teaching strategies for one month, participants completed a parallel post-test to the pre-test.
4. Interview: Students participated in FGDs in a semi-structured interview in the local dialect of Cebuano to gather qualitative data and then translate it into English. The 30 students who participated in the FGDs in the experimental group were divided into six groups of five members each. The researchers then asked them how they liked the carousel strategy in terms of their experience and why. The interviews lasted 30 minutes.

A t-test, a form of inferential statistics, was applied to evaluate paired samples. To detect any meaningful distinction in students' scores before and after testing, researchers set the significance threshold at $p = 0.05$ (Toprak, 2019; Oladejo et al., 2023). The focus group discussions (FGD) data underwent thematic analysis (Peel, 2020; Kiger & Varpio, 2020).

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RESULTS AND DISCUSSION

Table 1 presents the science pre-and post-test scores of the research subjects exposed under the experimental group using the carousel strategy and lecture method as a control group. Right before the carousel strategy was implemented, the mean score of the experimental group during the pre-test was 17.37, which is slightly lower than that of the control group (17.67). In the pre-test, the control group outperformed the experimental group by a narrow margin of 0.3 points on average. This slight edge was consistent across nearly all measurements except for a single instance where both groups achieved identical scores. The t-stat -0.254 from statistical analysis also showed no significant differences between means for both pretests($p=0.8$). In contrast with this finding, after implementing the carousel strategy, their posttest means scores differed significantly – 26.30 and 23.20, respectively, among others; it follows an increase of three point one marks on average per candidate belonging to different categories, namely those taught using carousels as an approach compared against peers taught traditionally through lectures only (experimental versus control). Statistical analysis yielded a t-value of 2.128 and a p-value of 0.038, indicating a statistically significant difference in the mean post-test scores between the two groups. The difference between the post- and pre-test scores for the experimental group was calculated by subtracting the pre-test mean score of 17.37 from the post-test mean score of 26.30, revealing an increase of 8.93 points. The statistical analysis results obtained from the t-test calculation provide a t-value of 10.905 with a corresponding p-value of 0.0001, indicating that the observed improvement in the scores is highly significant. In this group, the difference between the pre-test and post-test scores for the control group was therefore measured through the increase from the initial mean score of 17.67 to the final mean score of 23.20, representing an improvement of 5.53 points. The statistical analysis for this group gives a t-value of 7.259 with a corresponding p-value of 0.0001, portraying again a highly significant improvement in scores.

Table 1: Pre- and post-test Scores in science when exposed to the Carousel Strategy and Lecture Method

Difference between	Mean	Mean Difference	t-value	*p*-value	Remarks
Carousel Strategy Pretest Lecture Method Pretest	(17.37–17.67)	-0.3	-0.254	0.8	Not Significant
Carousel Strategy Posttest Lecture Method Posttest	(26.30–23.20)	3.1	2.128	0.038	Significant
Carousel Strategy (Posttest – Pretest)	(26.30–17.37)	8.93	10.905	0.0001	Significant
Lecture Method (Posttest – Pretest)	(23.20–17.67)	5.53	7.259	0.0001	Significant

Note: With a 0.05 level of significance

Table 2 presents the FGD results of participants regarding their experiences with the carousel teaching strategy. Thematic analysis identified six themes: promoting collaboration and teamwork, building confidence, enhancing engagement and enjoyment, improving knowledge retention and review, improving learning outcomes, and instructional time management.

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Table 2: Focus Group Discussion of Carousel Strategy Experiences among Grade 8 Students

Theme	Participant Responses
Collaboration & Teamwork	I admire the carousel strategy for fostering teamwork and collaboration among peers. It allows for idea sharing and establishes a safe environment for exchanging ideas through working together, which builds self-belief and encourages us to comprehend and react to other student's ideas.
Confidence Building	The carousel method helped me express my thoughts and combine them with those of my classmates. I had an active role in my teacher's science classes, who was responsible for enhancing our knowledge about biodiversity and other scientific topics; this allowed me to actively participate in such discussions and speak up more often, not only confidently but also with relevant contributions.
Engagement & Enjoyment	The carousel strategy was viewed as an interesting and enjoyable method of learning. I find the carousel strategy appealing, particularly the rotation part. It ensures active participation from everyone in addressing the discussion topics, unlike passive listening during lectures.
Knowledge Retention & Review	The carousel strategy was really helpful for me to easily remember the lessons through cooperation and discussion with my classmates. The ideas presented by my classmates that came from our collaboration helped me recollect my prior knowledge. I find it easy to remember lessons coming from activities such as working around the carousel because they involve students both physically and mentally.
Improved Learning Outcomes	The carousel technique enabled me to attain great grades in science because it enhanced active learner involvement. Conversely, the lecture method makes learners passive participants, which does not encourage understanding.
Instructional Time Management	During our cooperative learning sessions in the carousel, we covered more lessons quickly because we collaborated and exchanged ideas with classmates. With lectures, we devoted much time to listening without participating in the discussion. Using the carousel benefited students by making our lessons more interesting and active. It helped save time, which we frequently lost during lectures when we had to wait for the teacher to repeatedly explain things.

DISCUSSION

Students had lower average pre-test scores before implementing the carousel strategy in their Grade 8 science class. However, after employing the carousel strategy, they achieved significantly higher post-test scores than those taught using the lecture method. This study's findings are consistent with those reported by Rufon & Forlale (2022), who examined the efficacy of carousel-based instruction versus traditional teaching approaches in sixth-grade science classes. At the outset, both student groups demonstrated similarly low average scores, hovering around 30%. Following the intervention, the carousel group achieved significantly higher post-test scores than the conventional group. Similarly, Rizal & Susanto (2021) studied the carousel brainstorming strategy. They found a significant increase in post-test scores for reading comprehension: the mean scores of students improved from pre-assessment to the second meeting, indicating a positive change. According to Slavin (1996) and Takko et al. (2020), one of the main reasons this strategy boosts students' academic performance is that

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group activities such as quizzes and exercises create supportive environments where students can easily understand what is required to achieve their learning objectives. Discussions among students during collaborative work could lead them to desire better results than their peers, resulting in higher academic achievements. Owen & Thomas (2021) found that the carousel strategy embodies a student-centered approach by putting students at the center of their learning and giving them a feeling of control over their education. This method catches learners' attention, which results in improved performance. The thematic analysis indicated different student feedback concerning the carousel teaching method in Grade 8. Regarding the first theme, participants reported that the carousel enhanced teamwork and cooperation. This is similar to the feedback in Utami's (2020) study, which noted that this strategy fostered collaboration through group work among students where they could discuss answers in Indonesian; subsequently, teachers would help them translate them into English while promoting cooperation and idea-sharing. Second, this method built students' confidence, allowing them to express their ideas during science classes. This corresponds with Rufon & Forlale's (2022) findings that interaction based on collaborative strategies such as a carousel creates safe environments for shy students to express themselves while boosting their self-esteem through active participation. The third theme was regarding student engagement. this technique was viewed as a fun way of learning owing to its interactive nature, and many students enjoyed participating in it because they got to move around from one station to another, thus increasing their interest in a given topic. One student responded, "I like rotation within this approach because it makes me more involved," demonstrating increased involvement. Research conducted by Hunter et al. (2017) and Ahmadifar et al. (2019) yielded comparable results, indicating that the implementation of carousel brainstorming techniques led to increased student participation and a reduction in anxiety associated with speaking tasks. Fourth, knowledge retention was significantly improved through recall of prior knowledge done collaboratively with active participation during the entire process; students easily remembered lessons by talking with classmates about what they knew regarding different subjects under consideration. These results aligned with Avisteva's (2017) & Yuli's (2013) findings, emphasizing the importance of recalling prior knowledge. Students became more engaged and active by moving around the classroom to discuss topics rather than passively sitting, thus maintaining their involvement throughout the learning process. The fifth theme noted that the carousel strategy enhanced students' learning outcomes, aligning with previous findings that cooperative learning fosters genuine engagement and higher academic achievement in science than individualistic lectures. This improvement was evidenced by the significant score increases observed from pre- to post-test for the carousel strategy group (Geletu, 2022). Furthermore, comparable studies demonstrated that cooperative learning activities positively affect students' academic performance in education compared with solely using lectures (Gull & Shehzad, 2015). The final finding from the thematic analysis is that the carousel strategy saved instructional time for students in science classes. This result corresponds with that of Dyson et al. (2010), which reported a substantial decrease in instruction time, management time, transitions, and wait time" during cooperative learning units. This implies that less time is allocated to direct instruction and structuring activities by the teacher, more control over student behavior, and more time for learning. According to

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Rachmadewi et al. (2021), working together enables teachers to cover more content within the same time as traditional methods like lecturing. In this research, two new themes emerged that were not found in other studies conducted in the Philippines, such as Rufon & Forlales' (2022): knowledge retention and review and instructional time management. This finding can help us understand better how effective the carousel teaching strategy is as an instructional method in science classes while also contributing towards general knowledge expansion about its effectiveness.

CONCLUSION

The data demonstrates that implementing the carousel strategy in Grade 8 leads to significantly higher science post-test scores for students, outperforming those taught through traditional lectures. A thematic analysis of student experiences indicated that collaboration, confidence building, and increased engagement were some of the benefits of using carousels as a teaching strategy in science among grade eight learners. In addition to this, the carousel teaching approach effectively enhances student learning and knowledge retention while decreasing instructional time requirements. These outcomes corroborate prior research, validating the method's success. Furthermore, this strategy offers valuable insights into innovative, interactive pedagogical techniques. It has proven particularly beneficial for science educators in Philippine public high schools, stimulating student engagement and elevating academic achievement. Subsequent investigations could examine its efficacy across various educational environments, cultural contexts, and academic disciplines to expand its global applicability, thereby contributing to a more comprehensive framework for active learning methodologies.

Limitations of the Study

The quasi-experimental design with non-equivalent control groups and pre-and post-tests used in the research limits its ability to establish causality and may introduce selection bias (Eshaq, 2024; Andrade, 2021). Future research should employ true experimental designs with randomized participant allocation to more accurately assess the carousel teaching method's effectiveness, thereby reducing bias and enhancing the findings' validity and reliability.

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References

1) Ahmadifar, M., Shangarfamm, N. & Marashi, H. (2019). The comparative effect of using fishbowl and carousel brainstorming strategies on EFL learners' foreign language speaking ability and anxiety. Journal of Applied Linguistics and Language Research, 6(1), 276-294. http://www.jallr.com/index.php/JALLR/article/view/970/pdf970

2) Andrade, C. (2021). The limitations of quasi-experimental studies and methods for data analysis when a quasi-experimental research design is unavoidable. *Indian Journal of Psychological Medicine*, *43*(5), 451–-452.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.14463572

3) Andriani, D., & Jufrizal, R. (2018). The effect of carousel brainstorming strategy and high conscientiousness toward students reading comprehension. *International Journal of Science and Research (IJSR)*, *8*(5), 1444–1448.

4) Avisteva, R. T. (2017). *The effect of using carousel activity on students' writing ability of descriptive text*. [Unpublished Thesis]. at Syarif Hidayatullah State Islamic University Jakarta.

5) Badeo, J. M., & Koc, B. C. O. K. (2021). Use of comic-based learning module in mechanics in enhancing students' conceptual understanding and motivation. *Science Education International*, *32*(2), 131–-136.

6) Barrot, J. S. (2023). K to 12 curriculum reform in the Philippines: Towards making students future-ready. Asia Pacific Journal of Education, 43(4), 1193–1207.

7) Bartlett, Jayne. (2015). *Outstanding assessment for learning in the classroom*. New York: Taylor & Francis Group.

8) Basco, R. O. (2020). Effectiveness of science infographics in improving academic performance among sixth grade pupils of one laboratory school in the Philippines. *Research in Pedagogy*, *10*(2), 313–-323.

9) Boladola, B. R. (2018). Memory retention and retrieval in K–12 spiral progression approach in science: A curriculum issue analysis. *Silliman Journal*, *59*(1).

10) Burhanuddin, W. (2015). Improving the students' reading comprehension through carousel brainstorm strategy. JKIP (*Jurnal Keguruan dan Ilmu Pendidikan (JKIP)*, *2*(1), 34–-44.

11) De La Cruz, R. J. D. (2022). Science education in the Philippines. In R. Huang, B. Xin, A. Tlili, F. Yang, X. Zhang, & M. Jemni (eds.), *Science education in countries along the Belt & Road: Future insights and new requirements* (pp. 331–-345). Singapore: Springer Nature Singapore.

12) del Valle, J. L. (2023). A rough sail for learner-centred education as a global reform policy in the Philippines. *Pedagogy, Culture & Society*, *31*(1), 109–-128.

13) Dunton, J., & Co, W. (2019). Spiral progression approach in teaching science and the performance of learners in District I, Capiz. *Journal of Physics: Conference Series*, *1254*(1), 1–-6. https://doi.org/10.1088/1742-6596/1254/1/012045

14) Dyson, B. P., Linehan, N. R., & Hastie, P. A. (2010). The ecology of cooperative learning in elementary physical education classes. *Journal of tTeaching in Physical Education*, *29*(2), 113–-130.

15) Eshaq, H. A. (2024). The effect of using STEM education on students' mathematics achievement. *Journal of Pedagogical Research*, *8*(1), 75–-82.

16) Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American jJournal of Theoretical and aApplied sStatistics*, *5*(1), 1–-4.

17) Galceran, G. C., & Mugot, B. (2019). Three step interview as a strategy on the performance in science of grade 8 students. *Journal of Education & Social Policy*, *6*(1), 97–103.

18) Geletu, G. M. (2022). The effects of teachers' professional and pedagogical competencies on implementing cooperative learning and enhancing students' learning engagement and outcomes in science: Practices and changes. *Cogent Education*, *9*(1), 2153434.

19) Genovia, J. A., Eslit, A. R. C., Tamse, A. L. G., & Barquilla, M. B. (2018, January). Development of a WebQuest as instructional material in teaching biodiversity for grade 8 learners. *In AIP Conference Proceedings, (Vol. 1923*(, No. 1). AIP Publishing.

20) Gerondio, L. B., Unabia, W. A. R., Mayang, Z. M., & Alimbon, J. A. (2023). Junior high school students' views of nature of science: evidence from a private school in Davao Region, Philippines. *International Journal of Science Education*, 1–-19.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.14463572

21) Guerrero, J. S., & Bautista, R. G. (2023). Inquiry-based teaching in secondary science. *International Journal of Social Sciences & Humanities (IJSSH), 8*(2), 146–-154.

22) Gull, F., & Shehzad, S. (2015). Effects of cooperative learning on students' academic achievement. *Journal of eEducation and Learning (EduLearn)*, *9*(3), 246–-255.

23) Hunter, W. C., Maheady, L., Washington, C., Christopher-Allen, A., & Jasper, A. D. (20178). Effects of carousel brainstorming on student engagement and academic performance in a summer enrichment program. *Journal of Evidence-Based Practices for Schools*, *17*(2), 220–-244.

24) Johnston, H. (2012). *The Spiral Curriculum*. Florida: Education Partnerships, Inc. https://www.eric.ed.gov/?id=ED538282.

25) Kiger, M. E., & Varpio, L. (2020). Thematic analysis of qualitative data: AMEE Guide No. 131. *Medical Teacher*, *42*(8), 846–-854.

26) Limueco, J. M., & Prudente, M. S. (2018). Flipping classrooms to improve physics teaching. *Advanced Science Letters*, *24*(11), 8292–-8296.

27) Mantey, G. K., Osei, L., & Assuah, C. K. (2022). The effect of inquiry-based learning on senior high school students' achievement in plane geometry: Pre-test-post-test randomized experimental design. *Asian Research Journal of Mathematics*, *18*(11), 320–-331.

28) McKnight, K. S. (2010). The teacher's big book of graphic organizers: 100 reproducible organizers that help kids with reading, writing, and the content areas. John Wiley & Sons.

29) Mirasol, J. M., Necosia, J. V. B., Bicar, B. B., & Garcia, H. P. (2021). Statutory policy analysis on access to Philippine quality basic education. International Journal of Educational Research Open, 2, 100093.

30) Molina-Azorin, J. F. (2016). Mixed methods research: An opportunity to improve our studies and research skills. *European Journal of Management and Business Economics*, *25*(2), 37–38.

31) Namoco, S. O., Duero, J. G. Q., Jr, N. F. B., Dumaog, A. C., & Walag, A. M. P. (20223) Narrative inquiry to understand the national achievement test of primary and secondary school students in Misamis Oriental, Philippines. *Science International*, *34*(5), 495–501.

32) Newman, K., & Gentile, E. (2020). How teachers teach: Comparing classroom pedagogical practices in the Asia and Pacific Region. *ADB Briefs*, *154*, 1–19.

33) Noviani, W., Chong, M. C., & Tang, L. Y. (2023). Socialization in professional reality integration for nursing student transition (SPRINT) to improve professional competence: A quasi-experimental study. *Heliyon*, *9*(3), e13433.

34) Oladejo, A. I., Nwaboku, N. C., Okebukola, P. A., & Ademola, I. A. (2023). Gender difference in students' performance in chemistry–can computer simulation bridge the gap? *Research in Science & Technological Education*, *41*(3), 1031–-1050.

35) Organization for Economic Co-operation and Development (OECD). (2018). *PISA 2015 Results in focus*.

36) Owen, C. & Thomas, L. (202119). The carousel-style lesson: an effective intervention to enhance motivation and the learning foreign language at primary school. *The Language Learning Journal*, *4*(9), 318–-329.

37) Palines, K. M. E., & Cruz, R. A. O. D. (2021). Facilitating factors of scientific literacy skills development among junior high school students. LUMAT: *International Journal on Math, Science and Technology Education (LUMAT)*, *9*(1), 546–-569.

38) Peel, K. L. (2020). A beginner''s guide to applied educational research using thematic analysis. *Practical Assessment, Research, and Evaluation*, *25*(1), 2.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.14463572

39) Precious, E. C., & Feyisetan, A. V. A. (2020). Influence of teacher-centered and student-centered teaching methods on the academic achievement of post-basic students in biology in Delta State, Nigeria. *Teacher Education and Curriculum Studies*, *5*(3), 120–-124.

40) Rachmadewi, S. N. N., Nurulita, H. L., Filhak, R. N., Zahra, S. A., & Pemanasari, A. (2021, November). Cooperative learning model in science online learning for 9th grade students. In *Journal of Physics: Conference Series*, (Vol. *2098*, No. (1), p. 012006). IOP Publishing.

41) Ramadhanti, D., & Yanda, D. P. (2018). Understanding poetry through the use of cooperative learning model. *Jurnal Cakrawala Pendidikan*, *37*(3).

42) Resurreccion, J. A., & Adanza, J. (2015). Spiral progression approach in teaching science in selected private and public schools in Cavite.. In *Proceedings of the DLSU Research Congress, 3*, (Vol. 3, pp. 1–-12).

43) Rizal, S., & Susanto, F. (2021). Implication principles of carousel brainstorming strategy as an efficiency motivation for improving reading comprehension in pandemic era. *International Journal of Educational Research and Social Sciences (IJERSC)*, *2*(2), 439–-448.

44) Rufon, A., & Forlales, E. (2022). Effect of carousel strategy on the academic achievement in earth and space science of Grade Six Pupils. *Romblon State University Research Journal*, *4*(1), 40–-47.

45) Sarsale, J. S., & Langub, M. K. C. (2023). Effects of student-centered learning approaches towards interest in science. *Journal of Research, Policy & Practice of Teachers and Teacher Education*, *13*(2), 73–85. https://doi.org/10.37134/jrpptte.vol13.2.5.2023

46) Science Education Institute and University of the Philippines-National Institute for Science and Mathematics Education (SEI-DOST & UP NISMED). (2011). *Science Framework for Philippine Basic Education. Manila: SEI-DOST & UP NISMED*. Retrieved from http://www.sei.dost.gov.ph

47) SEAMEO-INNOTECH. (2012). *K to 12 Toolkit: Resource Guide for Teacher Educators, School Administrators and Teachers*. https://www.seameo-innotech.org/wp-content/uploads/2020/05/k-12-toolkit.pdf

48) Siedlecki, S. L. (2020). Quasi-experimental research designs. *Clinical Nurse Specialist*, *34*(5), 198–-202.

49) Simesso, M. D., Gutu, T. S., & Tarekegn, W. M. (2024). The contribution of using cooperative learning methods on students' achievement and retention in secondary schools during chemistry lesson. *Education Research International*, *2024*(1), 1830124.

50) Slavin, R. E. (1995). Cooperative learning: Theory, research, and practice (2nd ed.). Allyn and Bacon.

51) Snider, M. (2004). Do school facilities affect academic outcomes*?* Washington DC: National Clearinghouse for Educational Facilities.

52) Sugano, S. G. C., & Nabua, E. B. (2020). Meta-analysis on the effects of teaching methods on academic performance in chemistry. *International Journal of Instruction*, *13*(2), 881–-894.

53) Takko, M., Jamaluddin, R., Kadir, S. A., Ismail, N., Abdullah, A., & Khamis, A. (2020). Enhancing higher-order thinking skills among home science students: The effect of cooperative learning student teams-achievement divisions (STAD) module. *International Journal of Learning, Teaching and Educational Research*, *19*(7), 204–-224.

54) Tesorio, P. J. C., & Canizares, M. J. F. (2018). Philippine K-12 secondary science teachers'' assessment conceptions in promoting student learning. *The Normal Lights*, *12*(2).

55) Tirol, S. L. (2022). Spiral progression approach in the K to 12 science curriculum: A literature review. *International Journal of Education (IJE)*, 10(4), 29–44.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.14463572

56) Toprak, T. E. (2019). Analysis of differences between groups: The t-test and the analysis of variance (ANOVA) in language assessment. In V. Aryadoust & M. Raquel (Eds.), *Quantitative data analysis for language assessment volume I* (pp. 179–-197). Routledge.

57) Utami, M. A. (2020). The impact of using carousel activity strategy on students' speaking ability of asking and giving opinion (A quasi-experimental study at the eighth grade students of MTs Jamiyyah Islamiyyah in academic year 2019/2020). [(Bachelor"s thesis]., Jakarta: Fitk Uin Syarif Hidayatullah Jakarta).

58) Villanueva, J. M. (2022). Language profile, metacognitive reading strategies, and reading comprehension performance among college students. *Cogent Education*, *9*(1), 2061683.

59) White, M. A., & Kern, M. L., (2018). Positive education: Learning and teaching for wellbeing and academic mastery. *International Journal of Wellbeing*, *8*(1), 1–-17. https://doi.org/10.5502/ijw.v8i1.588

60) Yeboah, R., Abonyi, U. K., & Luguterah, A. W. (2019). Making primary school science education more practical through appropriate interactive instructional resources: A case study of Ghana. *Cogent Education*, *6*(1), 1611033.

61) Yuli, R. F. (2013). Teaching reading comprehension by using carousel brainstormin strategy at senior high school. *Journal of English Teaching*, *2* (2), 423–-424.