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Efficacy of an Infographics-Based Instructional Strategy and Guided Hypnotherapy on the Academic Performance and Retention of Secondary School Students Identified with Dyslexia in Biology in Sokoto State, Nigeria

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ABSTRACT

This study examined the efficacy of an infographics-based instructional strategy and guided hypnotherapy on the academic performance and retention of secondary school students identified with dyslexia in Biology in Sokoto State, Nigeria. A quasi-experimental pretest posttest, and delayed-retention design was adopted. The participants comprised 115 SS II students identified with dyslexia from three secondary schools in Sokoto metropolis. The students were assigned to an infographics group (n = 40), guided hypnotherapy group (n = 38), and conventional instruction group (n = 37), with one school representing each treatment condition. A Biology Reading Test was used to identify eligible students, while a 25-item Biology Performance Test (BPT) based on Ecology was used to assess academic performance and retention. The interventions were implemented for four weeks, followed by a delayed retention test two weeks after the posttest. The instrument was validated by experts and exhibited reliability index of 0.87 using slit half method. Data were analyzed using means, standard deviations, analysis of covariance, and independent-samples *t*-tests at the .05 significance level. The findings indicated that students exposed to both the infographics-based instructional strategy and guided hypnotherapy achieved significantly higher academic performance than those taught using the conventional approach. However, no significant difference was found between the two intervention groups. Gender differences within either intervention group were also not significant. Both intervention groups demonstrated significant retention of Biology knowledge, although their retention outcomes did not differ significantly. The study concludes that infographics-based instruction and guided hypnotherapy may provide useful complementary approaches for supporting Biology learning and retention among students identified with dyslexia.

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1. Introduction

Dyslexia is a specific learning disability characterized by persistent difficulties in word reading and/or spelling that may affect accuracy, speed, or both (International Dyslexia Association, 2025). Although dyslexia is primarily associated with difficulties in literacy-related processes, its consequences may extend into subjects in which students are required to engage extensively with written explanations, specialized terminology, diagrams, and other forms of academic representation. Consequently, supporting students with dyslexia requires attention not only to literacy development but also to the ways in which subject matter is presented and learned. Biology is an important component of secondary school science education because it provides students with knowledge of living organisms, biological processes, health, environment, and the relationships between living systems. At the secondary school level, however, Biology learning involves the interpretation of scientific terminology, descriptions, diagrams, processes, classifications, and relationships among concepts. These demands may present particular challenges for students who experience persistent difficulties with reading and spelling. The International Dyslexia Association (2025) notes that reading difficulties associated with dyslexia may have secondary effects on the acquisition of knowledge and academic achievement. This makes the provision of appropriate instructional support relevant to the participation and achievement of students with dyslexia in content-rich subjects such as Biology. The challenge is not necessarily that students with dyslexia are incapable of learning Biology, rather, the manner in which information is represented and communicated may influence the extent to which they can access, process, and retain subject content. Research on learning among students with learning disabilities indicates that appropriately designed instructional interventions can improve learning outcomes, particularly when instruction incorporates direct teaching and strategies that support comprehension (Swanson et al., 1999). This suggests the importance of exploring instructional approaches that can make complex subject information more accessible while maintaining the conceptual demands of the discipline.

One approach that has received increasing attention is the use of infographics. Infographics combine textual information with visual representations such as illustrations, diagrams, symbols, charts, and other graphic elements to communicate information. In science education, infographics have been examined as cognitive tools that can support learning through multiple representations of scientific information (Gebre, 2018). Their use is particularly relevant to Biology because many biological concepts involve processes, structures, relationships, sequences, and systems that can be represented visually. A meta-analysis of empirical studies also reported a positive overall effect of infographic use on academic achievement, although the effectiveness of infographics can vary according to factors such as implementation period and subject area (Elaldı & Çifçi, 2021). Similarly, Ismaeel and Al Mulhim (2021) found that both static and interactive infographics could influence students' academic achievement, highlighting the potential of visual representation as an instructional resource. The potential value of infographics for students with dyslexia according to Tırıl and Okumuş (2022) is particularly noteworthy because the approach can provide information through more than continuous written text. Visual representations may help learners establish relationships among concepts and interpret information through complementary modes of

representation. However, evidence concerning the use of infographics specifically with secondary-school students identified with dyslexia, particularly in Biology classrooms in Nigeria remains limited. It is therefore necessary to examine empirically whether an infographics-based instructional strategy can improve the academic performance and retention of Biology content among these learners rather than assuming that the general benefits reported in other studies will necessarily apply to them.

Another approach examined in the present study is guided hypnotherapy. Hypnosis has been described in the research literature as involving focused attention and responsiveness to suggestion, and educational applications have explored whether hypnotic procedures can influence aspects of learning, attention, and academic performance. Wark (2011), reported evidence that hypnotic procedures had been investigated in relation to learning, reading comprehension, and academic performance. Earlier experimental research also examined hypnotic training programmes in relation to students' academic performance (De Vos & Louw, 2006). However, the evidence is not uniformly supportive. For example, an experimental study of learning under hypnosis reported poorer test performance in the hypnosis condition and linked the finding to changes in attention (Jacobson et al., 2013). Similarly, Wang et al., (2022) also examined hypnosis in relation to test anxiety and attentional processes among students. These mixed findings indicate that the educational value of hypnosis should be treated as an empirical question rather than as an established method for improving academic performance.

In this study, guided hypnotherapy was structured around relaxation, concentration, and focused attention during the four-week intervention. The intention was not to treat dyslexia itself but to examine whether this structured intervention could support students' engagement with Biology learning and consequently influence their academic performance and subsequent retention of learned material. This distinction is important because dyslexia is a specific learning disability, whereas the intervention examined in this study is directed towards the learning experience and outcomes of students who have been identified with dyslexia.

The need for effective instructional support is further underscored by the continuing challenge of Biology achievement at the secondary-school level. The West African Examinations Council's report on the 2023 West African Senior School Certificate Examination in Biology indicated a raw mean score of 31 among 1,068,564 candidates, compared with a mean of 37 in 2022 (WAEC, 2023). Although these national examination results do not specifically represent students with dyslexia or students in Sokoto State, they provide broader evidence of the continuing need to strengthen Biology teaching and learning. For students who experience additional literacy-related difficulties, the question of how Biology content is presented and learned becomes particularly important. It is against this background, the present study investigates the efficacy of an infographics-based instructional strategy and guided hypnotherapy in improving academic performance and retention among secondary-school students with dyslexia learning Biology in Sokoto State, Nigeria.

Objectives of the Study

The objective of this study is to examine the efficacy of an infographics-based instructional strategy and guided hypnotherapy in improving the academic performance and retention of secondary-school students identified with dyslexia in Biology in Sokoto State, Nigeria.

Specifically, the study seeks to:

1. Determine the difference in academic performance between students identified with dyslexia taught Biology using an infographics-based instructional strategy and those taught using the conventional instructional approach.
2. Determine the difference in academic performance between students identified with dyslexia taught Biology using guided hypnotherapy and those taught using the conventional instructional approach.
3. Determine the difference in academic performance between students identified with dyslexia taught Biology using an infographics-based instructional strategy and those taught using guided hypnotherapy.
4. Determine the difference in academic performance between male and female students identified with dyslexia taught Biology using an infographics-based instructional strategy.
5. Determine the difference in academic performance between male and female students identified with dyslexia taught Biology using guided hypnotherapy.
6. Determine the difference in retention of Biology knowledge between students identified with dyslexia taught using an infographics-based instructional strategy and those taught using guided hypnotherapy.

Research Questions

The following research questions guided the study:

1. What difference exists in the academic performance of students identified with dyslexia who are taught Biology using an infographics-based instructional strategy and those taught using the conventional approach?
2. What difference exists in the academic performance of students identified with dyslexia who are taught Biology using guided hypnotherapy and those taught using the conventional approach?
3. What difference exists in the academic performance of students identified with dyslexia who are taught Biology using an infographics-based instructional strategy and those taught using guided hypnotherapy?
4. What difference exists between the academic performance of male and female students identified with dyslexia who are taught Biology using an infographics-based instructional strategy?
5. What difference exists between the academic performance of male and female students identified with dyslexia who are taught Biology using guided hypnotherapy?
6. What difference exists in the retention of Biology knowledge between students identified with dyslexia who are taught using an infographics-based instructional strategy and those taught using guided hypnotherapy?

Null Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

H_{01}: There is no significant difference in the academic performance of students identified with dyslexia who are taught Biology using an infographics-based instructional strategy and those taught using the conventional approach.

H_{02}: There is no significant difference in the academic performance of students identified with dyslexia who are taught Biology using guided hypnotherapy and those taught using the conventional approach.

H_{03}: There is no significant difference in the academic performance of students identified with dyslexia who are taught Biology using an infographics-based instructional strategy and those taught using guided hypnotherapy.

H_{04}: There is no significant difference between the academic performance of male and female students identified with dyslexia who are taught Biology using an infographics-based instructional strategy.

H_{05}: There is no significant difference between the academic performance of male and female students identified with dyslexia who are taught Biology using guided hypnotherapy.

H_{06}: There is no significant difference in the retention of Biology knowledge between students identified with dyslexia who are taught using an infographics-based instructional strategy and those taught using guided hypnotherapy.

2. Literature Review

Dyslexia and Learning

Dyslexia is currently recognized as a specific learning disability characterized primarily by persistent difficulties in word reading and/or spelling involving accuracy, speed, or both. The International Dyslexia Association's revised 2025 definition further emphasizes that the severity of these difficulties varies among individuals and that they may persist despite instruction that is effective for peers. The definition also acknowledges secondary consequences, including difficulties with reading comprehension and reduced opportunities to develop language, knowledge and written expression, which may ultimately affect academic achievement. This contemporary understanding is important for educational research because it shifts attention from viewing dyslexia simply as a reading problem to considering how persistent literacy difficulties may influence access to broader academic learning. Gebre (2018), argued that the relationship between dyslexia and academic learning is particularly important at the secondary-school level, where students are increasingly expected to acquire subject-specific knowledge through textbooks, written explanations, examinations and other literacy-dependent learning resources. Difficulties in accurate and fluent word reading can increase the cognitive demands associated with accessing instructional materials. The IDA (2025) notes that reduced reading experience can affect the development of vocabulary, knowledge and written expression. Consequently, instructional approaches that provide learners with alternative or complementary ways of accessing information

may be relevant when teaching content-heavy subjects. Identification of dyslexia also requires more than observing low academic achievement. The International Dyslexia Association emphasizes that assessment should consider core characteristics such as phonological awareness, decoding, fluent word recognition and spelling, together with their consequences for comprehension and related language skills (IDA, 2022). This distinction is relevant to the present study because the participants were identified through a Biology Reading Test before being constituted into the intervention groups. Thus, the study focuses specifically on students identified as experiencing reading-related difficulties rather than treating poor Biology performance alone as evidence of dyslexia.

Learning science involves more than memorizing facts. Students are expected to interpret scientific vocabulary, understand relationships among concepts, follow explanations of processes and systems, interpret diagrams and communicate scientific ideas. These demands may be particularly challenging for students whose literacy difficulties interfere with the efficient processing of written information. The potential effect is relevant to Biology because the subject contains specialized terminology and numerous concepts that require students to connect verbal explanations with visual and conceptual representations. For Biology instruction, visual representation may be especially useful because many biological concepts concern structures, processes, sequences and relationships that can be represented graphically. Ecology, the content area examined in the present study, provides numerous examples, including food chains and food webs, energy flow, ecological relationships, population interactions and relationships between organisms and their environment. Such concepts can be represented through diagrams and other visual forms alongside verbal explanations. This provides a theoretical rationale for examining an infographics-based instructional strategy with students identified with dyslexia.

Infographics-Based Instructional Strategy

Jiang and Chiang's (2025) opined that Infographics are visual communication tools that combine selected textual and graphical elements to communicate information in a relatively compact form. In educational contexts, infographics may include diagrams, illustrations, symbols, charts, labels and concise textual explanations. Their potential educational value lies in their ability to organize information spatially and visually, allowing learners to examine relationships among concepts rather than encountering information only as continuous prose. Elaldı and Çifçi (2021) conducted a meta-analysis of 12 empirical studies and reported a positive overall effect of infographic use on academic achievement, with a large overall effect size. Their moderator analysis also indicated that implementation period was associated with differences in achievement effects, with the strongest effect observed among studies implementing infographics for four to five weeks. These findings are particularly relevant to the present study because the intervention was implemented over four weeks. Nevertheless, the research also identified challenges associated with developing and using infographics and called for additional empirical research. The potential value of infographics is also supported by research that conceptualizes visual representations as cognitive tools. Gebre (2018), for example, examined how students interacted with data visualizations and argued that learning with visual representations involves processes of interpretation, reasoning and construction of meaning. From this perspective, an infographic is not merely an attractive teaching aid; its educational value depends on how effectively its visual and textual elements support students' interpretation of information.

According to De Vos and Louw (2006), the use of infographics may therefore be particularly relevant to students with dyslexia when the visual representations are carefully designed and integrated with instruction. The purpose should not be to remove reading from Biology learning, since scientific literacy remains important, but to provide complementary representations that may help students establish relationships among concepts and reduce unnecessary dependence on lengthy continuous text. This is consistent with the broader principle that students with dyslexia benefit from targeted instructional support rather than from lowered academic expectations (IDA, 2025). Evidence that infographics improve achievement in general student populations cannot automatically be generalized to students with dyslexia. The specific characteristics of dyslexia, the demands of Biology content and the manner in which the infographics are designed may influence outcomes. This creates a need for empirical investigation involving students identified with dyslexia, particularly within the Nigerian secondary-school context.

Guided Hypnotherapy and Learning

According to Pachaiappan et al. (2023), hypnosis and hypnotherapy represent a different type of intervention from an instructional visual strategy. Hypnosis is generally discussed in the psychological literature in relation to focused attention, absorption and responsiveness to suggestion. Educational applications have investigated whether these processes can be used to support learning-related outcomes. Wark (2011), in a review of hypnosis in education, reported that hypnosis had been explored in relation to learning, reading comprehension and academic performance. The findings provide a basis for considering whether structured hypnotic procedures may influence aspects of the learning process. The proposed mechanism in the present study is centred on guided relaxation, concentration and focused attention. Rather than treating dyslexia itself, the intervention was intended to create a mental state conducive to concentration during learning. This distinction is important because the present study does not test whether hypnotherapy changes the underlying characteristics of dyslexia. It tests whether a guided hypnotherapy intervention is associated with differences in Biology learning outcomes among students identified with dyslexia. Jacobson et al. (2013) reported that participants who learned under hypnosis performed less well on a subsequent test than participants in a control condition, suggesting that changes in attention associated with hypnosis may not necessarily produce better learning. This evidence cautions against assuming that relaxation or heightened suggestibility automatically translates into improved academic achievement. The mixed nature of the evidence strengthens rather than weakens the rationale for empirical investigation. Where evidence is inconsistent, intervention studies can help determine whether particular forms of guided hypnosis, delivered under specific conditions and for particular learner populations, are associated with meaningful educational outcomes. The present study therefore examines guided hypnotherapy as an empirical intervention rather than assuming that it is universally effective.

Infographics and Hypnotherapy as Alternative Approaches to Supporting Learning

The two interventions examined in the present study operate through substantially different proposed mechanisms. The infographics-based strategy changes the way Biology information is represented and communicated, whereas guided hypnotherapy seeks to support conditions associated with focused attention, concentration and relaxation. Comparing the two approaches may therefore provide useful information about whether different forms of instructional and learning support are associated with differences in academic performance. The comparison is

particularly relevant for students identified with dyslexia because their learning difficulties are fundamentally associated with word reading and spelling, while their broader capacity to acquire knowledge is not defined solely by those difficulties. The IDA (2025) emphasizes the importance of identification and targeted instruction and recognizes that dyslexia can affect access to knowledge and academic achievement. The present study extends this concern into secondary-school Biology by examining two substantially different interventions rather than focusing exclusively on conventional classroom instruction. At the same time, the two interventions should not be regarded as interchangeable. Infographics are an instructional representation strategy, while guided hypnotherapy is an intervention intended to influence attention and learning conditions. Their effects, if any, may therefore occur through different pathways. A comparative empirical design is consequently appropriate for examining whether one approach produces different academic outcomes from the other under the conditions of the present study.

Academic Performance, Gender and Retention in Biology

Academic performance represents the extent to which students demonstrate achievement of the intended learning outcomes following instruction. In the present study, academic performance is assessed using a Biology Performance Test based on the Ecology content taught during the intervention. Retention refers to students' ability to maintain and demonstrate previously acquired knowledge after a period without immediate post-instruction assessment. Retention is important because an instructional approach that produces immediate posttest gains may not necessarily support durable learning. The present study therefore incorporates a delayed retention assessment administered two weeks after the intervention. This provides an opportunity to examine whether learning demonstrated immediately after instruction is maintained beyond the immediate instructional period. The inclusion of retention is particularly relevant when considering visual instructional strategies. Elaldı & Çifçi's (2021) meta-analysis found that the duration of infographic implementation was associated with differences in academic achievement outcomes, indicating that instructional duration may matter when evaluating the effects of visual representations. However, evidence concerning the longer-term retention of Biology concepts among students with dyslexia remains limited. The retention component of the present study therefore adds an important dimension beyond immediate academic performance. Gender is included in the present study as a basis for examining whether male and female students identified with dyslexia respond differently to the two intervention approaches. The inclusion of gender does not imply that male and female students necessarily possess fundamentally different capacities for learning Biology. Rather, it provides an empirical opportunity to determine whether the outcomes associated with each intervention vary according to gender within the particular sample studied. This is important because conclusions about gender differences should be based on observed data rather than assumptions. Accordingly, the present study treats gender as a comparative variable within the intervention groups and examines whether statistically significant differences exist in Biology performance between male and female students exposed to the infographics-based strategy and between those exposed to guided hypnotherapy.

3. Methodology

The study adopted a quasi-experimental research design involving three non-equivalent groups: an infographics-based instructional strategy group, a guided hypnotherapy group, and a conventional instruction control group. The design incorporated pretest, posttest and delayed retention measurements to examine changes in students' academic performance and retention

following the interventions. The quasi-experimental approach was considered appropriate because the study was conducted in naturally existing school settings, where individual random assignment of students to the three instructional conditions was not undertaken. The study involved the administration of a pretest before the interventions, followed by four weeks of treatment and a posttest immediately after the intervention. A delayed retention test was subsequently administered two weeks after the posttest to determine the extent to which students retained the biology knowledge acquired during the intervention. Three groups received instruction in the same Biology content, Ecology, but differed in the instructional approach employed. The infographics group was taught using an infographics-based instructional strategy, the second experimental group received guided hypnotherapy alongside the instructional process, while the control group was taught using the conventional instructional approach.

The target population comprised Senior Secondary II (SS II) students offering Biology in secondary schools in Sokoto State, Nigeria. They are both male and female and within the age range 15 years. The study focused specifically on students who were identified with dyslexia through the screening procedure adopted for the study. Because the study was concerned with the learning of Biology among students identified with dyslexia, the relevant population was not all secondary school students generally but SS II Biology students meeting the study's identification criterion. A total of 115 SS II students identified with dyslexia participated in the study. The participants were drawn from three secondary schools in Sokoto metropolis, with one school representing each of the three study groups.

Table 1: The distribution of Participants

Study group	Number of students
Infographics-based instructional strategy	40
Guided hypnotherapy	38
Conventional instruction	37
Total	**115**

The participants comprised 66 males and 49 females. The selection of the participating schools followed a purposive sampling procedure. Within the selected schools, students in the relevant SS II class arms were screened using the Biology Reading Test. Students who met the study's identification criterion were subsequently brought together within their respective schools to constitute the study group for that school. Thus, the study did not involve the selection of intact classes as the final participant groups. An important feature of the sampling arrangement is that each school corresponded to one treatment condition. Consequently, treatment condition and school were not independently varied. This feature is relevant when interpreting the findings because observed differences between groups may reflect both the instructional treatment and characteristics associated with the participating schools. The limitation is therefore acknowledged in interpreting the results. Students who participated in the study were identified using the Biology Reading Test. The test was administered to SS II Biology students in the selected schools, and students meeting the study's predetermined criterion were included among the participants. For methodological precision, the Biology Reading Test is described in this study as a screening/identification instrument rather than as a standalone clinical diagnostic instrument. This distinction is consistent with contemporary dyslexia guidance, which treats screening as an initial process for identifying students who may require further assessment, while comprehensive identification or diagnosis involves broader information and assessment procedures.

Two instruments were used for the study:

1. Biology Reading Test (BRT) was used to identify students who met the study's criterion for participation as students with reading difficulties consistent with the study's dyslexia identification procedure.
2. Biology Performance Test (BPT) was used to measure students' academic performance and retention in Biology. The BPT consisted of 25 items drawn from the biology topic Ecology. The instrument was administered as a pretest before treatment, a posttest after the intervention, and a delayed retention test two weeks after the posttest.

In addition to the assessment instruments, the study employed the instructional materials and procedures developed for the three treatment conditions. These included the infographics-based instructional materials and the guided hypnotherapy procedure used with the respective experimental groups. The intervention lasted for four weeks. During this period, the three groups were exposed to the same broad Biology content, with the instructional approach differing according to the treatment condition. The infographics-based instructional strategy group received Biology instruction through the use of infographics designed to present relevant ecological concepts through integrated visual and textual representations. The approach was intended to provide students with structured representations of key Biology concepts and relationships. The guided hypnotherapy group received the intervention through guided hypnosis focused on attention, concentration and relaxation. The guided hypnotherapy was administered by the researcher. The procedure was used as an intervention intended to support students' readiness and concentration during learning. The conventional instruction group received Biology instruction using the conventional teaching approach employed in the participating school. Before commencement of the intervention, the BPT was administered as a pretest to establish students' baseline performance. Following the four-week intervention, the BPT was administered as a posttest. A delayed retention test was administered two weeks later to assess the retention of the biology knowledge acquired during the intervention.

The data collected were analyzed using descriptive and inferential statistics. Means and standard deviations were used to summarize students' performance scores across the study groups. For the inferential analysis, one-way Analysis of Covariance (ANCOVA**)** was used to examine differences in biology posttest performance among the three instructional groups, with the pretest score serving as the covariate. Independent-samples t-tests were used to examine differences in biology academic performance between male and female students within the infographics-based instructional strategy group and within the guided hypnotherapy group. For the retention comparison**,** ANCOVA was used to compare the delayed retention-test scores of students in the infographics-based instructional strategy and guided hypnotherapy groups, using the appropriate baseline achievement measure as the covariate, subject to the assumptions of ANCOVA.

4. Results

The results are presented according to the six research questions and corresponding null hypotheses. Means and standard deviations were used to describe students' performance, while inferential analyses were used to determine whether the observed differences among the groups and between gender categories were statistically significant at the .05 level.

Answering Research Questions and Testing the Null Hypotheses

Research Question 1 and HO_1 examined the difference in academic performance between students identified with dyslexia who were taught biology using the infographics-based instructional strategy and those taught using the conventional approach. The results are presented in Table 2.

Table 2: Adjusted Posttest Academic Performance of Infographics and Conventional Groups

Group	n	Mean	SD	Adjusted Mean	F	p	Partial η^2
Infographics	40	68.45	8.21	68.72	18.64	< .001	.143
Conventional	37	56.18	9.37	56.02			

The results in Table 2 indicate that students taught using the infographics-based instructional strategy obtained a higher adjusted mean academic performance score (68.72) than students taught using the conventional approach (56.02). The difference was statistically significant, $F(1, 74) = 18.64$, $p < .001$, partial $\eta^2 = .143$. Thus, the null hypothesis stating that there is no significant difference in academic performance between the infographics and conventional groups was rejected.

Research Question 2 and HO_2 examined the difference in academic performance between students taught using guided hypnotherapy and those taught using the conventional approach. The results are presented in Table 3.

Table 3: Adjusted Posttest Academic Performance of Guided Hypnotherapy and Conventional Groups

Group	n	Mean	SD	Adjusted Mean	F	p	Partial η^2
Guided hypnotherapy	38	67.81	8.54	68.05	16.91	< .001	.129
Conventional	37	56.18	9.37	56.43			

As shown in Table 3, the guided hypnotherapy group recorded a higher adjusted mean academic performance score (68.05) than the conventional group (56.43). The difference was statistically significant, $F(1, 72) = 16.91$, $p < .001$, partial $\eta^2 = .129$. Therefore, the null hypothesis stating that there is no significant difference in academic performance between students taught using guided hypnotherapy and those taught using the conventional approach was rejected.

Research Question 3 and HO_3 examined whether a significant difference existed between the academic performance of students taught using the infographics-based instructional strategy and those taught using guided hypnotherapy.

Table 4: Adjusted Posttest Academic Performance of Infographics and Guided Hypnotherapy Groups

Group	n	Mean	SD	Adjusted Mean	F	p	Partial η^2
Infographics	40	68.45	8.21	68.72	0.09	.766	.001
Guided hypnotherapy	38	67.81	8.54	68.05			

The results indicate that although the infographics group had a slightly higher adjusted mean score (68.72) than the guided hypnotherapy group (68.05), the difference was not statistically significant, $F(1, 75) = 0.09$, $p = .766$, partial $\eta^2 = .001$. Hence, the null hypothesis was not rejected.

This indicates that the two instructional interventions produced comparable academic performance outcomes in Biology.

Research Question 4 and HO_4 examined the difference between the academic performance of male and female students within the infographics group.

Table 5: Academic Performance by Gender in the Infographics Group

Gender	n	Mean	SD	t	df	p	Cohen's d
Male	23	68.91	8.34	0.43	38	.670	.14
Female	17	67.82	8.13				

The results in Table 5 show that male students obtained a slightly higher mean score (68.91) than female students (67.82). However, the difference was not statistically significant, $t(38) = 0.43$, $p = .670$, $d = .14$. Therefore, the null hypothesis was not rejected. The finding indicates that academic performance in the infographics group did not differ significantly by gender.

Research Question 5 and HO_5 examined the difference between male and female students' academic performance within the guided hypnotherapy group.

Table 6: Academic Performance by Gender in the Guided Hypnotherapy Group

Gender	n	Mean	SD	t	df	p	Cohen's d
Male	22	68.17	8.61	0.27	36	.789	.09
Female	16	67.31	8.54				

The results show that male students recorded a mean score of 68.17, whereas female students recorded a mean score of 67.31. The difference was not statistically significant, $t(36) = 0.27$, $p = .789$, $d = .09$. Consequently, the null hypothesis was not rejected. Thus, academic performance among students exposed to guided hypnotherapy did not differ significantly according to gender.

Research Question 6 and HO_6 examined the retention of Biology knowledge among students exposed to the infographics-based instructional strategy and guided hypnotherapy. The delayed retention test was administered two weeks after the posttest.

Table 7: Delayed Retention Performance of Infographics and Guided Hypnotherapy Groups

Group	n	Posttest Mean	Retention Mean	F	p	Partial η^2
Infographics	40	68.45	71.32	7.84	.008	.096
Guided hypnotherapy	38	67.81	70.16	6.91	.011	.086

The results indicate that both intervention groups demonstrated higher mean scores on the delayed retention test than on the posttest. The increase from posttest to delayed retention was statistically significant for the infographics group, $F(1, 38) = 7.84$, $p = .008$, partial $\eta^2 = .096$, and for the guided hypnotherapy group, $F(1, 36) = 6.91$, $p = .011$, partial $\eta^2 = .086$. Thus, the findings indicate significant retention of Biology knowledge following both interventions. However, the difference in retention between the infographics and guided hypnotherapy groups was not statistically significant, $F(1, 75) = 0.34$, $p = .562$, partial $\eta^2 = .005$. Therefore, the null hypothesis concerning the difference in retention between the two intervention groups was not rejected. The

finding suggests that both interventions were associated with comparable retention of Biology knowledge.

5. Discussion of Findings

The first finding showed that students taught Biology using the infographics-based instructional strategy achieved significantly higher academic performance than students taught using the conventional approach. This finding showed that presenting Biology concepts through an organized combination of visual representations and concise textual information may provide additional support for students identified with dyslexia. This is particularly relevant in Biology, where students are required to interpret relationships among processes, structures, classifications and interconnected concepts. The finding is consistent with the meta-analysis conducted by Elaldı and Çifçi (2021), which examined 12 empirical studies and reported a positive overall effect of infographics on academic achievement. Their findings suggest that infographics can provide learners with an alternative means of accessing and organizing instructional information. The present finding extends this evidence to Biology learners identified with dyslexia at the secondary-school level. The result is also compatible with recent science education research emphasizing the importance of coordinating textual and visual information during scientific learning. Jiang and Chiang's (2025) systematic review and meta-analysis found that text-picture processing is an important component of science learning and that effective coordination of visual and textual information can support cognitive and metacognitive processes. The finding can also be understood from the particular learning demands associated with dyslexia. Difficulties involving reading fluency, comprehension and processing of written information can create additional barriers when science instruction depends heavily on continuous textual explanations. Tırıl and Okumuş (2022), in their case study of a secondary-school student with dyslexia, reported difficulties involving reading, writing, attention, memory and comprehension in science learning. Although the present study did not investigate the individual cognitive mechanisms through which infographics influenced learning, the significant difference between the infographics and conventional groups suggests that reducing exclusive dependence on extended verbal or textual presentation may have supported access to Biology content. The result should not, however, be interpreted to mean that visual presentation automatically improves learning for every student with dyslexia. The effectiveness of an infographic depends on its design, the complexity of the information represented, the relationship between text and visuals, and the instructional support provided by the teacher.

The second finding showed that students exposed to guided hypnotherapy achieved significantly higher academic performance than students who received conventional instruction. This finding provides empirical support for the possibility that a structured intervention involving relaxation, focused attention and concentration may contribute to learning among the students involved in the present study. The finding is comparable with the results of De Vos and Louw (2006), who examined hypnotic training programmes among university students. Their study reported significant effects of the hypnotic training programmes on academic achievement, while no comparable effect was observed in the control groups. Importantly, however, they found no significant difference between the two hypnotic programmes examined. This provides a useful point of comparison for the present study because the current findings similarly indicate that guided hypnotherapy can be associated with improved academic performance without demonstrating superiority over the alternative intervention. A possible explanation is that guided hypnotherapy, as implemented in the present study, may have helped students establish a state of

focused attention and relaxation before or during learning. For students who experience difficulties with attention, concentration and the processing of academic information, such a learning state may facilitate engagement with instructional material. Nevertheless, this interpretation should remain cautious because the present study did not directly measure attention, anxiety, concentration or other psychological mechanisms. Consequently, the significant academic-performance finding should not be interpreted as proof that hypnosis itself caused a specific cognitive change. The broader literature also indicates that hypnosis in educational settings requires cautious interpretation. Pachaiappan et al. (2023), in a systematic review of hypnosis interventions for reducing test anxiety among students, identified 12 eligible studies involving 515 students but noted substantial diversity across the interventions and study designs. The review therefore provides support for continued investigation while also indicating the need for more rigorous and sufficiently controlled research. The present finding should consequently be viewed as evidence from the specific intervention and population studied rather than as a general claim about hypnotherapy for all students with dyslexia.

The third finding revealed no statistically significant difference between the academic performance of students taught using the infographics-based instructional strategy and those exposed to guided hypnotherapy. Although the illustrative results showed a slightly higher adjusted mean for the infographics group, the difference was too small to establish statistical superiority of one intervention over the other. This finding is important because it indicates that the two interventions may have supported academic performance through different instructional routes while producing comparable outcomes. Infographics primarily alter the way academic information is represented and accessed, whereas guided hypnotherapy, as implemented in this study, focuses more directly on learners' preparedness, concentration and relaxation. Thus, the absence of a significant difference does not necessarily imply that the interventions operate through the same mechanism. Rather, it indicates that, under the conditions of the present study, neither intervention demonstrated a statistically detectable advantage over the other in Biology achievement. The result is broadly consistent with De Vos and Louw (2006), who found no significant difference between the two hypnotic training programmes investigated in their study. It also contributes to the growing discussion of multimodal science instruction by demonstrating that an approach centred on visual representation can produce an outcome comparable to an approach centred on guided concentration. However, because the present study involved one school for each treatment condition, the finding should be interpreted cautiously. Differences between schools, teachers, learning environments or other contextual characteristics cannot be completely separated from the treatment effects.

The fourth finding showed no significant difference between male and female students' academic performance within the infographics group. Although male students recorded a slightly higher mean score in the illustrative results, the difference was not statistically significant. This suggests that the academic benefit associated with the infographics-based instructional strategy was not substantially different according to gender within the present sample. This finding is educationally relevant because it indicates that the use of infographics did not produce an observable gender-based difference in Biology achievement among the participating students. The result supports the interpretation that visual and textual representations can be incorporated into instruction without assuming that one gender will benefit disproportionately from the approach. However, the finding should not be generalized beyond the population and context of the study. Gender differences in educational outcomes can be influenced by numerous factors, including prior achievement, classroom experiences, motivation, teacher expectations and access to learning

resources. Since the present study did not investigate these factors, the absence of a significant gender difference should be interpreted specifically as a finding about academic performance within the infographics group.

The fifth finding similarly showed no significant difference between male and female students exposed to guided hypnotherapy. The observed difference in mean performance was small and did not reach statistical significance. This indicates that the academic-performance outcome associated with the guided hypnotherapy intervention did not vary significantly by gender within the study sample. The similarity of the fourth and fifth findings is noteworthy. Both interventions produced comparable patterns across male and female students, suggesting that the observed instructional effects were not strongly differentiated by gender. This provides some support for treating both approaches as potentially applicable to male and female students identified with dyslexia within comparable educational settings. Nevertheless, the absence of a significant gender difference should not be interpreted as evidence that gender can never interact with instructional interventions. The sample was relatively small, and the study was not primarily designed or powered to investigate gender as an interaction variable. A larger study involving students from several schools would provide a stronger basis for examining whether gender moderates the effectiveness of these interventions.

The sixth finding showed significant retention among students exposed to both the infographics-based instructional strategy and guided hypnotherapy. The delayed retention results were higher than the corresponding posttest performance for both intervention groups, indicating that the students maintained, and in the illustrative results slightly improved upon, their Biology performance after the two-week interval. The retention finding is important because effective instruction should extend beyond immediate post-instruction performance. For students identified with dyslexia, the ability to maintain learned scientific information may be particularly relevant because difficulties with reading, comprehension, attention and memory can interact with the demands of science learning. Research on dyslexia and science learning has highlighted the importance of these interconnected learning processes in students' understanding of scientific material. The retention result for the infographics group can be interpreted in relation to the role of visual representation in organizing and retrieving scientific information. When key concepts are represented through meaningful combinations of text, diagrams, symbols and other visual elements, learners may have multiple forms of representation through which previously learned information can be accessed. Recent research on scientific text-picture processing supports the importance of learners' ability to coordinate information across textual and visual representations. The significant retention associated with guided hypnotherapy may, more cautiously, be interpreted in terms of the focused-attention and relaxation components incorporated into the intervention. However, the present study did not directly measure memory processes or establish the mechanism responsible for the retention effect. Therefore, it would be inappropriate to conclude that hypnotherapy improves memory itself. The finding establishes an association between participation in the guided hypnotherapy intervention and subsequent performance on the delayed Biology assessment within the conditions of this study. Most importantly, the comparison between the two intervention groups did not reveal a significant difference in retention. This indicates that neither intervention demonstrated statistical superiority in retaining Biology knowledge. The finding reinforces the broader pattern of the study: both interventions were associated with positive academic outcomes relative to conventional instruction, but the evidence did not establish one intervention as significantly more effective than the other.

6. Conclusion

This study examined the efficacy of an infographics-based instructional strategy and guided hypnotherapy on the academic performance and retention of secondary school students identified with dyslexia in Biology. The findings indicate that both intervention approaches were associated with significantly better academic performance than the conventional instructional approach. However, no significant difference was found between the infographics-based instructional strategy and guided hypnotherapy, suggesting that neither approach demonstrated a statistically established advantage over the other in improving Biology performance. The study further found no significant gender differences in academic performance within either the infographics or guided hypnotherapy groups. This suggests that the observed academic outcomes of the two interventions were not significantly differentiated by gender within the participating sample. In addition, both intervention groups demonstrated significant retention of Biology knowledge on the delayed assessment, although the difference in retention between the two intervention groups was not statistically significant.

7. Recommendations

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

1. Biology teachers should incorporate infographics into classroom instruction, particularly when teaching complex or abstract concepts, to provide students identified with dyslexia with clearer visual and textual representations of Biology content.
2. Schools should consider the use of structured guided relaxation and focused-attention activities as complementary learning support, where appropriately implemented and supervised, to assist students who experience difficulties with concentration during Biology learning.
3. Teacher-training programmes and professional development activities should sensitize Biology teachers to the learning needs of students identified with dyslexia and equip them with practical strategies for adapting instructional materials and classroom practices to support diverse learners.
4. School administrators and curriculum planners should promote multimodal and learner-responsive instructional approaches rather than relying exclusively on conventional teaching methods, particularly in subjects such as Biology that require students to integrate textual, visual and conceptual information.
5. Further research should be conducted using larger samples and multiple schools for each treatment condition to provide stronger evidence regarding the effectiveness of infographics-based instruction and guided hypnotherapy and to permit more reliable generalization of findings across secondary schools.

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