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Discovery Puzzle-Based Learning and Students' Retention of Sentence Structures and Technical Writing Skills Among Senior Secondary School Students in Port Harcourt City LGA

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Abstract

This study examined the effect of Discovery Puzzle-Based Learning on Senior Secondary School students' retention of sentence structures and technical writing skills in Rivers State, Nigeria. Two research questions and two null hypotheses guided the study. A pretest-posttest-delayed posttest control-group quasi-experimental design was adopted. The population comprised 30,528 SS II students, while a sample of 98 students was selected from two public secondary schools in Port Harcourt City Local Government Area using a multistage sampling procedure. The experimental group comprised 47 students taught using Discovery Puzzle-Based Learning, while 51 students in the control group were taught using the conventional teaching method. Data were collected using the Sentence Structure Assessment Test (SSAT) and Technical Writing Assessment Test (TWAT), each comprising 25 multiple-choice items. The instruments were validated by experts in language education, linguistics, and measurement and evaluation. Reliability coefficients of 0.87 and 0.79 were obtained for the SSAT and TWAT, respectively, using the Kuder-Richardson 20. Data were analysed using the mean and standard deviation to answer the research questions and analysis of covariance to test the hypotheses at the 0.05 level of significance. The findings showed that students taught using Discovery Puzzle-Based Learning recorded a higher mean gain in sentence structure retention (17.00) than those taught using the conventional method (9.02). Similarly, the Discovery Puzzle-Based Learning group recorded a higher mean gain in technical writing retention (20.91) than the conventional group (8.02). The ANCOVA results revealed a significant effect of instructional method on sentence structure retention, $F(1, 95) = 50.955$, $p < .001$, partial $\eta^2 = .349$, and technical writing retention, $F(1, 95) = 77.229$, $p < .001$, partial $\eta^2 = .448$. Both effect sizes were large, indicating substantial effects of the instructional method. The study concluded that Discovery Puzzle-Based Learning is more effective than the conventional teaching method in promoting students' retention of sentence structures and technical writing skills. It was recommended that English Language teachers incorporate puzzle-based activities involving sentence reconstruction, error identification, language manipulation, and authentic technical writing tasks into classroom instruction.

Keywords: Discovery Puzzle-Based Learning, Sentence Structure, Technical Writing, Retention, English Language

Introduction

Knowing how to construct a sentence correctly is not the same as being able to reproduce that knowledge accurately after instruction has ended. A student may identify the subject and predicate during a lesson, arrange words into a meaningful sentence, or reproduce a model provided by the teacher, yet struggle to apply the same knowledge independently weeks later. This difficulty becomes more apparent when students are required to produce technical

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writing, where accuracy, logical organisation, clarity, appropriate vocabulary, and adherence to established conventions matter. For senior secondary school students, therefore, the concern is not merely whether English language concepts are taught, but whether students retain the knowledge and skills sufficiently to apply them in subsequent academic and practical writing situations.

Sentence structure is a fundamental component of effective written communication because it provides the grammatical framework through which ideas are organised and conveyed. Weaknesses in sentence construction can affect the clarity, coherence, and accuracy of students' written expression. Adebayo et al. (2024) examined classroom activities and writing proficiency among 100 senior secondary school students across five schools in Akoko, Ondo State, Nigeria, using a descriptive research design, an essay-writing task, and error analysis. The study found persistent difficulties in sentence structure, cohesion, grammar, and vocabulary, indicating weaknesses in students' written expression. In a different context, Medina et al. (2025) investigated scientific writing skills and research learning among 109 secondary school students. Using a mixed-methods design, the study employed a descriptive-correlational questionnaire, classroom observations, a knowledge test, thematic analysis, and a rubric-based review of students' written products. This underscores the importance of retaining sentence structures at the senior secondary level, where students are expected to move beyond recognising grammatical rules to independently and accurately using those structures.

The difficulty becomes more significant when sentence structures are taught predominantly as isolated rules to be memorised and reproduced. Grammar instruction that relies heavily on explanation and repetition enables students to perform during immediate classroom exercises without necessarily providing sufficient opportunities to identify relationships among grammatical forms, test alternatives, receive feedback and reconstruct knowledge. A number of researchers have attempted to identify instructional approaches that make teaching and learning grammar interesting in a classroom setting. Awing and Nasri (2023), in a systematic review of game-based learning in grammar education, reported that game-based approaches were associated with improvements in achievement, motivation and learner involvement. In another study, Xie and Huang (2022) investigated digital game-based learning among 98 secondary school students from two first-grade classes in a public high school in Guangzhou, China. Using a quasi-experimental design with 49 students in the experimental group and 49 in the control group, the study found that digital game-based learning significantly improved students' English grammar performance. While Xie's study demonstrated the value of an interactive learning approach, its outcome focused on immediate grammar performance rather than delayed retention of sentence structures. These findings show that teaching of grammar can benefit from learning environments in which students actively manipulate language forms rather than receive explanations about them.

The relevance of involving students in the learning process becomes clearer when retention is considered. Retention requires students to reconstruct previously learned knowledge and use it beyond the immediate teaching episode. Game-based grammar activities create opportunities for students to meet and gain control of how words are arranged and used, thereby making learning more participatory. Awing and Nasri (2023) assert that knowledge retention is one of the intended functions of game-based learning, while also noting that the long-term effects of such approaches require further investigation. Ramadhanti and Pratiwi (2025) also reported improved grammar performance and active participation among Grade 11 students who engaged in scrambled-game activities, but the longer-term effects on grammar mastery remained unresolved. Thus, there is a distinction between demonstrating immediate improvement and establishing that students can retain sentence structures after instruction.

Technical writing presents a related but broader challenge. Unlike ordinary sentence exercises, technical writing requires students to communicate information in a precise, organised and purposeful manner. It involves tasks such as reports, formal descriptions, instructions, explanations, summaries and other forms of functional writing in which language accuracy must serve a particular communicative purpose. Difficulties in sentence construction can consequently extend into technical writing because poorly controlled sentence patterns interfere with clarity, precision and logical sequencing. Medina et al. (2025) found substantial difficulties among secondary students in clarity, coherence, formal structure and academic language, while writing competence was strongly related to learning in science and technology research. This shows that strengthening students' control of language structures is part of developing the written communication required for academic work.

The instructional approach used to develop such skills provides systematic explanation, direct modelling and gives students opportunities to investigate language problems, make decisions and learn through the consequences of those decisions. Discovery-oriented instruction is one of those instructional approaches that places learners in situations where they examine information, identify relationships, generate possible solutions and construct understanding with teacher guidance. Umami et al. (2025) reported consistent positive associations with conceptual understanding, critical thinking, motivation and academic performance, while also identifying time, learner readiness and instructional resources as factors that can influence implementation. For English language learning, this orientation can be adapted into activities in which students discover how sentence elements relate to one another, identify grammatical patterns, reconstruct incorrectly arranged sentences and apply the discovered rules to new writing situations.

Puzzle-based learning offers a practical way of translating these principles into classroom activities. A puzzle requires learners to work with parts of a problem and determine how those parts fit together. In teaching language, this involves rearranging words to form grammatically acceptable sentences, matching sentence components, identifying errors, completing patterns, reconstructing technical statements or selecting appropriate expressions for a given communicative purpose. Such activities shift some of the cognitive responsibility from the teacher to the learner. Rather than receiving the correct sentence structure immediately, students have to examine alternatives, make judgments, test their choices and revise them. Ramadhanti and Pratiwi (2025) reported gains in grammar mastery alongside improvements in problem-solving and active participation. In a related study, Awing and Nasri (2023) indicate that game-based activities provide useful conditions for grammar learning by combining repeated practice with engagement and interaction.

The same logic extends to writing skills, where more than memorising rules is required because students must retrieve linguistic knowledge and apply it while generating and organising meaning. Mohamad et al. (2024) in a systematic review showed that gamified writing activities generally increased learners' motivation and engagement, while Pentikäinen and Kallionpää (2024) reported that game-based approaches support writing processes, agency, fluency and collaborative creation. Yet these studies also reveal an unresolved issue. Improvements in participation or immediate writing performance do not automatically establish durable learning. Pentikäinen and Kallionpää (2024) specifically identified limited attention to how learning is transferred beyond the immediate game context. This limitation is relevant to technical writing, where students must transfer knowledge of sentence structures and language conventions from classroom activities into independent writing tasks.

English language serves as a major medium of formal communication and is central to students' academic progression. At the senior secondary level, especially in the Nigerian context, students are expected to demonstrate increasing control of grammar and different forms of written expression rather than merely recall definitions of grammatical concepts. However, writing instruction is constrained by factors such as examination pressure, uneven learner proficiency, large classes and limited instructional resources. Kazaure (2025) showed that writing difficulties are associated with limited vocabulary, inadequate teaching approaches and low confidence, while reporting improvement following structured writing processes, peer feedback and the use of mentor texts. Gowon and Yashim (2022), in a study, also noted that instructional intervention could influence these writing outcomes. They demonstrate that sentence-level knowledge can be addressed as part of broader writing development rather than being treated as an isolated grammar exercise. Although the context differs from Rivers State and the treatment differs from the present study, the findings reinforce the need to examine instructional approaches that give learners greater responsibility and repeated opportunities to apply language knowledge.

Within Rivers State, the question is particularly relevant because senior secondary students are required to develop English language competencies that support success across school subjects and later academic or occupational activities. Technical writing is especially important in this regard because students increasingly encounter tasks requiring concise, accurate and organised communication of information. If sentence structures are not adequately retained, students may understand grammatical explanations during instruction but struggle to reproduce correct forms when completing later writing tasks. The problem, therefore, is not simply a question of whether students can learn sentence structures and technical writing skills, but whether the instructional process helps them retain and transfer these skills to subsequent tasks.

Despite the growing interest in discovery learning and game-based language instruction, an important gap remains. Existing studies have largely examined immediate academic performance, grammar mastery, motivation or engagement, while comparatively less attention has been given to retention of sentence structures after instruction. The literature on game-based grammar learning also calls for more longitudinal investigation of sustained learning outcomes (Awing & Nasri, 2023; Ramadhanti & Pratiwi, 2025). Likewise, research on gamified writing has established potential benefits for writing engagement and learning processes but leaves questions about transfer and durable application of acquired skills (Mohamad et al., 2024; Pentikäinen & Kallionpää, 2024). More specifically, there appears to be limited evidence on the puzzle-based discovery approach improving retention of sentence structures and technical writing skills among senior secondary school students.

Discovery Puzzle-Based Learning provides a potentially useful response to this gap. Discovery Puzzle-Based Learning combines the cognitive demands of discovery and the structured challenge of puzzles. Students are not expected simply to memorise sentence rules or imitate teacher-provided examples. They are placed in situations where they examine language components, identify patterns, reconstruct sentences, resolve grammatical problems and apply their discoveries to technical writing tasks. The teacher remains responsible for guidance, clarification and feedback, but students participate actively in constructing and retrieving the knowledge they are expected to retain. Whether this combination actually produces superior retention compared with conventional teaching, however, is an empirical question rather than an assumption. It is against this background that the present study investigates the effect of Discovery Puzzle-Based Learning on students' retention of sentence structures and technical writing skills among Senior Secondary School students in Rivers State, Nigeria.

Bruner's Discovery Learning Theory

Bruner's Discovery Learning Theory provides the theoretical foundation for this study. Jerome Seymour Bruner (1961) is the principal proponent of Discovery Learning Theory. Bruner developed discovery learning within his broader cognitive-constructivist perspective, which views learners as active participants in the construction of knowledge. In *The Act of Discovery*, Bruner (1961) argued that learning is strengthened when learners are enabled to discover relationships, principles, and solutions for themselves rather than merely receiving already organised information from the teacher. Ozdem-Yilmaz and Bilican (2025) identified Bruner's work as a foundational contribution to discovery learning and cognitive constructivism.

The central proposition of the theory is that learners construct knowledge through active engagement with problems, information, and learning experiences. Discovery does not mean that students learn without teacher support. Rather, the teacher creates appropriate learning situations, presents problems or materials, provides guidance where necessary, and allows learners to examine information, identify relationships, test possibilities, and arrive at meaningful conclusions. Gorbunova et al. (2023) distinguish discovery from completely unguided learning, emphasising active inference and the learner's role in obtaining knowledge through their own intellectual activity.

Discovery Puzzle-Based Learning reflects the central principle of the theory because students are required to engage actively with language problems rather than depend solely on direct teacher explanation. Through the puzzle activities, students work with sentence and technical-writing elements, examine possible relationships, identify appropriate constructions, reconstruct language expressions, and arrive at answers through the learning activities. The theory is particularly relevant to retention of sentence structures because students repeatedly engage with the structural features of sentences while solving the learning tasks. Rather than simply memorising rules presented by the teacher, students encounter, manipulate, and apply sentence structures during the discovery process. The same theoretical relationship applies to technical writing skills, where students engage with expressions, organisation of information, appropriate constructions, and meaningful technical statements through the activities provided in the intervention. Andung et al. (2024), who applied discovery-based approaches to writing, similarly report improvements in students' writing performance, supporting the relevance of active discovery to language learning.

The ability to identify the rules and principles of how words are constructed, arranged, and used correctly in appropriate sentences and to communicate ideas effectively through technical writing is an important component of English Language learning at the senior secondary school level. However, students' difficulties with sentence construction and written expression remain a concern in secondary school education. Such difficulties may affect

students' ability to communicate ideas clearly and apply grammatical knowledge appropriately in different writing situations.

The problem demonstrates that understanding of sentence structures during instruction may not necessarily be retained or appropriately applied after the instructional period. Similarly, difficulties in organising, expressing and presenting information may persist in technical writing tasks. These concerns raise questions about the extent to which students can develop and retain the required knowledge and skills. Although different instructional approaches are used in teaching English Language, there is limited empirical information on the retention of sentence structures and technical writing skills among senior secondary school students in Rivers State. In particular, it is not sufficiently clear whether the use of Discovery Puzzle-Based Learning would produce any measurable difference in students' retention of these aspects of English Language learning. This uncertainty constitutes the problem that necessitates the present study.

The aim of this study is to examine the effect of Discovery Puzzle-Based Learning on Senior Secondary School students' retention of sentence structures and technical writing skills in Rivers State, Nigeria.

The study specifically sought to:

1. Determine the difference in the retention of sentence structures among Senior Secondary School students taught using Discovery Puzzle-Based Learning and those taught using the conventional teaching method.
2. Determine the difference in the retention of technical writing skills among Senior Secondary School students taught using Discovery Puzzle-Based Learning and those taught using the conventional teaching method.

The following research questions will guide the study:

1. What is the difference in the mean retention scores in sentence structures of Senior Secondary School students taught using Discovery Puzzle-Based Learning and those taught using the conventional teaching method?
2. What is the difference in the mean retention scores in technical writing skills of Senior Secondary School students taught using Discovery Puzzle-Based Learning and those taught using the conventional teaching method?

The following null hypotheses will be tested at the 0.05 level of significance:

1. There is no significant difference in the mean retention scores in sentence structures of Senior Secondary School students taught using Discovery Puzzle-Based Learning and those taught using the conventional teaching method.
2. There is no significant difference in the mean retention scores in technical writing skills of Senior Secondary School students taught using Discovery Puzzle-Based Learning and those taught using the conventional teaching method.

Methodology

This study adopted a pre-/post-test, delayed post-test control group quasi-experimental research design. The design was considered fit for this study because the study examined the effect of Discovery Puzzle-Based Learning on students' retention of sentence structures and technical writing skills among Senior Secondary School students. The population comprised 30,528 SS II students. The study was carried out in Port Harcourt City Local Government Area of Rivers State. A multi-stage sampling technique was used in selecting the participants for the study. A purposive sampling technique was used to select public secondary schools in the state based on the availability of digital resources and the willingness of the participants. Out of the public schools that were selected, two were randomly selected using a simple balloting system where all the names of the schools were put in a container, and two schools were randomly selected by the simple random sampling technique. The study made use of the intact classes in those schools. The study used intact classes in the selected schools. One class was assigned to the experimental group, where the students were taught sentence structure and technical writing using Discovery Puzzle-Based Learning and one class to the control group, where the students were taught using the conventional method. All these were done using a simple random technique. The control group comprised 51 students while the experimental group comprised 47 students, giving a total sample of 98 students.

The sample size was determined by the availability of suitable intact SS II classes in the selected schools and the need to preserve the natural classroom arrangement required for the quasi-experimental design. Thus, the 98 participants

constituted the accessible sample for the study rather than a sample derived through a formal statistical power analysis. This constitutes a limitation of the study, as a formal power analysis could have provided an a priori estimate of the sample required to detect the anticipated treatment effect. Two instruments were used to obtain data from the students, namely the Sentence Structure Assessment Test (SSAT) and the Technical Writing Assessment Test (TWAT). Each instrument contained 25 multiple-choice questions with options A–D. Each correctly answered question carried 2 marks, giving a maximum obtainable score of 50 marks for each instrument. The Sentence Structure Assessment Test (SSAT) was designed to assess students' knowledge and understanding of sentence structures, while the Technical Writing Assessment Test (TWAT) assessed students' competence in technical writing. Both instruments were subjected to validation by experts in Language Education, Linguistics, and Measurement and Evaluation to establish their appropriateness, content coverage, clarity, and alignment with the objectives of the study. The reliability of the instruments was determined using Kuder-Richardson 20, and reliabilities of 0.87 and 0.79 were obtained, respectively.

After obtaining all necessary permissions from the participating schools, the teachers at the school used as the experimental group were trained in Discovery Puzzle-Based Learning for teaching sentence structure and technical writing, and were assigned to the experimental group. Over a one-week period, the teachers received instruction on the steps and applications of Discovery Puzzle-Based Learning, while the teachers at the school used as the control group did not receive any training but were instructed to use conventional methods to teach the students. Microteaching sessions were used to assess the teachers' use of the treatment. All the teachers in the schools served as the researcher's assistants. The following week, the Sentence Structure Assessment Test (SSAT) and Technical Writing Assessment Test (TWAT) were administered as a pre-test to all participating students. Treatment then commenced. Sentence structure and technical writing were taught over two weeks. A reshuffled version of the Sentence Structure Assessment Test (SSAT) and Technical Writing Assessment Test (TWAT) was used as a post-test after two weeks to assess retention across the groups. Data collected were analysed using the mean and standard deviation to answer the research question, and analysis of covariance was used to test the hypotheses at the 0.05 level of significance. It is acknowledged that the use of different teachers and the additional training received by the experimental-group teachers may introduce a potential teacher or novelty effect, which could not be completely separated from the effect of the instructional method.

Results

Table 1: Differences in the retention mean score of students in Sentence structure based on method

Method		Posttest	Retention	Mean gain
Discovery Puzzle-Based Learning	Mean	10.94	27.94	17.00
	N	47	47	47
	Std. Deviation	2.29	5.28	5.93
Conventional Method	Mean	10.67	19.69	9.02
	N	51	51	51
	Std. Deviation	2.08	6.04	6.34

Table 1 shows that students taught using Discovery Puzzle-Based Learning had a post-test mean score of 10.94 with a standard deviation of 2.29 and a retention mean score of 27.94 with standard deviation of 5.28, which gave a mean gain of 17.00 while students taught using the Conventional method obtained a post-test mean score of 10.67 with standard deviation of 2.08 and a retention mean score of 19.69 with standard deviation of 6.04, resulting to the mean gain of 9.02. This indicates that students exposed to Discovery Puzzle-Based Learning demonstrated greater improvement in their retention of sentence structure than those taught using the Conventional method.

Table 2: Differences in the retention mean score of students in technical writing skills based on method

Method		Post Test	Retention	Mean gain
Discovery Puzzle-Based Learning	Mean	11.57	32.49	20.91
	N	47	47	47
	Std. Deviation	2.03	4.29	5.07
Conventional Method	Mean	11.73	19.75	8.02
	N	51	51	51
	Std. Deviation	2.43	9.85	11.28

Table 2 shows that students taught using Discovery Puzzle-Based Learning had a post-test mean score of 11.57 with a standard deviation of 2.03 and a retention mean score of 32.49 with a standard deviation of 4.29, resulting in a mean gain of 20.91. Students taught using the Conventional Method recorded a post-test mean score of 11.73 with a standard deviation of 2.43 and a retention mean score of 19.75 with a standard deviation of 9.85, with a mean gain of 8.02. This shows that students exposed to Discovery Puzzle-Based Learning demonstrated substantially greater retention of technical writing skills than those taught using the Conventional Method.

Table 3: ANCOVA Analysis of the difference in the mean retention scores in sentence structures based on Method

Tests of Between-Subjects Effects

Dependent Variable: retention

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	1666.880 ^a	2	833.440	25.495	0.000	0.349	
Intercept	2276.194	1	2276.194	69.628	0.000	0.423	
Posttest	2.169	1	2.169	0.066	0.797	0.001	
Method	1665.744	1	1665.744	50.955	0.000	0.349	
Error	3105.620	95	32.691				
Total	59553.000	98					
Corrected Total	4772.500	97					

a. R Squared = 0.349 (Adjusted R Squared = 0.336)

Table 3 shows $F(1, 95) = 50.955$, $p < .001$, partial $\eta^2 = .349$. This shows that there was a significant difference in the retention scores of students taught using Discovery Puzzle-Based Learning and those taught using the Conventional Method. The partial eta squared value of .349 indicates a large effect size, suggesting that the method of instruction had a substantial effect on students' retention of sentence structure. Therefore, the null hypothesis is rejected.

Table 4: ANCOVA Analysis of the difference in the mean retention scores in technical writing skills based on Method

Tests of Between-Subjects Effects

Dependent Variable: Posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	4947.804 ^a	2	2473.902	49.812	0.000	0.512	
Intercept	6257.316	1	6257.316	125.990	0.000	0.570	
Posttest	975.235	1	975.235	19.636	0.000	0.171	
Method	3835.574	1	3835.574	77.229	0.000	0.448	
Error	4718.196	95	49.665				
Total	75188.000	98					
Corrected Total	9666.000	97					

a. R Squared = .512 (Adjusted R Squared = .502)

Table 4 shows $F(1, 95) = 77.229$, $p < .001$, partial $\eta^2 = .448$. This shows that there was a significant difference in the retention scores of students taught using Discovery Puzzle-Based Learning and those taught using the Conventional

Method. The partial eta squared value of .448 indicates a large effect size, suggesting that the method of instruction had a substantial effect on students' retention of technical writing skills. Therefore, the null hypothesis is rejected.

Discussion

The findings in Table 1 show that students who were taught using the Discovery Puzzle-Based method performed better than students who were taught using the lecture method. This implies that the puzzle-based approach provided learners with opportunities to actively engage with sentence components rather than merely receiving explanations from the teacher. Through activities such as rearranging words, identifying errors, reconstructing sentences and testing different sentence patterns, students were required to think about how grammatical elements relate to one another. The analysis of covariance in Table 3 confirmed that the difference between the application of the Discovery Puzzle-Based method and the conventional method was significant.

This finding is consistent with Awing and Nasri (2023), who reported that game-based learning can improve learners' engagement and achievement in grammar instruction. It also agrees with Xie and Huang (2022) and Ramadhanti and Pratiwi (2025), who found that game-oriented activities improved students' grammar learning. In the context of the present study, the active manipulation of sentence components helped students develop a stronger understanding and recall of sentence structures. Rather than memorising rules in isolation, students encountered the rules while solving meaningful language problems. This active involvement provides a plausible explanation for the higher retention observed among the Discovery Puzzle-Based Learning group.

The teachers who implemented Discovery Puzzle-Based Learning received one week of specific training, including microteaching, whereas other teachers delivered the Conventional Method without equivalent training in the experimental strategy. Therefore, the observed difference is attributed to the instructional method under the conditions of the study, with the teachers' preparation, familiarity with the intervention, and exposure to the instructional approach forming part of the implementation conditions. Nevertheless, the findings demonstrate that Discovery Puzzle-Based Learning resulted in better retention of sentence structures under the conditions of the present study.

Table 2 showed that students exposed to Discovery Puzzle-Based Learning retained technical writing skills better than students taught using the Conventional Method. The analysis of covariance presented in Table 4 confirmed that the difference between the two groups was statistically significant. The finding therefore indicates that students who participated in the Discovery Puzzle-Based Learning demonstrated significantly better retention of technical writing skills than those taught using the Conventional Method. This result implies that the puzzle-based learning activities were associated with better consolidation of the technical writing skills addressed during the intervention, particularly skills involving the selection of appropriate expressions, logical arrangement of information, identification of inappropriate constructions, and reconstruction of meaningful technical statements.

The finding agrees with Mohamad et al. (2024), who found that gamified writing activities promote students' engagement in writing. It also agrees with Pentikäinen and Kallionpää (2024), who reported that game-based approaches support writing processes and learner agency. The finding further relates to Medina et al. (2025), who identified difficulties among students in areas such as clarity, coherence, formal structure, and academic language. In relation to the present study, the significant difference in retention indicates that students exposed to Discovery Puzzle-Based Learning performed better in retaining the technical writing skills taught during the intervention than students exposed to the Conventional Method. The repeated engagement with technical writing tasks through the puzzle activities provided opportunities for students to practise and revisit the skills addressed in the lessons.

The finding also demonstrates that the advantage observed in the experimental group extended beyond immediate exposure to the instructional content, as the outcome assessed was retention of technical writing skills. However, the significant ANCOVA result between the experimental and control conditions was delivered by different teachers, and only the experimental teachers received specific training in the intervention. Consequently, differences associated with teacher preparation and delivery cannot be completely separated from the effect of Discovery Puzzle-Based Learning. In addition, the newness of the puzzle-based activities influenced students' responses to the intervention. Therefore, while the result showed that students exposed to Discovery Puzzle-Based Learning achieved significantly better retention of technical writing skills than those taught using the Conventional Method, teacher-related and novelty-related factors remain possible explanations for part of the observed difference.

Conclusion

Based on the findings of the study, students taught using Discovery Puzzle-Based Learning demonstrated significantly higher retention of sentence structures and technical writing skills than students taught using the Conventional Method. The study therefore concludes that Discovery Puzzle-Based Learning was more effective than the Conventional Method in improving students' retention of sentence structures and technical writing skills. The findings establish that students exposed to Discovery Puzzle-Based Learning achieved better retention than those exposed to the Conventional Method. The approach therefore provides an effective learner-centred method for teaching sentence structures and technical writing skills among senior secondary school students.

However, the conclusion is made within the limitations of the study. The experimental-group teachers received specific training in Discovery Puzzle-Based Learning, whereas different teachers delivered the Conventional Method without equivalent training. Therefore, the contribution of teacher preparation and novelty effects cannot be completely separated from the effect of the instructional method. Despite this limitation, the findings of the study establish that students exposed to Discovery Puzzle-Based Learning had significantly higher retention of sentence structures and technical writing skills than those taught using the Conventional Method.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. English Language teachers should incorporate Discovery Puzzle-Based Learning into the teaching of sentence structure. Teachers can use activities involving sentence reconstruction, word arrangement, error identification and completion of sentence patterns to encourage students to actively practise grammatical structures.
2. Discovery Puzzle-Based Learning should be used in teaching technical writing skills. Teachers should design puzzles around authentic technical writing tasks, such as arranging technical statements, selecting appropriate expressions and identifying problems in clarity, organisation and sentence construction.
3. Schools should provide teachers with opportunities to develop competence in using puzzle-based instructional activities. Workshops and professional development programmes can focus on how to design puzzles that are aligned with specific English language learning objectives rather than using puzzles merely for entertainment.
4. Teachers should combine puzzle activities with opportunities for independent writing. After completing puzzle-based tasks, students should be encouraged to apply the structures and writing conventions learned in their own sentences and technical writing exercises. This can help bridge the gap between solving instructional puzzles and using the skills in authentic writing.
5. Curriculum planners and English Language educators should encourage learner-centred approaches that promote active participation. Discovery Puzzle-Based Learning can be considered as one of the instructional strategies for strengthening students' engagement and retention in areas of English language learning that require continuous practice and application.

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