International Journal of Academic Pedagogical Research (IJAPR)
ISSN: 2643-9123
Vol. 10 Issue 6 June - 2026, Pages: 185-192

Comparative Analysis Of Scenario-Based Instruction And Lecture Method On Students' Achievement In Basic Science In Delta State

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Abstract**:** *This study examined the effect of scenario-based instruction on students' achievement in Basic Science, comparing its effectiveness with that of the conventional lecture method, while also considering gender differences. A quasi-experimental approach was employed, specifically the non-randomized pretest–posttest control group design. The study population consisted of 174,570 Basic Eight students enrolled in public secondary schools across the state. From this population, a sample of 216 students was selected from four intact classes using a simple random sampling technique. Data for the study were collected using the Basic Science Achievement Test (BSAT), which comprised 50 multiple-choice items derived from previous Basic Education Certificate Examination questions. The instrument was subjected to expert validation to ensure its appropriateness, and its reliability was determined using the Kuder–Richardson Formula 21, yielding a coefficient of 0.88, which indicates a high level of consistency. Before the commencement of the instructional treatment, a pretest was administered to determine the initial equivalence of the groups. During the intervention period, which lasted six weeks, students in the experimental group were instructed using scenario-based teaching, where lessons were structured around real-life situations to enhance understanding. In contrast, students in the control group were taught the same concepts using the traditional lecture method. At the end of the treatment, a posttest was conducted to assess students' academic achievement. The data obtained were analyzed using descriptive statistics, including mean and standard deviation, as well as inferential statistics, specifically Analysis of Covariance (ANCOVA), tested at the 0.05 level of significance. The results indicated that students who were exposed to scenario-based instruction performed better, as reflected in their higher mean scores, compared to those taught through the lecture method. The findings also revealed a significant difference in achievement based on gender among students in the scenario-based group, although both male and female students showed improvement when exposed to this instructional approach. However, the analysis showed no significant interaction effect between instructional method and gender on students' academic achievement. Based on these findings, the study concluded that scenario-based instruction is a more effective, learner-centered strategy for enhancing students' academic performance in Basic Science when compared to the traditional lecture approach. Consequently, it was recommended, among other suggestions, that Basic Science teachers should integrate scenario-based teaching methods into their classroom practices to promote better understanding and improve students' academic outcomes.*

Keywords: *Scenario-based instruction, lecture method, Basic Science, academic achievement, gender.*

Introduction

Science education plays a vital role in national development because it provides learners with the knowledge and competencies needed to interpret natural phenomena, address societal challenges, and function effectively in a technologically advancing world. At the junior secondary school level, Basic Science forms the bedrock for further studies in core science subjects such as Biology, Chemistry, and Physics. As a result, considerable attention has been directed toward the teaching approaches employed in delivering Basic Science content. In many educational settings, the lecture method continues to dominate classroom instruction due to its structured nature and its suitability for handling large student populations. Despite these advantages, concerns have been expressed regarding its effectiveness in fostering meaningful understanding and encouraging active student participation in science learning. Abdulbaki et al. (2018) noted that although the lecture method is prevalent, it often positions learners as passive recipients of information rather than active participants in knowledge construction. Similarly, Omoregie and Nwosu (2022) observed that excessive dependence on traditional teaching methods may restrict students' opportunities to investigate scientific ideas and develop essential critical thinking skills.

In light of these concerns, contemporary educational discourse increasingly emphasizes the need for learner-centered instructional approaches that actively engage students in the learning process. Such approaches promote inquiry, collaboration, exploration, and the practical application of knowledge. Among these innovative strategies, scenario-based instruction has emerged as a promising method for improving students' engagement and conceptual understanding. This approach involves presenting learners with carefully designed real-life situations or problems that reflect authentic experiences, thereby requiring them to analyze information, discuss possible solutions, and apply relevant concepts during instructional activities. According to Aslan (2019), learning through contextualized scenarios enables students to achieve deeper understanding because it links theoretical knowledge with real-world

applications. In the same vein, Olatoye and Ogunleye (2020) reported that scenario-based teaching fosters meaningful learning by encouraging interaction among students, instructional content, and the learning environment.

Beyond its emphasis on contextual learning, scenario-based instruction also supports the development of collaborative and problem-solving skills. Students are often required to work in groups to interpret situations, identify challenges, and propose solutions grounded in scientific reasoning. This collaborative process not only strengthens conceptual understanding but also enhances motivation and participation during classroom activities. Empirical studies suggest that instructional approaches incorporating realistic scenarios and active engagement can positively influence academic achievement and students' attitudes toward science. For example, Mamakli et al. (2023) found that scenario-based learning significantly improved students' academic performance and engagement in science-related contexts. Similarly, Hassan et al. (2023) reported that the use of scenario-based instructional models enhanced both students' achievement and their mental motivation, indicating that contextualized learning experiences promote deeper cognitive engagement.

Notwithstanding the advantages associated with innovative instructional methods, debates continue regarding the relevance and effectiveness of traditional approaches such as the lecture method. Some scholars argue that lectures can still yield positive learning outcomes when they are well-structured and supported with relevant examples and illustrations. Djudin (2018) emphasized that properly organized lectures can contribute meaningfully to students' academic success, particularly when instructional goals are clearly articulated. Likewise, Achimugu (2018) suggested that combining the lecture method with complementary teaching strategies may enhance students' learning in science subjects. These viewpoints highlight the importance of conducting empirical comparisons between conventional and modern instructional methods to determine their relative effectiveness within specific educational contexts.

Another critical dimension frequently explored in science education research is the role of gender in students' academic achievement. Factors such as participation levels, learning preferences, and classroom interaction patterns may influence how male and female students respond to different teaching approaches. Akinyemi and Abiola (2021) observed that instructional strategies emphasizing interaction and active participation may produce varying achievement outcomes for male and female learners. Similarly, Adesope and Okonkwo (2022) reported that the effectiveness of certain teaching methods in science education could differ based on gender-related classroom dynamics. Conversely, other studies suggest that learner-centered approaches may help reduce gender disparities in academic performance. Musa and Ibrahim (2020) argued that active learning strategies create inclusive environments that benefit both male and female students. In addition, Olatoye and Oladipo (2022) emphasized the importance of examining the interaction between gender and instructional strategies in order to improve teaching effectiveness in science education.

Given the increasing emphasis on learner-centered pedagogy and the need to enhance students' performance in Basic Science, it is essential to explore instructional methods that can improve learning outcomes while ensuring equal participation among learners. Although numerous studies have investigated innovative teaching strategies in science education, there remains a lack of sufficient empirical evidence comparing the effectiveness of scenario-based instruction and the traditional lecture method within Basic Science classrooms in Delta State. Furthermore, the influence of gender on students' achievement when exposed to scenario-based instruction has not been adequately examined in this context. Against this backdrop, the present study was conducted to evaluate the comparative effects of scenario-based instruction and the lecture method on students' academic achievement in Basic Science, as well as to examine the role of gender and the interaction effect between instructional method and gender on students' performance. This investigation is therefore important for providing empirical insights that can guide instructional practices and contribute to the improvement of teaching and learning in Basic Science.

Statement of the Problem

The teaching and learning of Basic Science at the junior secondary school level play a crucial role in developing students' scientific understanding, inquiry competencies, and problem-solving skills. As a core foundational subject, Basic Science is designed to arouse learners' curiosity, promote investigative learning, and prepare them for further studies in science and technology-related disciplines. Despite its importance, concerns have persisted regarding students' academic performance in the subject, particularly in relation to the instructional methods commonly employed in classrooms. In many school settings, teaching practices are still largely centered on the teacher, with emphasis placed on the delivery of information rather than on engaging students actively in the learning process. Such approaches tend to restrict students' opportunities to interact meaningfully with scientific ideas and to apply their knowledge in real-life contexts, which are essential for effective science learning.

In response to these challenges, recent educational discussions have increasingly highlighted the importance of adopting innovative instructional strategies that encourage active participation, enhance conceptual understanding, and improve overall learning outcomes. Instructional approaches that embed learning within real-life contexts and problem-based situations have been identified as promising alternatives for increasing students' engagement and achievement in science subjects. At the same time, the issue of gender differences in academic performance continues to receive attention in science education, as variations in participation and

achievement may exist between male and female learners. Despite these concerns, there is still a shortage of empirical studies that directly compare the effectiveness of scenario-based instruction and the traditional lecture method in influencing students' academic achievement in Basic Science within the study area. Furthermore, the extent to which gender interacts with these instructional approaches remains underexplored. In view of these gaps, this study seeks to determine the comparative effects of scenario-based instruction and the lecture method on students' academic achievement in Basic Science, as well as to examine the influence of gender on these outcomes.

Purpose of the Study

The primary objective of this study is to investigate the comparative achievement of students taught Basic Science through scenario-based instruction and lecture method. More specifically, the study aims to:

1. examine the difference in the mean achievement scores of students exposed to scenario-based instruction and those taught through the lecture method in Basic Science;
2. assess the variation in mean achievement scores between male and female students taught Basic Science using scenario-based instruction;
3. determine whether there is an interaction effect between instructional method and gender on students' mean achievement scores in Basic Science.

Research Questions

The study was guided by the following research questions:

1. What difference exists in the mean achievement scores of students taught Basic Science using scenario-based instruction compared to those taught using the lecture method?
2. What difference exists in the mean achievement scores of male and female students taught Basic Science using scenario-based instruction?
3. What is the interaction effect of instructional method and gender on students' mean achievement scores in Basic Science?

Hypotheses

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

1. There is no statistically significant difference in the mean achievement scores of students taught Basic Science using scenario-based instruction and those taught using the lecture method.
2. There is no significant difference in the mean achievement scores of male and female students taught Basic Science through scenario-based instruction.
3. There is no significant interaction effect between instructional method and gender on students' mean achievement scores in Basic Science.

Methods

The study utilized a quasi-experimental research design, specifically the non-randomized pretest–posttest planned variation group design. This approach was deemed appropriate because it enabled the researcher to investigate cause-and-effect relationships between instructional strategies and students' learning outcomes without randomly assigning individual learners to groups. Instead, intact classes were maintained and assigned to treatment conditions in order to preserve the normal school routine and avoid disrupting existing classroom structures. The design comprised two groups: an experimental group and a control group. The experimental group received instruction through a scenario-based teaching strategy, whereas the control group was taught using the conventional lecture method. Both groups were administered a pretest prior to the intervention to establish baseline equivalence. At the end of the instructional period, a posttest was conducted to measure students' achievement, and a delayed posttest was later administered to assess retention of the Basic Science concepts taught. Within the context of this study, the independent variable was the teaching strategy, categorized into scenario-based instruction and lecture method. The dependent variable was students' academic achievement in Basic Science, while sex (male and female) functioned as a moderating variable.

The population of the study consisted of 174,570 Basic Eight (Upper Basic II) students enrolled in Basic Science. This group was considered suitable because they were actively engaged in Basic Science instruction during the period of the research and were readily accessible for participation. From this population, a sample of 216 students was selected from four intact classes across four public secondary schools. The schools were chosen using a simple random sampling technique to ensure equal chances of selection. The use of intact classes helped maintain the natural classroom setting and avoided interference with the academic organization of the schools. Following the selection, the classes were assigned to the two treatment conditions, resulting in a scenario-based instruction group and a lecture method group.

Data collection was carried out using the Basic Science Achievement Test (BSAT). The instrument was divided into two sections. Section A collected demographic information such as students' names, schools, and sex, while Section B consisted of fifty multiple-choice questions derived from selected Basic Science topics, including simple machines, kinetic energy, and thermal energy. Each

item provided four response options labeled A–D, with only one correct answer. Correct responses were awarded one mark, while incorrect answers received no mark. The total scores obtained by students were later converted into percentages for analysis. The BSAT served as the primary tool for measuring students' academic achievement. Additionally, instructional materials in the form of lesson plans were developed to guide teaching during the intervention period, covering both scenario-based and lecture approaches.

To ensure the quality of the instrument, several validation procedures were carried out. Face validity was established by presenting the test and related materials, such as lesson plans, research questions, hypotheses, and the table of specification, to experts in Basic Science education, measurement and evaluation, as well as an experienced classroom teacher. Their feedback was used to refine the instrument. Content validity was achieved through the use of a table of specification, which ensured that test items were adequately distributed across content areas and cognitive levels. Construct validity was determined through trial testing with students outside the study area, during which item difficulty and discrimination indices were analyzed. The results confirmed that the items were appropriate and capable of distinguishing between high- and low-performing students.

The reliability of the BSAT was established using the Kuder–Richardson Formula 21, which is suitable for objective multiple-choice tests. The instrument was administered to a group of students with similar characteristics to those in the main study but who were not part of the sample. Analysis of the scores produced a reliability coefficient of 0.88, indicating a high level of internal consistency and confirming that the instrument was dependable for the study.

The treatment process was implemented in stages. Initially, the selected schools were assigned to their respective instructional groups. Basic Science teachers in the participating schools served as research assistants. Those in the experimental group were trained on the effective application of scenario-based teaching to ensure uniformity in delivery, while teachers in the control group followed prepared lesson plans based on the lecture method. Before instruction began, the BSAT was administered as a pretest to determine students' initial achievement levels. The teaching phase lasted six weeks, during which both groups were taught the same topics using their assigned instructional strategies. Each group received two lessons per week, with each lesson lasting forty minutes. At the end of the intervention, the posttest was administered to evaluate students' achievement.

Several measures were implemented to control extraneous variables. Standardized lesson plans were used across groups to reduce variations in teaching. Teachers involved in the study had comparable qualifications and teaching experience to ensure consistency. The use of regular classroom teachers as research assistants minimized students' awareness of participation in an experiment. Furthermore, appropriate time intervals were maintained between the pretest and posttest to limit testing effects, and pretest scores were used as covariates during data analysis to control for initial differences among the groups.

For data analysis, descriptive statistics such as mean, standard deviation, and percentages were used to address the research questions. Inferential analysis was conducted using Analysis of Covariance (ANCOVA) to test the hypotheses at the 0.05 level of significance, with the aid of the Statistical Package for Social Sciences (SPSS).

Results

Table 1: Pretest and Posttest Mean Achievement Scores by Instructional Method

Group	N	Pretest		Posttest		Mean Gain
		Mean ($\bar{x}$)	SD	Mean ($\bar{x}$)	SD	
SBI	93	24.09	9.15	62.80	10.06	38.71
LM	123	22.11	8.40	49.22	10.71	27.11

Table 1 presents the pretest and posttest mean scores of students taught Basic Science through scenario-based instruction (SBI) and the lecture method (LM). The findings show that learners in the scenario-based instruction group achieved a higher posttest mean score (M = 62.80, SD = 10.06) than those in the lecture group (M = 49.22, SD = 10.71). Furthermore, the mean gain score recorded by students exposed to scenario-based instruction (38.71) was considerably greater than that of their counterparts taught using the lecture method (27.11). This indicates that scenario-based instruction was more effective in enhancing students' achievement in Basic Science than the lecture method.

Table 2: ANCOVA of Students' Achievement by Instructional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17915.891[a]	2	8957.945	126.000	.000
Intercept	42002.684	1	42002.684	590.798	.000
Pretest	8154.990	1	8154.990	114.706	.000
Methods	7759.847	1	7759.847	109.148	.000
Error	15143.202	213	71.095		

Total	688000.000	216
Corrected Total	33059.093	215

Table 2 displays the results of the ANCOVA conducted to determine the effect of instructional method on students' achievement, with pretest scores controlled. The outcome showed a statistically significant effect of instructional strategy on students' performance ($F = 109.148$, $p < 0.05$). This suggests that the difference in achievement between students taught through scenario-based instruction and those taught using the lecture method is significant. Consequently, the null hypothesis is rejected. This finding indicates that the type of instructional method employed has a significant effect on students' achievement in Basic Science.

Table 3: Mean Achievement Scores of Male and Female Students in Scenario-Based Instruction

Group	N	Pretest		Posttest		Mean Gain
		Mean ($\bar{x}$)	SD	Mean ($\bar{x}$)	SD	
Male	47	27.06	10.025	66.98	9.865	39.92
Female	46	21.04	7.039	58.52	8.382	37.48

Table 3 presents the pretest and posttest mean scores of male and female students who were taught using scenario-based instruction. The findings reveal that male students obtained a higher posttest mean score ($M = 66.98$, $SD = 9.87$) compared to female students ($M = 58.52$, $SD = 8.38$). Similarly, the mean gain scores indicate that male students (39.92) performed slightly better than their female counterparts (37.48). This implies that while both male and female students benefited from the scenario-based approach, male students showed marginally greater improvement in achievement.

Table 4: ANCOVA of Achievement by Gender under Scenario-Based Instruction

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2632.523[a]	2	1316.261	17.764	.000
Intercept	30297.138	1	30297.138	408.893	.000
Pretest	969.861	1	969.861	13.089	.000
Sex	793.754	1	793.754	10.713	.002
Error	6668.596	90	74.096		
Total	376028.000	93			
Corrected Total	9301.118	92			

Table 4 shows the ANCOVA results examining the difference in achievement between male and female students exposed to scenario-based instruction, with pretest scores controlled. The findings indicate that gender had a statistically significant influence on students' achievement ($F = 10.713$, $p = 0.002 < 0.05$). This suggests that the variation in achievement between male and female students is meaningful. Therefore, the null hypothesis is rejected.

Table 5: Mean Achievement by Instructional Method and Gender

Methods		SBI			LM	
	N	Mean	SD	N	Mean	SD
Pretest						
Male	47	27.06	10.03	76	22.84	8.12
Female	46	21.04	7.04	47	20.94	8.79
MD		6.02			1.90	
Posttest						
Male	47	66.98	9.87	76	49.87	9.59
Female	46	58.52	8.38	47	48.17	12.36
MD		8.46			1.70	

Table 5 provides the descriptive statistics illustrating the mean achievement scores of male and female students under the two instructional approaches. The findings indicate that, for both genders, students exposed to scenario-based instruction attained higher posttest mean scores compared to those taught using the lecture method. In particular, male students in the scenario-based group recorded the highest posttest mean score (66.98), followed by female students within the same group (58.52). Conversely, both male

and female students in the lecture group achieved comparatively lower posttest mean scores. This suggests that scenario-based instruction improves students' achievement irrespective of gender.

Table 6: ANCOVA on Interaction Effect of Method and Gender on Achievement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	18353.210[a]	4	4588.302	65.833	.000
Intercept	41914.024	1	41914.024	601.382	.000
Pretest	6845.897	1	6845.897	98.225	.000
Methods	7674.006	1	7674.006	110.107	.000
Sex	289.869	1	289.869	4.159	.043
Methods * Sex	204.810	1	204.810	2.939	.088
Error	14705.883	211	69.696		
Total	688000.000	216			
Corrected Total	33059.093	215			

Table 6 displays the ANCOVA results assessing the interaction effect of instructional method and gender on students' achievement. The results show that this interaction effect is not statistically significant ($F = 2.939$, $p = 0.088 > 0.05$). This indicates that the relative effectiveness of scenario-based instruction compared to the lecture method does not vary based on students' gender. Consequently, the null hypothesis, which states that there is no significant interaction between instructional method and gender, is upheld.

Discussion

The findings of the study showed that students who were taught Basic Science through scenario-based instruction obtained higher mean achievement scores than those who received instruction through the lecture method. This outcome suggests that scenario-based teaching is more effective in improving students' academic performance in Basic Science than the traditional lecture approach. A likely explanation for this result lies in the interactive and learner-focused nature of scenario-based instruction, which immerses students in real-life situations, stimulates critical thinking, and promotes a deeper grasp of scientific concepts. When learners are actively engaged in realistic problem contexts, they are more inclined to construct knowledge meaningfully rather than passively absorb information. This result may also be attributed to the fact that scenario-based learning encourages participation, interaction, and the practical application of knowledge, which are core elements of constructivist learning theory as advanced by Jean Piaget and Albert Bandura. This finding is in agreement with the studies of Olatoye and Ogunleye (2020) and Aslan (2019), which reported that scenario-based teaching significantly enhances students' achievement in science subjects. However, the result differs from the findings of Abdulbaki et al. (2018) and Djudin (2018), who argued that the lecture method can still yield satisfactory academic outcomes when properly organized. The variation between these findings may be due to differences in instructional settings, subject focus, and the increasing emphasis on learner-centered teaching practices in modern classrooms.

Another important result of the study indicated a significant difference in the achievement of male and female students exposed to scenario-based instruction, with male students recording slightly higher mean scores than their female counterparts. This suggests that gender may have influenced students' academic performance under the scenario-based approach. One possible explanation is that variations in participation levels, confidence, or prior exposure to inquiry-based learning activities may exist between male and female students. It is also conceivable that male students were more actively involved in discussions or problem-solving tasks during the instructional process. This outcome may reflect differences in how learners respond to innovative teaching methods based on their individual learning preferences and classroom dynamics. The finding is consistent with the studies of Adesope and Okonkwo (2022) and Olatoye and Oladipo (2022), which reported that gender differences can emerge in science achievement when interactive or problem-based instructional strategies are employed. Conversely, this result is not in line with the findings of Akinyemi and Abiola (2021) and Musa and Ibrahim (2020), who reported minimal or no gender differences when active learning strategies are used. The discrepancy between these results may be explained by contextual factors such as classroom interaction patterns, cultural influences, and differences in sample characteristics.

In addition, the study showed that scenario-based instruction enhanced the academic achievement of both male and female students when compared to the lecture method, as indicated by the descriptive analysis of instructional method and gender. This suggests that, although slight differences may exist, the effectiveness of scenario-based teaching is generally beneficial to all students regardless of gender. This outcome can be explained by the fact that scenario-based learning fosters collaboration, critical thinking, and the application of knowledge in meaningful contexts, all of which contribute to improved learning outcomes. A possible reason is that this approach creates a supportive learning environment where students actively participate in discussions, engage in problem-solving, and reflect on real-life situations related to scientific concepts. This finding aligns with the studies of Mamakli et al. (2023)

and Hassan et al. (2023), which reported that scenario-based learning significantly improves students' achievement and engagement in science-related subjects. However, the finding contrasts with the studies of Okeke and Anyaogu (2020) and Bello and Musa (2019), which suggested that traditional lecture methods can produce comparable learning outcomes in some science classrooms. The differences between these findings may be attributed to variations in how the instructional strategies were implemented, the effectiveness of teachers, and the level of student involvement during the learning process.

Finally, the study revealed that there was no significant interaction effect between instructional method and gender on students' academic achievement in Basic Science. This indicates that the relative effectiveness of scenario-based instruction compared to the lecture method does not significantly depend on whether the students are male or female. In essence, both genders benefited in a similar manner from the instructional strategies employed in the study. This result may be explained by the inclusive nature of scenario-based instruction, which provides equal opportunities for engagement, participation, and knowledge construction for all learners. It is also likely that well-designed instructional strategies help to reduce gender disparities when students are actively involved in the learning process. This finding is consistent with the studies of Nwankwo and Oladipo (2022) and Omole and Ajayi (2020), which reported that learner-centered instructional approaches often yield gender-neutral outcomes in science education. However, the result differs from the findings of Adeyemi and Afolabi (2021) and Adebayo and Yusuf (2021), who suggested that gender may interact with instructional methods to influence students' achievement and retention in science. The differences observed across studies may be due to variations in research design, subject focus, duration of instruction, and contextual factors such as school environment and students' prior learning experiences.

Conclusion

From the findings of the study, it was concluded that scenario-based instruction led to a significant improvement in students' academic performance in Basic Science when compared to the lecture method. The results also showed that, although both male and female students benefited from this instructional approach, male students achieved slightly higher scores. Nevertheless, the interaction between instructional method and gender was not statistically significant, suggesting that the effectiveness of scenario-based instruction does not depend on students' gender. In general, the study demonstrated that the use of innovative, learner-centered teaching strategies such as scenario-based instruction can effectively enhance students' comprehension and academic achievement in Basic Science.

Recommendations

In line with the findings of the study, the following recommendations are proposed:

1. Basic Science teachers should integrate scenario-based teaching approaches into their classroom practices to promote better understanding and enhance students' academic performance.
2. Curriculum developers and educational authorities should include scenario-based instructional methods in Basic Science curricula and teacher education programmes.
3. Teachers should foster engaging and participatory classroom environments that support the active involvement of both male and female students during scenario-based learning activities.
4. Relevant educational stakeholders should provide continuous training through workshops and professional development initiatives to equip teachers with the necessary competencies for effective implementation of scenario-based instruction.

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