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EFFECTS OF EXPERIENTIAL SPATIAL PROBLEM-BASED LEARNING INSTRUCTIONAL MODEL ON STUDENTS' INTEREST IN STUDYING GEOGRAPHY AND RETENTION OF KNOWLEDGE: ACHIEVEMENT AS A MEDIATOR

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ABSTRACT

This is a study on the effects of the Experiential Spatial Problem-based Learning (ESPBL) Model on the interest, achievement, and retention of knowledge in Geography problem-based topics in Plateau State, Central Nigeria. A set of four research questions was posed and four hypotheses formulated to guide the investigation. A quasi-experimental design for independent groups was adopted and a sample of 47 Geography students spread into an experimental group (27 students) and a control group (20 students) was used. Data was collected using the Spatial Problem-based Achievement Test (SPBAT) and Spatial Problems Interest Inventory (SPII) with reliability coefficients of .96 and .88 respectively, tested using the Pearson Product Moment and Cronbach Alpha techniques in that order. Data was analysed using mean, standard deviation, analysis of covariance (ANCOVA), the Linear Regression Model (LRM), and the Andrew Hayes' Process Macro (version 4.2). The study gathered that the ESPBL model significantly increased the academic achievement and interest of student in the experimental group compared to the control group. The interest of students in learning was found to be a strong predictor of their retention of learning. Evidence from the study also showed that academic achievement significantly mediated the relationship between students' interest and retention of knowledge. The study recommends Geography and science teachers to follow the instructional plan for applications in various fields and provide training for teachers interested in practical application of the models to solve environmental problems.

KEYWORDS: *ESPBL model, retention, interest, academic achievement, Geography problem-based topics.*

INTRODUCTION

Geography is one of the core subjects taught at the senior secondary school level in Nigeria. According to the Nigerian National Policy on Education (NPE) (2009), Geography is concerned with the understanding of the earth as a planet and the activities of man on it. Waugh's (2009) definition of Geography as spatial interaction is concise and comprehensive. Waugh's definition means that the study of Geography constitutes an investigation of the interactions that occur on the surface of the earth or near it. The scope of Geography includes studying the biotic and abiotic interactions, techniques of Geographic investigation (such as Geographic Information Systems and remote sensing), and spatial distribution of phenomena on the earth's surface. Hence Geography is a spatial science because it studies interactions and distribution of phenomena in space systematically.

The study of the interrelationships between man and his environment and what the relationship generates is crucial in the study of Geography. The man-environment interaction, though with boundless benefits, has left us with numerous environmental problems and relics of some others. This is a result of man's exploration and exploitation of the natural resources in the environment (Singh & Sharma, 2016). Because of the inability of man to maintain a sustainable balance in the use of resources in the environment, the entire globe battles environmental problems including climate change, pollution (air, land, and water), acid rain, loss of forests, poor sanitation/hygiene, floods, erosion, diseases and many others, Singh and Singh added. Following the degeneration of the environment, due largely to anthropogenic factors, we are currently faced with the above-stated crisis of local and global dimensions. In response, global efforts, majorly through the United Nations (UN) have been directed toward addressing these crises since the mid-20th century.

The effort that would be significant in addressing environmental problems embattling man must be both local and universal. No effort toward prevention, mitigation, and adaptation must be spared. Penetrating schools and learning institutions with workable ideas for addressing environmental problems can have far-reaching results as schools largely host youth populations. In a school setting, the methods used in conveying information to students affect the quality of learning. To address spatial problems, teaching, and learning approaches that create room for learners to explore spatial problems and proffer solutions that address them must be priorities. Rote learning or memorization has never achieved this goal. This is because, beyond students' ability to remember contents, they must engage experientially in advancing concrete methods and actions that address environmental problems and execute the same. One such approach is the Experiential Spatial Problem-based Learning (ESPBL) Model postulated by Dakur in 2023.

The ESPBL model is a composite of experiential, spatial, and problem-based learning strategies that if well executed,

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guarantee learners gain maximum benefit from the instructional process. As opposed to teacher-centered learning approaches such as lecture and chalk-talk, the ESPBL model puts the learner at the center of the instruction. Dakur (2023) in "Guide to Teaching Geography for achieving analytical skills among secondary school students" makes a deep exposition of the execution of the ESPBL model, highlighting in detail, the roles of the teacher and the learners during instruction. See Figure 1. This is particularly appropriate for instruction on diverse environmental problems.

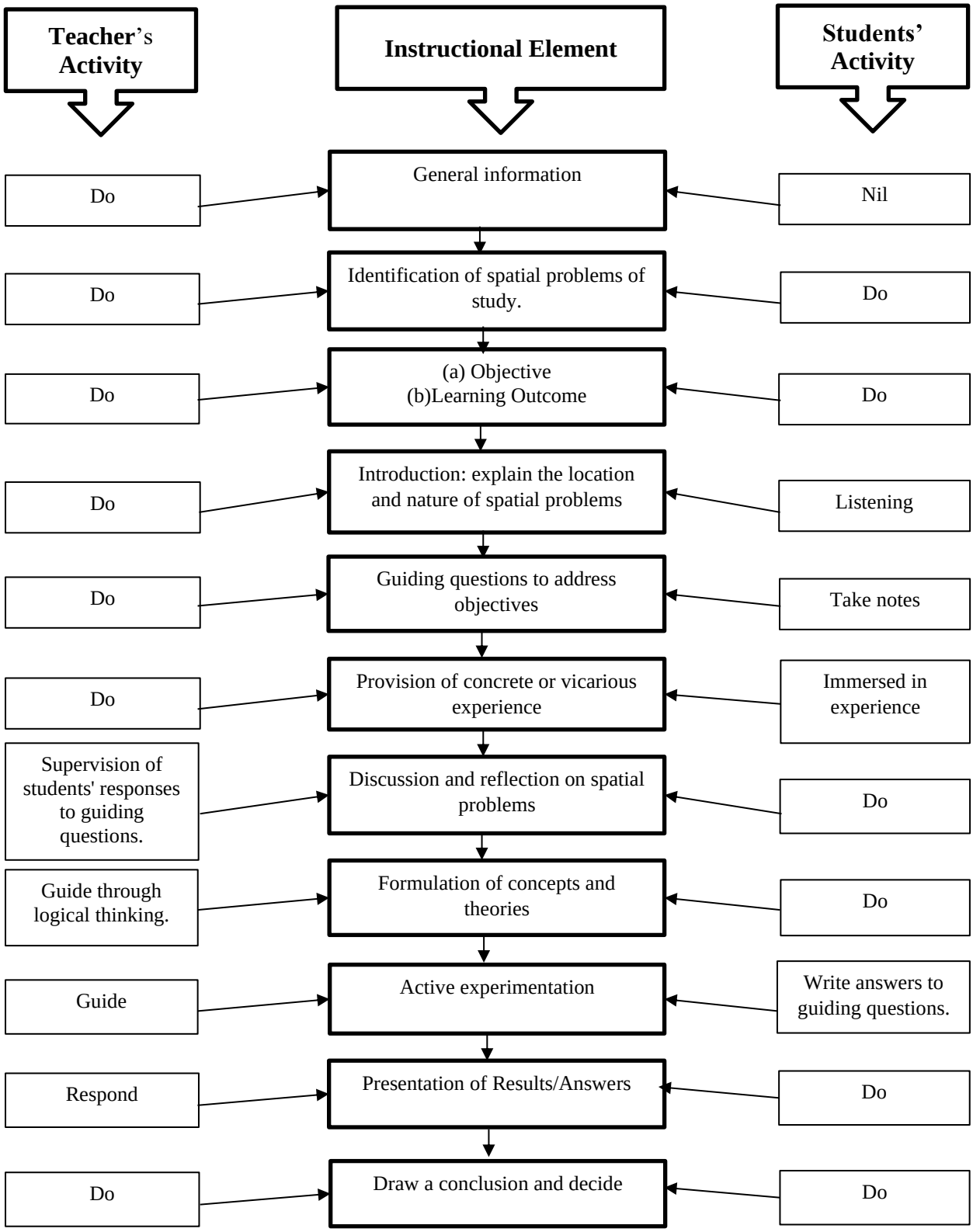


Figure 1: Instructional Guide for Experiential Spatial Problem-Based Learning (ESPBL)

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In executing ESPBL, a spatial problem such as deforestation is identified and the teacher and students engage in several experiential activities such as readings, discussions, explanations, questioning, hands-on activities, experiments, proffering solutions, presentations, and drawing conclusions. An example of a step-by-step instructional plan on the topic Deforestation (an environmental problem) is presented as follows to serve as a guide to the interesting reader.

Topic: Environmental Problems – Deforestation
Teaching Method: Experiential Spatial Problem-based Learning (ESPBL)
Resources: Textbooks, charts, video clips, fieldwork.
Entry Knowledge: Students have seen people cutting trees for fuel wood.
Learning outcome: At the end of the lesson, students should be able to do the following:

a. Explain the meaning of deforestation.
b. Locate some areas affected by deforestation in Nigeria and around the school.
c. Explain the causes of deforestation.
d. Explain the effects of deforestation.
e. Explain the methods of preventing deforestation.
f. Perform some activities to control deforestation.

Introduction

1. The teacher briefly explains the following while students listen:
   a. The meaning and location of the spatial problem (Deforestation) – The permanent destruction of forests. It involves the clearance of forest trees usually as a result of human activities like agriculture, urbanization, logging, etc. Areas affected include the Amazon Forest, Madagascar, the Congo Basin, the forests of Nigeria, and many more.
   b. Explain the causes of deforestation including (Agriculture, urbanization, logging, fuel wood gathering poverty, and mining).
   c. Explain the effects of deforestation as follows:
      - Climate change.
      - Loss of biodiversity.
      - Soil erosion.
      - Ecological imbalance and Indigenous communities
      - Water cycle disruption.
   d. Explain the methods of preventing deforestation:
      - Conservation efforts
      - Sustainable forest management
      - Restoration and afforestation
      - Policy and legislation.
      - Community-led forest management.
      - Education and awareness.
2. Teachers raise thought-provoking questions with respect to (a)-(d) in (1) above. The questions should include:
   a. What is deforestation and where can we locate deforestation?
   b. What are the causes of deforestation?
   c. What are the effects of deforestation?
   d. How can you prevent deforestation?

Presentation

Step	Teacher's Activity	Students' Activity
1	The teacher raises the following provoking questions: a. What is deforestation and where can we locate deforestation? b. What are the causes of deforestation? c. What are the effects of deforestation? d. How can you prevent deforestation?	a. Students read materials on deforestation in groups a. They also take notes from the reading materials. b. Students discuss, ask questions, and answer questions from the teacher as they read materials.
2	a. The teacher projects video clips and explains: - The meaning of deforestation. - Locate some areas affected by deforestation in Nigeria and around the school. - The causes of deforestation. - The effects of deforestation. - Explain the methods of preventing deforestation. b. Where possible, the teacher takes the students out to observe: - Deforestation at nearby locations. - Causes of deforestation. - Effects of soil deforestation. - Methods of preventing deforestation.	a. Students observe both concrete and vicarious evidence on: - Meaning of deforestation. - Location of deforestation. - Causes of deforestation. - Effects of deforestation - Methods of preventing deforestation. b. Students ask questions c. Students discuss in groups.
3	a. The teacher responds to students' questions. b. Helps students in their discussions on deforestation. c. Guides students to reflect on their discussions.	a. Students reflect on deforestation b. Students discuss c. Students ask and answer questions

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4	a. Guide the students to form their different concepts of deforestation.	c. Form individual notes and concepts of deforestation. For example, "Deforestation is always faster than reforestation or afforestation"
5	a. Direct students in their groups to some sites where deforestation is taking place in their immediate environment to identify: i. Causes of deforestation. ii. Effects of soil deforestation. iii. Methods of preventing deforestation. b. Supervise the activities of students to ensure they are executed. c. Gather students after the expiration of the time of outdoor activities. **Note**: The sites could be nearby lumbering areas or old deforested sites	a. The students should go as directed by the teacher to old or active deforestation sites to carry out i – iii. b. Make observations of the deforested sites. c. Take immediate action against the deforestation activity where possible or recommend prevention strategies. d. Each group makes notes on activities carried out.
6	a. Set up students to make presentation of the reports of their activities group by group to the entire class. b. The teacher discusses the report together with the class in turns	a. Students make presentations of reports in groups. b. Effect corrections as made by the teacher
7.	a. Conclude with the students on deforestation as a spatial problem.	b. Students take note of the conclusions drawn by the teacher together with the class on deforestation.

The ESPBL model therefore presents us with a strategy capable of instilling a deep understanding of spatial problems and suggests practicable solutions. This means that at the end of the lesson, learners are not only knowledge absorbers but also solution providers. This builds students' critical thinking and problem-solving skills, which are revered skills in school graduates. This also prepares the students to solve real-world problems upon graduation.

It is equally worth noting that teaching method share a strong relationship with learning of content and achievement. According to Yilmaz and Korur (2021), teaching strategy significantly improves students' achievement. Tran (2014) also reported that students who were taught using the cooperative method of teaching achieved significantly higher than those taught using the lecture-based method. The inquiry method of teaching has proven to be more effective in improving the academic achievement of students in science subjects than non-inquiry methods (Kogan, & Laursen, 2014). Online Advance Organizer Concept Teaching Material (ONACOM) was effective in improving students' achievement in science (Korumaz, 2018), resulting in better students' achievement. Also, students taught algebraic concepts using the think-pair-share method performed better academically than those taught using the conventional method. These studies suggest that teaching method is a critical factor in teaching and learning. It is in this light that the researchers sought to investigate the effects of the ESPBL model on students' interest and retention of achievement in Geography.

It is important for students to not only achieve high in school subjects, but more important for the students to remember what they have learned in the future. For this reason, teaching methods such as the ESPBL that spur students toward critical thinking, deep learning, and problem-solving skills are experimented with. Retention of knowledge entails the students' ability to remember what has been taught after the period of instruction. Retention is the ability of students to recall things experienced or learned (Badar, Bala & Bello, 2024). Okeke (2015) opined that retention is the learners' ability to repeat performance earlier acquired after some time. The goal of every instruction is to instill knowledge, skills, and experiences in learners that could be remembered in the future, especially to solve relevant problems. If students do not recall their learning, their academic achievement suffers losses. In the opinion of Jimoh, Mamman & Kaseem (2020), retention of learning and enduring academic achievement have a strong connection. This suggests that the more students can retain their knowledge, the higher would be their academic achievement. Several factors are responsible for students' ability to recall knowledge or experience including self-discipline, quality of teachers and student interaction (Gaytan, 2013), and the methods or strategies used in teaching (Badar, Bala & Bello, 2024). For example, Karacalli and Korur (2014) found that project-based learning had a significant effect, not only on the student's achievement but also on their retention of knowledge. Based on the tenets of the ESPBL strategy, it holds strong potential to engender deep learning and promote the recall of past learning and experiences. This is because of the student-centered activities, requiring active readings, discussions, questioning, critical thinking, and proffering of solutions to spatial problems. These activities cement and concretize learning, making it easy for students to remember in the future.

In the studies of educational subjects over the years, students' interest in learning remains non-negotiable. Student's interest is a driving force for paying attention and seeking to know more about something and is inextricably associated with effective learning and achievement (Istifanus & Dakur, 2024). Interest is the zeal or a student's inclination to engage in an activity that gives one pleasure (Duyilemi & Bola, 2014). The interest of students in learning has severally been associated with

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achievement, but not much empirical evidence supports the relationship between interest and retention of learning. For instance, Istifanus and Dakur (2024) submitted that achievement and interest in learning are significantly related. This indicates that teaching methods are strong enough to determine the direction of students' interest, achievement, and retention. The current study seeks an understanding of the linkages between students' interest, achievement, and retention of learning when taught using ESPBL in the treatment group and the conventional method in the control group.

An investigation of the effects of ESPBL on students' interest, knowledge retention, and achievement is the motivation of the researchers in carrying out this study. A careful selection of world-class spatial problems including erosion, deforestation, pollution, and flooding was done, believing students who participate in the instructional process would acquire workable skills to address these problems. The study particularly focused on the students' learning outcomes such as interest in learning, retention of knowledge acquired, and the achievement of the students.

RESEARCH QUESTIONS

Four research questions probe the following:

1. The posttest achievement mean scores of students in the experimental and control groups.
2. The posttest interest mean scores of students in the experimental and control groups.
3. The relationship between interest and retention posttest scores of students of the experimental group.
4. The mediating effect of students' academic achievement on the relationship between interest and retention scores in the experimental group.

HYPOTHESES

Four hypotheses were postulated for the study as follows:

Ho_1: The difference between the experimental and control groups on posttest achievement mean scores is not significant.

Ho_2: The difference between the experimental and control groups on posttest interest mean scores is not significant.

Ho_3: The relationship between students' interest and retention scores is not significant.

Ho_4: The mediating role of students' academic achievement on the relationship between interest and retention is not significant.

METHODOLOGY

A quasi-experimental non-equivalent control group research design was employed for the study, involving two intact classes (one as an experimental group and the other as a control group). The population of the study consisted of senior secondary two (SS 2) Geography students in all senior secondary schools in Jos South Local Government Area of Plateau State, Nigeria, distributed in 92 schools. The sample of the study consisted of 47 students in two randomly selected senior secondary schools in the study area. The experimental group had 27 students while the control group had 20 students. A Spatial Problem-based Achievement Test (SPBAT) and Spatial Problems Interest Inventory (SPII) were used in data collection for pretest, posttest, and retention. The instrument was validated by experts in the field of Geography education. The reliability coefficients of the SPBAT and SPII were tested using Pearson Product Moment and Cronbach Alpha methods respectively to be 0.96 and 0.88. The research questions were answered using mean, standard deviation, and linear regression, while the hypotheses were tested using Analysis of Covariance (ANCOVA), Linear Regression Model (LRM), and Andrew Hayes' Process Macro (version 4.2) for mediation test on SPSS (Version 26) at 0.05 level of significance.

RESULTS

The study's results are presented based on research questions and hypotheses postulated:

Answers to Research Question

The four research questions were answered as follows:

Research Question One: The posttest achievement mean scores of students in the experimental and control groups.

Table 1: Summary of posttest achievement Mean Scores of the Experimental and Control Groups

Group	n	Mean ($\bar{x}$)	Standard Deviation (sd)	Mean Difference
Experimental	27	56.56	23.30	28.46
Control	20	28.10	9.00	

The results in Table 1 reveal that the experimental group had a posttest achievement mean score of 56.56 and a standard deviation of 23.30, while the control group had an achievement mean score of 28.10 and a standard deviation of 9.00. The mean difference of 28.46 was obtained in favour of the experimental group. This indicates that the treatment (using the Experiential Spatial Problem-based Learning model) increased students' achievement in Geography problem-based topics.

Research Question Two: The posttest interest mean scores of students in the experimental and control groups.

Table 2: Summary of posttest interest Mean Scores of the Experimental and Control Groups

Group	n	Mean ($\bar{x}$)	Standard Deviation (sd)	Mean Difference
Experimental	27	73.26	9.56	9.31
Control	20	63.95	10.68	

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The data in Table 2 shows that the experimental group had a posttest interest mean score of 73.26 and a standard deviation of 9.56, while the control group received an interest mean score of 63.96 and a standard deviation of 10.31. The mean difference was 9.31 in favour of the experimental group. This implies that the use of the ESPBL model positively affected students' achievement of spatial problems.

Research Question Three: The relationship between interest and retention scores of students of the experimental groups.

Table 3: Summary of the relationship between Interest and Retention Posttest Scores of the Experimental Group.

Model 1	Coefficient (β)	Standard Error (SE)
Constant		30.610
Interest of the Experimental Group	.445	.414

Table 3 contains the result of the analysis of the relationship between students' interest in spatial problems and their retention scores using the Linear Regression Model (LRM). The results reveal that the relationship is positive and moderately weak (beta = .445). The implication is that as the interest of the students in spatial problems increased, their retention scores also increased.

Research Question Four: The mediating effect of students' academic achievement on the relationship between interest and retention scores in the experimental group.

Table 4a: **Total and Direct Effects of Interest on Retention**

	Effect	SE
Total effect	1.0300	.4144
Direct effect (Interest → Retention)	.0628	.0881

Table 4b: **Summary of Indirect (Mediation) Effect of Achievement based on 5000 Bootstrap Samples.**

	Effect	BootSE
Indirect effect (Interest → Achievement → Retention)	.9672	.3310

Tables 4a and 4b contain the results of the analysis of the mediating effect of posttest achievement on the relationship between interest and retention. The outcome variable was retention, the predictor was interest and the mediating variable was academic achievement. The direct (unmediated) effect of interest and retention relationship as shown in Table 4a, was statistically small (Effect = .0628, SE =.0881). This is established by the small proportion of the Total Effect (1.0300) that the direct effect (.0628) represents. The small SE value (.0881 = 8%) also proposes that a minimal amount of error was involved in computing the reported direct effect, hence improving the reliability of the estimate. Thus, the interest of Geography students in spatial problems has a small direct effect on their retention of learning.

The indirect effect of interest (predictor) on retention (outcome) through achievement (mediator) path based on 5000 bootstrap samples is presented in Table 4b. The results showed that the mediated effect of interest on retention was statistically strong (Effect = .9672, BootSE =.3310), evident by the large proportion of the overall effect (1.0300) that the mediated (indirect) effect (.9672) represents. The BootSE value (.3310) provided that a 33% error was allowed in the test. This result implied that achievement substantially mediated the relationship between interest and retention.

Testing Hypotheses

Hypothesis One: The difference between the experimental and control groups on posttest achievement mean scores is not significant.

Table 5:Analysis of Covariance (ANCOVA) of Significant Difference of posttest achievement Mean Scores between the Experimental and Control Groups.

Source	Type III Sum of Squares	df	Mean Square	F	Sig. of F (ρ-value)	Decision
Corrected Model	9538.101[a]	2	4769.051	13.610	.000	Reject
Intercept	3522.588	1	3522.588	10.053	.003	
Achievement Pretest	234.951	1	234.951	.671	.417	
Group	9270.854	1	9270.854	26.458	.000	
Error	15417.516	44	350.398			
Total	117805.000	47				
Corrected Total	24955.617	46				

a. R Squared = .382 (Adjusted R Squared = .354)

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Table 5 contains the results of the ANCOVA test of significant difference between the experimental and control groups on posttest achievement mean scores using SPSS (26). The results show that F (1, 44) = 26.46 and ρ-value (ρ = .000) indicate a statistically significant difference, supplying sufficient evidence to reject the null hypothesis. This means there was a significant difference between the experimental and control groups on posttest achievement mean scores in favour of the experimental group, and therefore concluded that the ESPBL increased students' achievement in spatial problems.

Hypothesis Two: The difference between the experimental and control groups on posttest interest mean scores is not significant.

Table 6:Analysis of Covariance (ANCOVA) of Significant Difference of posttest Interest Mean Scores between the Experimental and Control Groups.

Source	Type III Sum of Squares	df	Mean Square	F	Sig. of F (ρ-value)	Decision
Corrected Model	1089.560[a]	2	544.780	5.386	.008	Reject
Intercept	3126.802	1	3126.802	30.915	.000	
Pretest Interest	93.865	1	93.865	.928	.341	
Group	819.958	1	819.958	8.107	.007	
Error	4450.270	44	101.143			
Total	231243.000	47				
Corrected Total	5539.830	46				

a. R Squared = .197 (Adjusted R Squared = .160)

Data in Table 6 is the results of the ANCOVA test of significant difference between the experimental and control groups on posttest interest mean scores using SPSS (26). The results show that F(1, 44) = 8.107 and ρ-value (ρ = .007), highlighting a statistically significant difference. This evidence supports the rejection of the null hypothesis. This means there was a significant difference between the experimental and control groups on posttest interest in favour of the experimental group. This means the use of ESPBL to teach Geography problem-based topics increased students' interest.

Hypothesis Three: The relationship between students' interest and retention scores is not significant.

Table 7: Significance of the Relationship between interest and retention posttest scores of the Experimental Group.

Model 1	Coefficient (β)	Standard Error (SE)	Sig	Decision
Constant		30.610	.020	Reject
Interest of the Experimental Group	.445	.414		

The analysis of a significant predictive relationship between students' interest in spatial problems and their retention scores tested using the Linear Regression Model (LRM) is provided in Table 7. The results show that the relationship is positive and moderately weak (beta = .445), but statistically significant (ρ = .007 < .05). The null hypothesis was rejected implying that as the interest of the students in spatial problems increased, their retention scores also increased. Furthermore, evidence reveals that the interest of students had a significant predictive effect on students' retention of learning and thus concluded that interest is a predictor of students' retention of learning.

Hypothesis Four: The mediating role of students' academic achievement on the relationship between interest and retention is not significant.

Table 8a: **Significance of the Total and Direct Effects of Interest on Retention**

	Effect	Se	t	ρ	LLCI	ULCI
Total Effect	1.0300	.4144	2.4852	.0200	.1764	1.8836
Direct Effect (Interest → Retention)	.0628	.0881	.7128	.4828	-.1190	.2446

Table 8b:Significance of the Indirect (Mediation) Effect of Achievement on the Relationship between Interest and Retention based on 5000 Bootstrap Samples.

	Effect	BootSE	BootLLCI	BootULCI
Indirect Effect (Interest → Achievement → Retention)	.4180	.1100	.1769	.6075

Note: *LLCI = Lower Limit Confidence Interval; ULCI = Upper Limit Confidence Interval.*

Tables 8a and 8b contain results of analysis of the significant direct effect of interest on retention, and the mediated effect of achievement on the relationship between interest and retention of Geography students in spatial problems respectively. The direct effect of the relationship between interest and retention as shown in Table 8a, was found to be statistically insignificant (Effect =.0628, SE =.0881, t=.7128, ρ = .4828). Thus, the

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interest of students taught using ESPBL did not have a significant direct effect on their retention of knowledge.

The analysis of the indirect effect of interest (predictor) on retention (outcome) through achievement (mediator) path, based on 5000 bootstrap samples is presented in Table 8b. The results indicate that the mediating effect of achievement on the relationship between interest and retention of knowledge was statistically significant (Effect = .4180, BootSE = .1100, BootLLCI =.1769, BootULCI =.6075). The decision is to reject the null hypothesis, supported by the non-inclusion of zero in the values between BootLLCI (.1769) and BootULCI (.6075). The results implied that achievement mediated the relationship between interest and retention. It follows that the achievement of students played a crucial role in the relationship between interest and retention. The result indicates that students who received high achievement scores are more likely to retain their knowledge. The conclusion is that students who are interested in spatial problems and score high on the achievement test are more likely to retain their learning.

DISCUSSION

The study found that the use of the Experiential Spatial Problem-based Learning (ESPBL) model significantly increased the academic achievement of students in the experimental group, indicating the method is effective. In support of this finding, Yilmaz and Korur (2021), Dakur and Istifanus (2024), and Tran (2014) have submitted that the appropriate use of instructional methods including cooperation and forum methods could have significant positive effects on students' achievement. The ESPBL strategy is therefore applicable in teaching content that is problem-based and requires students to be deeply involved in the learning process and come up with solutions to such problems. The ESPBL strategy unlike other interactive strategies such as the inquiry method studied by Kogan and Laursen (2014), does not only discover and acquire knowledge but ensures that students present a workable solution to the problem. Students end up being equipped with critical thinking and problem-solving.

The interest of students in environmental problems significantly increased as a result of the instruction with the ESPBL model. The students in the experimental group displayed higher interest than those in the control group. This aligns with Istifanus and Dakur (2024) whose study revealed that teaching methods can have a significant effect on students' interest in learning. Similarly, the positions of Onah (2017) and Arhin and Yanny (2020) on teaching techniques sufficiently align with the current study. Thus, the ESPBL strategy, if used properly is potent enough to stir students' interest in favour of learning about environmental problems.

The findings also reveal that students' interest in learning is significantly related to their retention of learning when taught using the ESPBL model. That is to say, students' interest in learning can predict the extent of their retention of what they are taught in the future. The finding corroborates Hussain and Ali (2012) who reported that computer-aided instruction improved students' interest in learning. Nkok and Anietie (2022) also aligned with this study by finding that the use of computer simulation strategy affected the achievement of students, but not their retention of knowledge. The current study offers new insights into the predictability of retention by interest in learning. This proffers that if teachers seek to improve students' retention of knowledge, they should employ teaching methods that are known to stimulate interest, such as the ESPBL model.

It was also the study's finding that students' achievement mediated the relationship between their interest and retention. The finding revealed that the retention of a student is significantly determined by the combined effects of their interest in learning and achievement. This assures that students who achieve higher scores and record higher interest when taught using the ESPBL strategy are more likely to recall what they are taught in the future. Studies by Hussain and Ali (2012), Tran (2014), and Yilmaz and Korur (2021) support this finding. The authors unanimously found that achievement significantly affects retention. Hence, high achievers are more likely to retain their learning than low achievers. The current study however adds that if students who achieve high are also interested in the learning content, then they have higher chances of recalling what they learned in the future.

CONCLUSION

The use of the ESPBL model engages students deeply in the instructional process and equips them with the critical thinking and problem-solving skills required to proffer solutions to diverse environmental problems. The use of the model assures that learners' interest in learning is kindled and sustained, achievement is heightened, and retention of learned materials is improved.

RECOMMENDATION

1. Teachers of science and other fields may follow the instructional plan and explore the applicability of the ESPBL model in their various fields.
2. The strategy is strongly recommended for inclusion in the curriculum for the teaching of physical and environmental sciences, especially where a solution is needed for spatial problems. The problem is usually solved while the students actively learn.
3. Government and relevant private entities should provide training to the teachers of Geography and other interested persons on the use of the ESPBL model not only to teach students but to solve the raging environmental problems including floods, erosion, deforestation, pollution, and many more locally.

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