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EFFECTS OF REPETITIVE-COLLABORATIVE LEARNING STRATEGY ON STUDENTS' ACADEMIC PERFORMANCE AND RETENTION IN COMPUTER IN EDUCATION COURSE

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ABSTRACT

Successful learning and application are hinged upon the pedagogical approach (es) an instructor adopts during instruction. This study assessed the effects of the repetitive-collaborative learning strategy on students' performance and retention in the Computer in Education course based on five objectives and hypotheses. The quasi-experimental research design and a 61-sample size selected through a purposive sampling were used for the study. Computer in Education Achievement Test (CAAT), which had a 0.69 reliability coefficient, and paired sample t-test and Analysis of Covariance were used for data collection and analyses, respectively. The paired sample t-test results showed that the repetitive-collaborative learning strategy significantly improved students' performance ($p = 0.01$) and retention ($p = 0.00$). The ANCOVA results showed negligible and insignificant differences in the effects of the repetitive-collaborative and collaborative learning strategies ($F (1, 45) = 0.89$, $p = 0.35$, Partial Eta Square (PES) = 0.02); collaborative and repetitive learning strategies ($F (1, 37) = 0.64$, $p = 0.43$, PES = 0.02); and repetitive-collaborative, collaborative, and repetitive learning strategies ($F (2, 57) = 1.51$, $p = 0.23$, PES = 0.05) on students' performance in the Computer in Education course, respectively. However, the effects of the repetitive-collaborative and repetitive learning strategies on students' performance in the Computer in Education course differ significantly ($F (1, 31) = 4.92$, $p = 0.03$, PES = 0.14), favoring students in the repetitive learning group. Conclusively, educators should use repeated practice alongside collaborative elements during instruction to promote knowledge consolidation and future application among students.

Keywords: Repetitions, collaboration, repetitive-collaborative learning strategy, students' performance, retention, and Computer in Education course

1.INTRODUCTION

Innovative learning strategies are pivotal to learners' conceptual internalization and deeper understanding, enabling the effective application of knowledge. A learner needs to internalize a learning concept for deeper understanding and to retain it for a longer period for adequate performance. Facilitating a deeper understanding of the learning experience remains a key to success and good performance among learners. Learning is a process that requires a learner to study repeatedly, engage with the learning content, and connect with people in their community of practice. Observations show that exposing a learner to a learning concept once may not lead to deeper understanding.

Repetitive learning involves consistently engaging in an activity, such as studying a piece of information or practicing a skill, to avoid forgetting and achieve mastery. In 1885, Hermann Ebbinghaus plotted the forgetting curve, which shows the geometric rate at which people lose learned information without revision over time. Ebbinghaus later demonstrated how to use constant revisions and repetitive learning to reduce forgetfulness and retain knowledge. To minimize forgetting, Cloke [1] suggested splitting the content into smaller, more relevant parts, exposing learners to the materials, and actively engaging them with the content. Brown [2] remarked that effective repetitive learning requires breaking down larger information into manageable and smaller chunks to enable learners to concentrate on specific topics for more knowledge retention

According to Muppalla et al [3], there are two primary methods for engaging in repetitive learning: spaced practice and retrieval practice. Spaced practice or repetition, according to McDermid, [4], is a strategy where a learner revises a lesson at accelerated intervals to embed new knowledge in long-term memory. Teachers can employ spaced practice as an instructional strategy by delivering the same content many times, allowing learners to distribute the time for a particular study across different rehearsal periods rather than cramming the entire information at once.
Retrieval practice is the purposeful act of retrieving stored information from memory. Retrieval practice involves retrieving concepts, events, or facts from memory to enhance learning [5]. Talanquer [6] asserts that combining spaced and retrieval practices help the brain identify and connect similar information to maximize learning. With spaced retrieval, a teacher can ask students to retrieve or recall learned concepts or topics in homework, presentations, or other in-class assessment activities at scheduled intervals before the final examination. The best schedule for spaced retrieval activities should vary based on the learners' characteristics, learning goals, and expected retention duration.

Repetitive learning through spaced retrieval practice proves effective in enhancing learners' deeper understanding [7], knowledge retention [8]; and future application [9]. Khalafi et al. [10] found that students in the spaced repetition group had lower pretest scores than those in the lecture group, with no significant difference; however, post-test and retention mean scores were higher for the spaced repetition group than for the lecture group. However, as Brown noted, this learning strategy may be challenging and unrealistic for classroom lessons with large amounts of content, numerous topics, and class size, especially in Nigerian higher institutions. This challenge can prevent educators from adopting a repetitive instructional approach. Thornley et al. [11] noted that balancing repetition with other instructional techniques is necessary for effective learning. Thus, combining repetitive learning with an innovative learning strategy, such as a collaborative approach, may be what educators need to help learners in higher institutions avoid memorization while revising course content repeatedly, developing a deeper understanding, and retaining acquired knowledge for improved learning outcomes and long-term application.

A repetitive-collaborative learning strategy involves teaching course content to students and sharing the course outline among small groups, allowing each group to present and share their knowledge on different topics with the entire class. This, therefore, creates an opportunity for learners to repeat and learn the same content through a collaborative approach. Groh [12] averred that collaborative learning utilizes grouping strategies and teamwork to enhance students' learning. The group assigns responsibilities (such as leadership and participant roles) and learning tasks to individual members to support the group's success. Groh noted that collaborative learning helps learners engage actively in information processing and synthesis, rather than just memorizing facts.

Repetitive-collaborative learning is anchored in the theoretical foundations of information processing theory by George Miller and other American psychologists in the 1950s [13], Social Constructivist theory by Lev Vygotsky in 1978 [14], and mastery learning theory by J. B. Carroll and B. S. Bloom in the 1960s [15]. Information Processing theory describes how a learner's brain moves and processes (stores, encodes, and retrieves) information from sensory memory (which stores sensory information) to working memory (for short-term remembrance) and finally to long-term memory (for longer retention) [16].

Repeating information many times moves the information from the outer to the inner memory, Kelubia, et, al [17]. Green [18] averred that repetition is a deliberate way of consolidating the bonds between neurons and brain cells. The social constructivist theory emphasizes the need for a learner to interact socially (especially, at his zone of proximal development or when faced with learning difficulties) with more knowledgeable others within his community of practice to share and acquire knowledge and clarify misconceptions. Mastery learning theory emphasizes providing learners' adequate time and practice to internalize learning materials [19]. Therefore, repeating learned concepts through collaborative discussion and presentation may facilitate memory consolidation, independent mastery of supported performance, and long-term retention of learning experiences more than either individual strategy or the traditional lecture method.

Assessing the effect of combining repetitive strategy with other learning strategies on students' academic performance, Jayaram [20] remarked that active recall and spaced repetition improved Pharmacy students' performance more than passively reviewing lecture materials. Çan and Toraman [21] found that Anatomy students in the repetition group had similar pretest and post-test mean scores. In contrast, those in the scenario-based repetition group had higher post-test mean scores than their pretest scores. Similarly, Ishaq, [22] found that post-test scores were higher in the scenario-based repetition group than in the repetition-only group.

Many studies have reported the positive impacts of collaborative learning strategies on students' performance and retention. [23] found that the pupils in the collaborative learning group had higher and improved pretest and post-test scores than their counterparts in the individualized learning group. Eskiyurt & Özkan [24] reported that the decision-making score of nursing students taught through collaborative learning was higher at post-program than at pre-program, with no significant difference, while their critical thinking scores were higher and significant at post-program. Vios [25] found that no significant difference exists in the pretest scores of experimental and control groups, while post-test performance scores showed a significant difference for the two groups, favouring those in the collaborative learning (experimental) group.

Most of the studies on the collaborative learning approach compared the traditional lecture method using secondary school students, with a few studies on higher and primary education students. However, with the reported significant effect of the collaborative learning approach, Vaughn discovered that there is no significant difference between collaborative learning and lecture methods among higher education students. Vaughn suggested adopting a collaborative learning approach in an appropriate context to achieve maximum performance among higher education students. Therefore, to the best of the researchers' knowledge, no study has compared the combined effect of repetitive and collaborative learning strategies on students' performance in higher institutions. The present study, however, wishes to discover if allowing learners to repeat what they have been taught in a collaborative learning approach can have a more positive impact on their performance, especially in a higher education environment with large class sizes and topics per semester.

1.1Statement of the Problem

Equipping learners with essential knowledge, attitudes, and skills to solve immediate and future societal challenges remains the ultimate educational goal at all levels. This, however, seems unattainable when learners engage in rote learning and memorization, which are characteristic of most traditional teaching methods prevalent in higher institutions in Nigeria. Additionally, the short academic calendar (10 weeks of lectures, 1 week of revision, and 4 weeks of examination periods) with large course content coverage per semester in most educational institutions may contribute to rote learning without content mastery among learners. Students' rote learning of the semester's coursework is always obvious during the examination. Observations indicate that most students struggle to recall and write down what they have memorized during an examination, likely due to a lack of deeper understanding and retention of the learned concepts and coursework. Most of them seem to forget everything they memorized immediately after the examination, thereby hindering the application of the learning experience in potential workplaces for improved work performance. Moreover, technology that seems to facilitate students' learning and retention has its inherent challenges, including high technology costs, poor power supply, Internet connectivity issues, low digital literacy, distractions, and others, which prevent adequate integration of classroom technology. Therefore, achieving instructional goals remains a challenge in the current Nigerian educational system. The crucial questions are: how can a teacher facilitate students' deeper understanding and retention of learning material from the classroom level beyond the traditional lecture method and without depending fully on technology-based instruction? Can a mixed strategy, repetitive-collaborative learning strategy have any significant impact on students' learning outcomes and retention?

The study's problem is to find out the effect of the repetitive-collaborative learning strategy on students' performance and retention in the Computer in Education course in the Faculty of Education, University of Port Harcourt.

1.2Objectives of the Study

The specific objectives were to:

1. Find out if the repetitive-collaborative learning strategy has a significant effect on students' performance in the Computer in Education course at the pretest and post-test stages
2. Determine if the repetitive-collaborative learning strategy has a significant effect on students' learning retention in the Computer in Education course at post-test and post-post-test stages
3. Ascertain if the repetitive-collaborative learning strategy has a significant effect on students' performance compared to the collaborative learning strategy in the Computer in Education course at pretest and post-test stages
4. Discover if the repetitive-collaborative learning strategy has a significant effect on students' performance compared to the repetitive learning strategy in the Computer in Education course at pretest and post-test stages.
5. Find out if the repetitive-collaborative learning strategy has a significant effect on students' performance compared to collaborative and repetitive learning strategies in the Computer in Education course at pretest and post-test stages
6. Determine if the repetitive learning strategy has a significant effect on students' performance compared to the collaborative learning strategy in the Computer in Education course at the pretest and post-test stages

1.3Null Hypotheses (tested at 0.05 alpha level)

1. The repetitive-collaborative learning strategy has no significant effect on students' performance in the Computer in Education course at the pretest and post-test stages.
2. The repetitive-collaborative learning strategy has no significant effect on students' learning retention in the Computer in Education course at the post-test and post-post-test stages
3. The repetitive-collaborative learning strategy has no significant effect on students' performance than the collaborative learning strategy in the Computer in Education course at the pretest and post-test stages
4. The repetitive-collaborative learning strategy has no significant effect on students' performance than the repetitive learning strategy in the Computer in Education course at the pretest and post-test stages.
5. Repetitive-collaborative learning strategy has no significant effect on students' performance compared to the collaborative and repetitive learning strategies in the Computer in Education course at the pretest and post-test stages
6. The repetitive learning strategy has no significant effect on students' performance compared to the collaborative learning strategy in the Computer in Education course at the pretest and post-test stages

2. METHODOLOGY

The study adopted a quasi-experimental research design. The population comprised 126 final-year (400-level) students from the Faculty of Education, University of Port Harcourt, drawn from Educational Foundations (67 students in the 2024/2025 session) and Educational Management, including Economics option students (42 in 2024/2025 and 17 in 2025/2026), based on departmental records. A sample of 61 students was selected using purposive sampling. This included 21 students from the 2024/2025 EDM Economics group assigned to the repetitive-collaborative learning group (experimental group), 13 students from the 2025/2026 EDM Economics group assigned to the repetitive learning group, and 27 students from Educational Foundations assigned to the collaborative learning group. The latter two served as control groups. Only students with full attendance and active participation were included. Data were collected using a self-developed Computer in Education Achievement Test (CAAT), consisting of 25 objective items: eight true/false and seventeen multiple-choice questions. Each correct answer carried four marks, giving a total score of 100%. The instrument was validated for face and content validity by experts and pilot-tested on 25 students. Reliability was established using Cronbach's alpha, yielding a coefficient of 0.69, indicating acceptable internal consistency. Ethical procedures were observed by obtaining students' consent and ensuring anonymity. All groups took a pre-test before instruction. The repetitive-collaborative group received seven weeks of instruction and later worked in small groups to review and present assigned topics, encouraging both repetition and collaboration. The collaborative group studied and presented assigned topics without prior instruction, while the repetitive learning group received instruction with content repeated before the end of the period. After instruction, all groups took a post-test, while the experimental group additionally completed a delayed post-test three weeks later to assess retention. For data analysis, a paired sample t-test was used to test hypotheses 1 and 2, while Analysis of Covariance (ANCOVA) was used to test hypotheses 3 to 6.

3.RESULTS

Objective 1: Find out if the repetitive-collaborative learning strategy has a significant effect on students' performance in the Computer in Education course at the pretest and post-test stages

Hypothesis 1: The repetitive-collaborative learning strategy has no significant effect on students' performance in the Computer in Education course at the pretest and post-test stages.

Table 1: Paired sample t-test summary of the repetitive-collaborative learning strategy effect on students' performance in the Computer in Education course at pretest and post-test stages.

			Paired differences					
	N	mean	Mean	Std. Dev.	df	t	p-value	Decision
Posttest	21	48.76						
			13.33	14.88	20	4.12	0.01	Rejected
Pretest	21	35.43						

Note: n = sample size for the repetitive-collaborative learning group

Table 1 shows the paired sample t-test summary of the repetitive-collaborative learning strategy effect on students' performance in the Computer in Education course at pretest and post-test stages. The result reveals that the students' performance mean score increased significantly ($t(20) = 4.12$, $p = 0.01 < 0.05$ alpha level) at the post-test stage (mean = 48.76) compared to the pretest stage (mean = 35.43) with a paired mean difference of 13.33 and 14.88 standard deviation. The researchers, therefore, rejected the hypothesis that the repetitive-collaborative learning strategy has no significant effect on students' performance in the Computer in Education course at the pretest and post-test stages and accepted the alternative. Thus, the repetitive-collaborative learning strategy had a significant positive effect on students' performance in the Computer in Education course.

Objective 2: Determine if the repetitive-collaborative learning strategy has a significant effect on students' learning retention in the Computer in Education course at the post-test and post-post-test stages

Hypothesis 2: The repetitive-collaborative learning strategy has no significant effect on students' learning retention in the Computer in Education course at the post-test and post-post-test stages

Table 2: Paired sample t-test summary of the repetitive-collaborative learning strategy effect on students' learning retention in the Computer in Education course at post-test and post-post-test stages

			Paired differences					
	N	mean	Mean	Std. Dev.	df	t	p-value	Decision
Post posttest	21	67.43						
			18.67	13.82	20	6.19	0.00	Rejected
Posttest	21	48.76						

Note: n = sample size for the repetitive-collaborative learning group

Table 2 presents the paired-sample t-test summary of the effect of the repetitive-collaborative learning strategy on students' learning retention in the Computer in Education course at post-test and post-post-test stages. The result reveals that the students' retention mean score increased significantly ($t(20) = 6.19$, $p = 0.00 < 0.05$ alpha level) at the post-post-test stage (mean = 67.43) compared to the post-test stage (mean = 48.76) with a paired mean difference of 18.67 and standard deviation of 13.82. The researchers, therefore, rejected the hypothesis that the repetitive-collaborative learning strategy has no significant effect on students' learning retention in the Computer in Education course at the post-test and post-post-test stages and accepted the alternative. Thus, the repetitive-collaborative learning strategy had a sustained and significant positive effect on students' retention in the Computer in Education course.

Objective 3: Ascertain if the repetitive-collaborative learning strategy has a different significant effect on students' performance compared to the collaborative learning strategy in the Computer in Education course at pretest and post-test stages

Hypothesis 3: The repetitive-collaborative learning strategy does not have a significantly different effect on students' performance compared to the collaborative learning strategy in the Computer in Education course at the pretest and post-test stages

Table 3: ANCOVA summary of the effect of repetitive-collaborative and collaborative learning strategies on students' performance in the Computer in Education course at pretest and post-test stages

Dependent Variable: Post-test Scores							
Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared (PES)**	**Decision**
Pretest Score	603.087	1	603.087	2.49	0.12	0.05	
Groups	216.176	1	216.176	0.89	0.35	0.02	Retained
Error	10883.389	45	241.853				
Total	143424.000	48					

Table 3 presents the ANCOVA summary of the effects of repetitive-collaborative and collaborative learning strategies on students' performance in the Computer in Education course at the pretest and posttest stages. The results show that the difference in the effects of the repetitive-collaborative learning strategy and the collaborative learning strategy on students' performance in the Computer in Education course is insignificant, with a small effect size ($F(1, 45) = 0.89$, $p = 0.35 > 0.05$ alpha level, PES = 0.02). This led the researchers to accept the hypothesis that the repetitive-collaborative learning strategy does not have a significantly different effect on students' performance compared to the collaborative learning strategy in the Computer in Education course at the pretest and post-test stages. Thus, repetitive-collaborative and collaborative learning strategies have a similar effect on students' performance in the Computer in Education course.

Objective 4: Discover if the repetitive-collaborative learning strategy has a significantly different effect on students' performance compared to the repetitive learning strategy in the Computer in Education course at pretest and post-test stages.

Hypothesis 4: The repetitive-collaborative learning strategy does not have a significantly different effect on students' performance than the repetitive learning strategy in the Computer in Education course at pretest and post-test stages.

Table 4: ANCOVA summary of the effects of repetitive-collaborative and repetitive learning strategies on students' performance in the Computer in Education course at pretest and post-test stages

Dependent Variable: Post-test Scores							
Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**	**Decision**
Pretest Score	44.177	1	44.177	0.22	0.65	0.01	
Groups	1003.393	1	1003.393	4.92	0.03	0.14	Rejected
Error	6326.402	31	204.077				
Total	102624.000	34					
Repetitive-Collaborative Group	48.76	10.779	21				
Repetitive Group	59.69	18.364	13				

Table 4 presents the ANCOVA summary of the effects of repetitive-collaborative and repetitive learning strategies on students' performance in the Computer in Education course at the pretest and post-test stages. The results reveal that the difference in the effects of the repetitive-collaborative learning strategy and the repetitive learning strategy on students' performance in the Computer in Education course is significant and meaningful ($F(1, 31) = 4.92$, $p = 0.03 < 0.05$ alpha level, PES = 0.14). Therefore, the researchers rejected the hypothesis that the repetitive-collaborative learning strategy does not have a significantly different effect on students' performance than the repetitive learning strategy in the Computer in Education course at pretest and post-test stages, and accepted the alternative. Thus, the repetitive learning strategy (mean=59.69, Std. Dev.=18.36) significantly improved students' performance in the Computer in Education course more than when combined with the collaborative learning strategy in a repetitive-collaborative learning approach (mean=48.76, Std. Dev.=10.78) (see Appendix 3).

Objective 5: Find out if the repetitive-collaborative learning strategy has a different significant effect on students' performance compared to collaborative and repetitive learning strategies in the Computer in Education course at pretest and post-test stages.

Hypothesis 5: The repetitive-collaborative learning strategy does not have a significantly different effect on students' performance compared to collaborative and repetitive learning strategies in the Computer in Education course at the pretest and post-test stages.

Table 5: ANCOVA summary of the effect of repetitive-collaborative, collaborative, and repetitive learning strategies on students' performance in the Computer in Education course at pretest and post-test stages

Dependent Variable: Post-test Scores							
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**	**Decision**
Pretest Score	300.58	1	300.58	1.13	0.29	0.02	
Groups	807.03	2	403.51	1.51	0.23	0.05	Retained
Error	15232.66	57	267.24				
Total	193792.00	61					

Table 5 discloses the ANCOVA summary of the effects of repetitive-collaborative, collaborative, and repetitive learning strategies on students' performance in the Computer in Education course at the pretest and post-test stages. The results showed that the difference in the effects of the repetitive-collaborative, collaborative, and repetitive learning strategies on students' performance in the Computer in Education course is small and insignificant ($F(2, 57) = 1.51$, $p = 0.23 > 0.05$ alpha level, PES = 0.05). This led the researchers to accept the hypothesis that the repetitive-collaborative learning strategy does not have a significantly different effect on students' performance compared to the collaborative and repetitive learning strategies in the Computer in Education course at the pretest and post-test stages. Thus, repetitive-collaborative, collaborative, and repetitive learning strategies have similar effects on students' performance in the Computer in Education course.

Objective 6: Determine if the repetitive learning strategy has a significantly different effect on students' performance compared to the collaborative learning strategy in the Computer in Education course at the pretest and post-test stages.

Hypothesis 6: The repetitive learning strategy does not have a significantly different effect on students' performance compared to the collaborative learning strategy in the Computer in Education course at pretest and post-test stages

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Table 6: ANCOVA summary of the effect of repetitive and collaborative learning strategies on students' performance in the Computer in Education course at pretest and post-test stages

Dependent Variable: Post-test Scores							
Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**	**Decision**
Pretest Score	457.81	1	457.81	1.33	0.26	0.04	
Groups	219.18	1	219.18	0.64	0.43	0.02	Retained
Error	12751.63	37	344.64				
Total	141536.00	40					

Table 6 reveals the ANCOVA summary of the effects of repetitive and collaborative learning strategies on students' performance in the Computer in Education course at the pretest and post-test stages. The results show that the difference in the effects of the collaborative and repetitive learning strategies on students' performance in the Computer in Education course is insignificant and negligible ($F(1, 37) = 0.64$, $p = 0.43 > 0.05$ alpha level, PES = 0.02). This led the researchers to accept the hypothesis that the repetitive learning strategy does not have a significantly different effect on students' performance compared to the collaborative learning strategy in the Computer in Education course at the pretest and post-test stages. Thus, collaborative and repetitive learning strategies have similar effects on students' performance in the Computer in Education course.

4. DISCUSSION OF FINDINGS

Table 1 paired sample t-test results revealed that the repetitive-collaborative learning strategy had a significant positive effect ($t(20) = 4.12$, $p = 0.01 < 0.05$ alpha level) on students' performance in the Computer in Education course, as the students' performance mean score increased significantly from 35.43 at pretest to 48.76 at the post-test. This finding agrees with Vagha et al. [26], who found that students in the scenario-based repetition group had higher post-test mean scores than their pretest scores. It also agrees with Zhang's [27], who argued that the repetition learning strategy increased vocabulary learning, and Zhan et, al [28] concluded that active recall and spaced repetition improved Pharmacy students' performance more than passively reviewing lecture materials. This result implies that the repetitive-collaborative learning strategy is an effective pedagogical approach that promotes students' deeper understanding of course content and improves their performance. Thus, the combination of repetitive and collaborative learning strategies during instruction is effective in fostering students' mastery of concepts and overall performance through regular practice, peer-to-peer interactions, exchange of ideas, and clarification of misconceptions. This learning strategy can be applied to other courses to promote learning engagement, mastery, collaboration, and outcomes.

Table 2 paired sample t-test results revealed that the repetitive-collaborative learning strategy had a sustained and significant positive effect ($t(20) = 6.19$, $p = 0.00 < 0.05$ alpha level) on students' retention in the Computer in Education course, as the students' retention mean score increased significantly from 48.76 at the post-test to 67.43 at the post-post-test stage. This finding is similar to that of Vaughn [29], who found that the repetition learning strategy improved knowledge retention and application significantly. This result indicates that the repetitive-collaborative learning strategy has a long-term knowledge retention capacity, as it sustained and improved students' performance in the Computer in Education course over time. This result confirms the suitability of the repetitive-collaborative learning strategy as a valuable pedagogical strategy when sustained mastery and application of knowledge are paramount.

Table 3 ANCOVA results showed that the difference in the effects of the repetitive-collaborative learning strategy and the collaborative learning strategy on students' performance in the Computer in Education course is insignificant and meaningless ($F(1, 45) = 0.89$, $p = 0.35 > 0.05$ alpha level, PES = 0.02). This result signifies that repetitive-collaborative and collaborative learning strategies have similar and beneficial impacts on students' learning. This finding agrees with those of Talan [30], who reported that there is no significant difference between collaborative learning and lecture methods among higher education students. Thus, the addition of a repetitive learning strategy to the collaborative approach may not cause students to perform better in the Computer in Education course compared to using the collaborative learning approach alone. This assertion supports the impact of a collaborative approach in improving learning Achor et al., [31]). This result implies that educators may use either of the repetitive-collaborative learning strategy or the collaborative learning strategy to facilitate higher learning outcomes among students.

Table 4 ANCOVA results disclosed that the effects of the repetitive-collaborative and repetitive learning strategies on students' performance in the Computer in Education course differ significantly and moderately ($F(1, 31) = 4.92$, $p = 0.03 < 0.05$ alpha level, PES = 0.14). The repetitive learning strategy (mean=59.69, Std. Dev.=18.36) significantly improved students' performance in the Computer in Education course more than the repetitive-collaborative learning approach (mean=48.76, Std. Dev.=10.78). This finding differs from that of Ojelowo & Sam-Kayode [32], who observed no significant difference in the type of repetition learning strategy used for instruction. It also differs from Almonia's [33] finding, which showed that post-test scores were higher in the scenario-based repetition group than in the repetition-only group. These differences may arise from the variations in the course content and learning context.

This result indicates the strength of the repetitive learning approach in reinforcing students' immediate learning outcomes and the ability of collaboration to consolidate and sustain knowledge, especially when combined with repetition in a repetitive-collaborative learning approach, as indicated in the earlier finding on students' retention. The implication of this result buttresses the need for educators to balance between the use of either repetitive or collaborative learning strategies, or their combination, to foster meaningful immediate performance based on learning goals and contexts, as supported by Gal & Ryder [34]. Table 5 ANCOVA results disclosed that the difference in the effects of the repetitive-collaborative, collaborative, and repetitive learning strategies on students' performance in the Computer in Education course is small and insignificant ($F(2, 57) = 1.51$, $p = 0.23 > 0.05$ alpha level, PES = 0.05). This result signifies that the three learning strategies produce a similar impact on students' performance in the Computer in Education course. This result confirms the suitability and usefulness of the repetitive-collaborative, collaborative, or repetitive learning strategies in supporting students' immediate performance. It also highlights the need to always analyze how a learning strategy, such as a collaborative or repetitive learning approach, may support long-term knowledge retention and application.

Table 6 ANCOVA revealed that the difference in the effects of the collaborative and repetitive learning strategies on students' performance in the Computer in Education course is insignificant and negligible ($F(1, 37) = 0.64$, $p = 0.43 > 0.05$ alpha level, PES = 0.02). This result tallies with that of 1a'ishatu and Bagudu [35], who discovered that there is no significant difference between collaborative learning and lecture methods among higher education students. However, it differs from those of Jekayinfa et al. [36], who found a significant performance of students in the collaborative group when compared with other learning strategies. This result indicates that the collaborative and repetitive learning strategies were beneficial and improved students' performance in the Computer in Education course equally. This, therefore, gives educators the confidence to use any of the strategies in supporting students' performance based on learning goals and contexts.

5. CONCLUSION

This study focused on examining the effect of the repetitive-collaborative learning strategy on students' performance and retention in the Computer in Education course, while comparing the differences in the effects of repetitive-collaborative, collaborative, and repetitive strategies on the students' performance using paired sample t-test and ANCOVA, respectively. The study found that the repetitive-collaborative learning strategy significantly improved students' performance and retention in the Computer in Education course. The ANCOVA results showed negligible and insignificant differences in the effects of the repetitive-collaborative and collaborative learning strategies; collaborative and repetitive learning strategies; and repetitive-collaborative, collaborative, and repetitive learning strategies on students' performance in the Computer in Education course, respectively. However, the effects of the repetitive-collaborative and repetitive learning strategies on students' performance in the Computer in Education course differ significantly and moderately, favoring students in the repetitive learning group. These findings signify that while repetitive-collaborative, collaborative, and repetitive learning strategies support and improve students' learning outcomes, the repetitive-collaborative strategy is outstanding in its ability to promote long-term retention. This study, therefore, emphasizes the pedagogical significance of combining repetition with collaboration in a repetitive-collaborative learning approach to promote comprehensive learning and knowledge retention in the Computer in Education course and other courses.

7. RECOMMENDATIONS

Based on the conclusion, the following recommendations were made:

1. Curriculum planners should integrate a repetitive-collaborative learning approach into course planning to ensure that students do not achieve just short-term success but a deeper understanding and long-term knowledge retention.
2. Educators should use repeated practice alongside collaborative elements during instruction to promote knowledge consolidation and future application among students.
3. Educators can choose between repetitive and collaborative learning strategies for immediate improvement in students' performance based on the learning goal and context.
4. Future research should involve other courses, disciplines, and institutions using larger sample sizes for easy generalization.
5. Future studies should compare the different effects of repetitive-collaborative, collaborative, and repetitive learning strategies on knowledge retention to also ascertain the long-term benefits of collaborative and repetitive learning strategies.

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