



doi:10.5281/zenodo.19676074

Scenario-Based Pedagogy And Students' Retention Of Basic Science Concepts Under Controlled Instructional Conditions In Delta State

Umukoro Ogheneovo Emmanuel

Primary Education Department, College of Education, Warri, Delta State, Nigeria.

Email: umukoroemmao@gmail.com +2348060402780

ABSTRACT

This study examined the effect of scenario-based instruction on students' retention of Basic Science concepts in comparison with the lecture method. The study adopted a quasi-experimental non-randomized pretest–posttest control group design. The population comprised 174,570 Basic Eight students in public secondary schools in Delta State, Nigeria. A sample of 216 students drawn from selected public co-educational secondary schools participated in the study. Data were collected using the Basic Science Achievement Test, a multiple-choice instrument developed from standardized examination items covering selected Basic Science topics. The instrument was validated by experts in science education and measurement, and its reliability was established using the Kuder–Richardson Formula 21 with a coefficient of 0.88. Students in the experimental group were taught using scenario-based instruction, while those in the control group were taught using the lecture method for a period of six weeks. A delayed posttest was administered four weeks after the posttest to determine students' retention of the concepts taught. Mean and standard deviation were used to answer the research questions, while analysis of covariance was used to test the hypotheses at the 0.05 level of significance. The findings revealed that students taught using scenario-based instruction demonstrated higher retention than those taught using the lecture method. The results also showed that there was no significant difference in the retention of male and female students taught using scenario-based instruction, and no significant interaction effect between instructional method and gender on students' retention. The study concludes that scenario-based instruction enhances students' retention of Basic Science concepts and provides equitable learning outcomes across gender. It is therefore recommended that science teachers integrate scenario-based instructional approaches into classroom practice to improve students' retention and engagement in Basic Science learning.

Keywords: Scenario-based instruction, lecture method, retention, Basic Science, gender differences, quasi-experimental design.

INTRODUCTION

Science education plays a crucial role in developing learners' understanding of natural phenomena, problem-solving abilities, and scientific reasoning required for societal and technological advancement. At the basic education level, Basic Science serves as a foundation for further learning in science-related disciplines and helps students develop curiosity, inquiry skills, and conceptual understanding. However, despite the importance of Basic Science in the school curriculum, concerns have continued to emerge regarding students' ability to retain scientific concepts after instruction. Retention of learned material is essential because meaningful learning is not only reflected in immediate academic performance but also

in the ability of learners to recall and apply knowledge over time in different contexts. Scholars have emphasized that effective instructional strategies are central to improving students' learning outcomes and retention in science education (Ekundayo, 2012; Ertmer & Newby, 2013).

In many classrooms, the lecture method remains one of the most widely used instructional approaches in teaching science subjects. The method is often preferred because it allows teachers to cover large portions of the syllabus within a limited time and maintain control of classroom activities. However, the lecture method is often characterized by passive learning, limited student interaction, and minimal opportunities for learners to apply knowledge in real-life situations. Studies have suggested that excessive reliance on traditional teaching methods may limit students' conceptual understanding and retention of learned content (Abdulbaki *et al.*, 2018; Omoregie & Nwosu, 2022). As a result, educational researchers and practitioners have continued to advocate for innovative and learner-centered instructional approaches capable of improving students' engagement and long-term retention of knowledge in science classrooms.

One instructional approach that has gained increasing attention in science education is scenario-based instruction. Scenario-based pedagogy involves presenting learners with real-life or simulated situations that require them to analyze problems, apply prior knowledge, and develop solutions collaboratively. This approach is grounded in constructivist learning principles, which emphasize active participation and knowledge construction through meaningful experiences. Research has shown that learning environments that encourage inquiry, problem-solving, and contextual application of knowledge tend to enhance students' understanding and retention of concepts (Aslan, 2019; Hassan *et al.*, 2023). In addition, studies have indicated that scenario-based and problem-oriented instructional strategies can significantly improve students' academic achievement and retention in science-related subjects (Olatoye & Ogunleye, 2020; Zulueta & Panoy, 2022).

Another important issue frequently examined in science education research is gender differences in learning outcomes. Over the years, scholars have explored whether male and female students benefit equally from different instructional strategies. Some studies have suggested that learner-centered and interactive teaching approaches can reduce gender disparities in science learning and promote equitable outcomes among students (Akinwale & Ojo, 2021; Nwankwo & Oladipo, 2022). However, other studies have reported that gender may still influence students' academic performance and retention depending on the instructional strategy and classroom environment (Adesope & Okonkwo, 2022). These mixed findings suggest the need for further investigation into how instructional methods interact with gender to influence learning outcomes in science education.

Although several studies have examined the effectiveness of innovative teaching strategies in science education, there is still a need to provide empirical evidence on how scenario-based instruction influences students' retention of Basic Science concepts, particularly when compared with the lecture method. In addition, limited studies have simultaneously examined retention outcomes and gender differences within the context of scenario-based pedagogy in Basic Science classrooms. Therefore, this study was undertaken to examine students' retention of Basic Science concepts when taught using scenario-based instruction and lecture method, as well as to determine whether gender plays any role in students' retention under these instructional conditions.

Statement of the Problem

The teaching and learning of Basic Science at the junior secondary school level are expected to equip students with foundational scientific knowledge and skills that can support further learning in science and related disciplines. However, in many educational contexts, students often demonstrate difficulty in retaining scientific concepts after instruction. This situation raises concerns because retention is a critical indicator of meaningful learning and the extent to which instructional experiences enable students to internalize and recall knowledge over time. When students are unable to retain previously learned concepts, it may affect their academic progression, reduce their confidence in science subjects, and limit their ability to apply scientific ideas in real-life situations. This challenge has continued to stimulate discussions on the effectiveness of instructional approaches commonly used in Basic Science classrooms.

Although teachers frequently rely on conventional teaching approaches such as the lecture method, questions remain regarding the extent to which such approaches support sustained understanding and retention of scientific concepts among students. Increasing attention has therefore been directed toward instructional strategies that emphasize active participation, contextual learning, and meaningful engagement with subject matter. Among such approaches is scenario-based instruction, which is designed to situate learning within realistic contexts that may enhance students' understanding and memory of concepts. At the same time, concerns about possible gender-related differences in learning outcomes continue to attract interest in science education research. In view of these considerations, the central issue that necessitated this investigation was: What is the effect of scenario-based instruction compared with the lecture method on students' retention of Basic Science concepts, and does gender influence students' retention under these instructional conditions?

Purpose of the Study

The main purpose of this study was to examine students' retention of Basic Science concepts when taught using scenario-based pedagogy compared with the lecture method. Specifically, the study sought to:

1. compare the mean retention scores of students taught Basic Science using scenario-based instruction and lecture method;
2. determine the difference in mean retention scores of male and female students taught Basic Science using scenario-based instruction;
3. examine the interaction effect of instructional method and gender on students' retention in Basic Science.

Research Questions

The following research questions guided the study:

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

Hypotheses

The following null hypotheses which guided the study were tested at 0.05 level of significance:

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

METHODS

This study adopted a quasi-experimental research design, specifically the non-randomized pretest–posttest control group design. The design was considered appropriate because it enabled the researcher to examine the effect of instructional strategies on students' learning outcomes in a natural school setting where random assignment of individual students to groups was not feasible. Intact classes were therefore used and assigned to treatment groups without disrupting normal school activities. The design allowed for the administration of a pretest before treatment, a posttest after the instructional period, and a delayed posttest to determine students' retention of Basic Science concepts. In this study, two instructional conditions were compared: scenario-based instruction and the lecture method. The independent variable was the instructional method, while the dependent variable was students' retention of Basic Science concepts. Gender served as a moderating variable.

The population for the study comprised all Upper Basic students in public secondary schools in Delta State. Specifically, Basic Eight students enrolled in public secondary schools formed the target population

because they were actively engaged in Basic Science learning and were available during the period of the study. The population consisted of 174,570 Basic Eight students distributed across the 473 public secondary schools in the three senatorial districts of Delta State, namely Delta Central, Delta North, and Delta South. From this population, a sample of 216 students drawn from selected public co-educational secondary schools participated in the study. Co-educational schools were considered appropriate to enable comparison of male and female students in relation to the instructional strategies used.

The sample was selected using a multi-stage sampling technique. First, public co-educational secondary schools in Delta State were grouped according to the three senatorial districts. Thereafter, schools were selected through simple random sampling to ensure that each eligible school had an equal chance of being included in the study. Intact Basic Eight classes in the selected schools constituted the participants used for the study. The intact classes were then assigned to either the scenario-based instruction group or the lecture method group. This approach ensured that the natural classroom structure was maintained while enabling comparison between the instructional methods.

Data for the study were collected using the Basic Science Achievement Test (BSAT). The instrument consisted of 50 multiple-choice items developed from past Basic Education Certificate Examination questions covering selected Basic Science topics, including simple machines, kinetic energy, and thermal energy. The instrument contained two sections. Section A elicited demographic information such as students' school and gender, while Section B consisted of objective test items designed to measure students' understanding of the selected concepts. Each item had four response options, with one correct answer and three distracters. The instrument was scored by awarding one mark for each correct response and zero for incorrect response, and the total scores were converted into percentages. The same instrument was used for the pretest, posttest, and delayed posttest in order to determine both students' achievement and retention of the taught concepts.

The validity of the instrument was established through experts review and content validation procedures. Experts in science education, classroom teaching, and measurement and evaluation examined the instrument, lesson plans, and study objectives to ensure that the items were appropriate, relevant, and representative of the content taught during the instructional period. Their comments and suggestions led to modifications that improved the clarity, relevance, and adequacy of the instrument. Content validity was further ensured through the development of a table of specification which guided the distribution of items across content areas and cognitive levels. In addition, the construct validity of the instrument was determined through item analysis procedures, including the calculation of item difficulty and discrimination indices to ensure that the test items functioned appropriately in distinguishing between high and low achievers.

The reliability of the instrument was determined using the Kuder–Richardson Formula 21, which is suitable for objective test items with dichotomous scoring. The instrument was trial-tested on students outside the study area who possessed similar characteristics to those in the main study. The reliability analysis yielded a coefficient of 0.88, indicating that the instrument had a high level of internal consistency and was suitable for use in the study.

The treatment procedure involved several stages. First, the selected schools were assigned to the respective instructional groups. Teachers in the participating schools served as research assistants and were briefed on the objectives and procedures of the study. Teachers assigned to the scenario-based instruction group received training on the implementation of the strategy to ensure uniformity in lesson delivery. The training emphasized the development and presentation of realistic learning scenarios, facilitation of group discussions, and guidance of students in identifying and solving problems embedded in the scenarios. Teachers assigned to the lecture method group implemented lessons using conventional instructional procedures based on structured explanation and teacher-led classroom interaction.

Prior to the commencement of the treatment, students in all groups were administered the pretest to determine their initial level of understanding of the selected Basic Science concepts. The treatment lasted for six weeks, during which students were taught the same topics using their respective instructional approaches. Each group received instruction for two periods per week, with each period lasting forty

minutes. At the end of the instructional period, the posttest was administered to assess students' learning outcomes after exposure to the instructional strategies. A delayed posttest was conducted four weeks after the posttest to measure students' retention of the learned concepts.

Efforts were made to control potential extraneous variables that could influence the outcome of the study. Uniform lesson plans were used across the groups to ensure consistency in content coverage. Teachers involved in the study had similar professional qualifications and teaching experience to minimize teacher-related variations. The use of regular classroom teachers also helped reduce possible experimental bias among students. Additionally, the time interval between the pretest, treatment, posttest, and delayed posttest was carefully structured to minimize testing effects and ensure that retention could be accurately measured.

Data collected from the study were analyzed using both descriptive and inferential statistical methods. Descriptive statistics, including mean and standard deviation, were used to answer the research questions relating to students' retention scores across instructional groups and gender. Inferential statistics were employed to test the hypotheses formulated for the study at the 0.05 level of significance. Analysis of covariance was used to determine the effect of instructional method on students' retention while controlling for pretest scores. The statistical analyses were carried out using SPSS software to ensure accuracy and reliability of the results.

RESULTS

Table 1: Mean Retention Scores by Instructional Method

Group	N	Posttest		Retention		Mean lost
		Mean (\bar{x})	SD	Mean (\bar{x})	SD	
SBI	93	62.80	10.06	58.97	8.85	3.83
LM	123	49.22	10.71	42.63	10.10	6.59

The results in Table 1 showed that students taught Basic Science using scenario-based instruction obtained higher mean posttest scores ($M = 62.80$, $SD = 10.06$) and retention scores ($M = 58.97$, $SD = 8.85$) than those taught using the lecture method (posttest: $M = 49.22$, $SD = 10.71$; retention: $M = 42.63$, $SD = 10.10$). In addition, the mean loss between posttest and retention scores was smaller for students in the scenario-based instruction group (3.83) compared with those in the lecture method group (6.59). This indicates that scenario-based instruction enhanced students' retention of Basic Science concepts more effectively than the lecture method.

Table 2: ANCOVA of Retention by Instructional Method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	31066.732 ^a	2	15533.366	1214.048	.000
Intercept	66.573	1	66.573	5.203	.024
Post	16938.171	1	16938.171	1323.844	.000
Methods	844.855	1	844.855	66.032	.000
Error	2725.268	213	12.795		
Total	566616.000	216			
Corrected Total	33792.000	215			

Table 2 presents the ANCOVA results examining the effect of instructional method on students' retention while controlling for posttest scores. The findings revealed a statistically significant effect of instructional method on retention, $F(1, 213) = 66.032$, $p < .05$. This indicates that the difference in retention scores between students taught using scenario-based instruction and those taught using the lecture method is significant. Therefore, the null hypothesis was rejected, implying that instructional method significantly influenced students' retention in Basic Science.

Table 3: Mean Retention Scores by Gender in SBI Group

Group	N	Posttest		Retention		Mean lost
		Mean (\bar{x})	SD	Mean (\bar{x})	SD	
Male	47	66.98	9.87	62.04	8.95	4.94
Female	46	58.52	8.38	55.83	7.65	2.69

Table 3 indicates that male students taught using scenario-based instruction had slightly higher mean posttest scores ($M = 66.98$, $SD = 9.87$) and retention scores ($M = 62.04$, $SD = 8.95$) than female students (posttest: $M = 58.52$, $SD = 8.38$; retention: $M = 55.83$, $SD = 7.65$). However, the mean loss was greater among male students (4.94) compared with female students (2.69). Although differences exist in the mean scores, further statistical analysis is required to determine whether the observed differences are statistically significant.

Table 4: ANCOVA of Retention by Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6412.963 ^a	2	3206.482	360.756	.000
Intercept	59.952	1	59.952	6.745	.011
Posttest	5514.584	1	5514.584	620.437	.000
Sex	17.935	1	17.935	2.018	.159
Error	799.940	90	8.888		
Total	330592.000	93			
Corrected Total	7212.903	92			

The ANCOVA results in Table 4 showed that gender had no statistically significant effect on students' retention when taught using scenario-based instruction, $F(1, 90) = 2.018$, $p = .159$. Since the p-value is greater than the 0.05 level of significance, the null hypothesis was not rejected. This implies that male and female students retained Basic Science concepts at comparable levels when taught using scenario-based instruction.

Table 5: Retention by Method and Gender

Methods	SBI			LM		
	N	Mean	SD	N	Mean	SD
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	
Retention						
Male	47	62.04	8.95	76	42.47	9.31
Female	46	55.83	7.65	47	42.39	11.37
MD		6.21			0.42	

Table 5 shows the mean posttest and retention scores of male and female students across instructional methods. Students taught using scenario-based instruction recorded higher posttest and retention mean scores than those taught using the lecture method for both male and female groups. The mean differences also indicate that the advantage of scenario-based instruction over the lecture method is evident across genders. However, the differences between male and female students within each method appear relatively small, suggesting that gender may not strongly influence retention when instructional method is considered.

Table 6: ANCOVA of Method–Gender Interaction

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	31194.884 ^a	4	7798.721	633.599	.000
Intercept	38.877	1	38.877	3.159	.077
Post	16162.823	1	16162.823	1313.132	.000
Methods	676.154	1	676.154	54.933	.000
Sex	109.285	1	109.285	8.879	.003
Methods * Sex	7.711	1	7.711	.626	.430
Error	2597.116	211	12.309		
Total	566616.000	216			
Corrected Total	33792.000	215			

Table 6 presents the ANCOVA results for the interaction effect of instructional method and gender on students' retention. The interaction effect was not statistically significant, $F(1, 211) = 0.626$, $p = .430$. Since the p-value is greater than 0.05, the null hypothesis was not rejected. This indicates that the effect of instructional method on students' retention does not depend on gender. In other words, scenario-based instruction improves retention similarly for both male and female students.

DISCUSSION

The study revealed that students taught Basic Science using scenario-based instruction demonstrated higher retention than those taught using the lecture method. This finding indicates that scenario-based pedagogy is more effective in enhancing students' retention of Basic Science concepts than the conventional lecture method. The result suggests that students exposed to contextual and real-life learning situations were able to retain the learned concepts better over time. A plausible explanation for this finding is that scenario-based instruction promotes active engagement, critical thinking, and meaningful learning, which improve students' understanding and ability to recall information. Another probable reason is that students became more motivated and involved in the learning process when instructional activities were connected to real-life situations rather than passive listening associated with the lecture method. This finding agrees with the study of Olatoye and Ogunleye (2020), who reported that scenario-based teaching significantly improved students' achievement and retention in Basic Science. The finding is also supported by the study of Oyovwi and Umukoro (2022), which revealed that problem-solving instructional strategies enhanced students' retention of Basic Science concepts. However, the finding contrasts with the study of Abdulbaki, Suhaimi, Alsaqqaf, and Jawad (2018), who found that the lecture method could still produce meaningful learning outcomes in classroom instruction. It also differs from the findings of Omoregie and Nwosu (2022), who reported that both lecture and participatory teaching strategies could produce comparable learning outcomes in Basic Science classrooms. The difference between the present finding and previous studies may be attributed to differences in instructional design, level of students' engagement, duration of treatment, and the learning environment in which the studies were conducted.

Another finding of the study showed that there was no significant difference in the retention scores of male and female students taught Basic Science using scenario-based instruction. This finding implies that scenario-based pedagogy provides equal learning opportunities for both male and female students, resulting in similar retention levels. The result indicates that gender did not significantly influence how students retained Basic Science concepts when taught using this instructional approach. A possible explanation for this finding is that scenario-based learning promotes collaboration, participation, and interaction among learners regardless of gender. Another probable reason is that the strategy encourages learners to construct knowledge actively through discussions and real-life problem-solving activities, thereby minimizing gender disparities in learning outcomes. This finding supports the study conducted by Akinwale and Ojo (2021), who found that interactive teaching strategies promote similar retention outcomes among male and female students in science education. The finding also agrees with the results

of Nwankwo and Oladipo (2022), who reported that collaborative and problem-based learning approaches lead to gender-neutral retention in science classrooms. However, this result contrasts with the findings of Adesope and Okonkwo (2022), who found that gender differences could influence the effectiveness of scenario-based learning in science education. It also differs from the study of Eze and Adamu (2019), who reported disparities in knowledge retention between male and female students when learner-centered strategies were used. The variation between the present finding and previous studies may be attributed to differences in sample characteristics, classroom interaction patterns, cultural context, and the level of participation encouraged during instruction.

Furthermore, the study found that there was no significant interaction effect between instructional method and gender on students' retention in Basic Science. This finding means that the effectiveness of scenario-based instruction in improving students' retention is consistent across both male and female students. In other words, gender did not moderate the influence of instructional method on students' retention of Basic Science concepts. This suggests that scenario-based pedagogy can serve as a gender-inclusive teaching strategy capable of improving learning outcomes for all learners. One possible explanation for this finding is that the instructional approach focuses on real-life problem situations that require collaboration and shared reasoning, which benefits both male and female students equally. Another probable reason is that the structured learning environment created through scenarios reduces gender bias and encourages equal participation during learning activities. This finding is consistent with the study of Adebayo and Yusuf (2021), who reported that learner-centered teaching strategies improved retention without significant gender interaction effects. It also aligns with the study of Okafor and Bello (2020), who found that gender did not significantly interact with instructional strategies in influencing knowledge retention in Basic Science. In contrast, the finding differs from the results of Olatoye and Oladipo (2022), who reported that gender could moderate the effectiveness of problem-based learning in science achievement. It also contradicts the findings of Musa and Ibrahim (2020), who observed that gender differences sometimes influence learning outcomes in active learning environments. The differences between the present finding and earlier studies may be due to variations in subject area, instructional procedures, treatment duration, and learner characteristics across the different studies.

CONCLUSION

Based on the findings of the study, it was concluded that scenario-based instruction is more effective than the lecture method in improving students' retention of Basic Science concepts. The study also concluded that male and female students retained Basic Science concepts at comparable levels when taught using scenario-based instruction. Furthermore, the effectiveness of scenario-based instruction in enhancing retention was not influenced by gender, indicating that the strategy is suitable for both male and female students in Basic Science classrooms.

RECOMMENDATIONS

Based on the findings and conclusion of the study, the following recommendations were made:

1. Teachers of Basic Science should adopt scenario-based instruction in classroom teaching in order to improve students' retention of scientific concepts.
2. Curriculum planners and education authorities should incorporate scenario-based learning activities into the Basic Science curriculum to promote active and meaningful learning.
3. Workshops and training programmes should be organized for teachers to equip them with the skills required to effectively implement scenario-based instructional strategies in schools.
4. Schools should encourage the use of learner-centered instructional approaches that engage both male and female students equally in the learning process.

REFERENCES

- Abdulbaki, K., Suhaimi, M., Alsaqqaf, A., & Jawad, W. (2018). The impact of using the lecture method on teaching English at university. *European Journal of Education Studies*, 4(5), 285–302.
- Adebayo, R. O., & Yusuf, M. O. (2021). Lecture method and gender differences in retention of Basic Science concepts among junior secondary school students. *Journal of Educational Research and Practice*, 11(2), 84–93.
- Adesope, T. O., & Okonkwo, C. A. (2022). Gender differences in the effectiveness of scenario-based learning in science education. *International Journal of Science Education*, 44(6), 985–1001. <https://doi.org/10.1080/09500693.2022.2031942>
- Akinwale, A. B., & Ojo, R. M. (2021). Gender and retention in science education: The influence of interactive teaching strategies. *Journal of Educational Psychology and Pedagogy*, 9(2), 76–85.
- Aslan, S. (2019). The impact of argumentation-based teaching and scenario-based teaching method on the students' academic achievement. *Journal of Baltic Science Education*, 18(2), 171–183.
- Ekundayo, M. B. (2012). *Teaching science in Africa*. Mede Nigeria Limited.
- Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly*, 26(2), 43–71. <https://doi.org/10.1002/piq.21143>
- Hassan, K. A., Hammadi, S. S., & Majeed, H. B. (2023). The impact of a scenario-based teaching model in mathematics achievement and mental motivation for high school students. *International Journal of Emerging Technologies in Learning*, 18(7), 103–115.
- Nwankwo, C. E., & Oladipo, O. F. (2022). Collaborative learning and gender-neutral retention in problem-based science education. *Journal of STEM Education Research*, 6(3), 121–133.
- Okafor, J. C., & Bello, A. L. (2020). The effect of problem-based learning on knowledge retention: A gender perspective. *Nigerian Journal of Science and Technical Education*, 9(1), 55–64.
- Olatoye, R. A., & Ogunleye, T. A. (2020). The impact of scenario-based teaching on achievement and retention in Basic Science. *African Journal of Educational Studies in Mathematics and Sciences*, 16(2), 54–65.
- Omorie, F. N., & Nwosu, H. O. (2022). Comparative analysis of lecture method and participatory teaching strategies in Basic Science classrooms. *African Journal of Pedagogical Studies*, 14(3), 201–212.
- Oyovwi, E. O., & Umukoro, O. E. (2022). Enhancing students' retention level of basic science curriculum concepts through problem solving instructional strategy. *Innovation*, 70, 144–150.
- Zulueta, L. F., & Panoy, J. D. (2022). Scenario-based microlearning strategy for improved basic science process skills in self-directed learning. *International Journal of STEM Education*, 2(4), 54–73. <https://media.neliti.com/media/publications/558933-scenario-based-microlearning-strategy-fo-c6fb3cca.pdf>