Effects of Place-Based Learning Strategy on Social Studies Pre-Service Teachers' Environmental Knowledge, Attitudes and Responsible Behaviour in Colleges of Education, South-West, Nigeria

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Abstract

In teaching Environmental Education in Social Studies, several strategies have been used without appreciable results; Therefore, this study investigated the effects of Place-based instructional strategy on Social Studies pre-service teachers' environmental knowledge, attitudes and responsible behaviour in Colleges of Education, South-west, Nigeria. The study adopted the pre-test, post-test, control group quasi-experimental design. The target population was 200 level pre-service teachers in Colleges of Education in South-west Nigeria. The sample consisted of 360 (180 males and 180 females) students, selected using stratified random sampling techniques. Three instruments namely: Knowledge of Environmental Concepts (KECT) (r=0.88); Environmental attitude Scale (EAS) (r=0.81); Environmental Responsible Behaviour Scale (ERBS) (r=0.76), were used to gather data. The data were analysed using frequency counts, percentages and Multivariate Analysis of Covariance (MANCOVA). Results showed that there was a significant main effect of treatment (F(6,704) =11,000,p<.05); while there was no significant effect of gender on the dependent variables (F(3,353)=1,710, p>.05). However, there was a significant interaction effect of treatment and gender, (F(3,231) = 3,575, p<.05); In conclusion, the place-based learning strategy have proved to be more effective than the conventional lecture strategy at improving students' knowledge, attitudes and behaviour to environmental issues and concepts in Social Studies. Therefore, it is recommended that teachers at all levels should adopt this strategy in their classroom teaching of environmental concepts in the Social Studies curriculum.

Key Words: Place-based, Social Studies, Pre-service Teachers, Environmental Education

Introduction

Education in general, and environmental education in particular, as a solution to the environmental problems, have played essential roles in mitigating the debilitating effects of degradation on human beings in many parts of the world (Ersoy.2018). Environmental

education's chief aim is to develop and acquire environmentally responsible behaviour. It is, therefore, essential to make the students understand the ecological problems and cause-effect to take action on the environment and show responsible behaviour for the environment. So, one powerful way of raising awareness and developing responsible behaviour of students concerning the environment is through education. (Spinola, 2015), hence Social Studies education.

Social Studies education is the integrated study of multiple fields of social science and the humanities. One of the purposes of social studies, particularly at the higher education level, is to integrate several disciplines, with their unique methodologies and special focuses of concentration, into a coherent field of subject areas. (Verma & Dhull, 2017). The content of social studies provides the necessary background knowledge to develop values and reasoned opinions, and the objective of the field is civic competence Social Studies is a problem-solving discipline that should help solve problems facing developing countries like Nigeria if adequately programmed and effectively taught. Social Studies emphasize discovery, dialogue, and experiences. (Ajiboye, 2021).

Environmental Education (EE) emerged due to human consciousness and awareness to confront global and environmental problems that affect the destiny and quality of life, world culture, and global survival. Environmental education provides the necessary information about the environment to help people be aware of handling environmental problems around them. "Environmental Education is concerned with and seeks to propagate learning more about the environment for the benefit of the entire component of the environment". (Payne,2016). The aims of environmental education include; equipping the people with the values and attitude of concern for the environment and its problems; helping the people acquire those skills needed for solving environmental issues; providing opportunities to develop the necessary knowledge and commitment to protect improve the environment. (Keles,2017).

Place-based education involves interdisciplinary studies that draw from the local community. Place-based education is defined as "using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science and other subjects across the curriculum". Emphasizing hands-on, real-world learning experiences, this approach to education increases academic achievement,

helps students develop stronger ties to the community, enhances students' appreciation for the national world, and creates a heightened commitment to serving as active, contributing citizens. (Wade-lyles, 2016). Place-based education is an example of a society-centred curriculum. In a society-centred curriculum, the goal structure "is to explore and solve societal issues the orientation is towards problems of living: life problems, community affairs, and real-world problems". PBE also integrates components from the learner-centred curriculum, including that the curriculum should be one of "discovery" and should be non-linear, emergent, seemingly unstructured, and often unpredictable (Best, Macgregor & Price, 2017)).

Many scholars have worked on different strategies to teach environmental education. Some of them are; Cooperative learning and Values-clarification strategies, Shadow learning and problem-based, participatory community learning, Service Learning and Educational trips, and Cooperative instructional strategy. Though valuable contributions have been made to the teaching and learning of environmental education through different approaches proposed by these authors/scholars over the years, environmental problems persist. Nigerian youths are rich in knowledge of environmental concepts but lack the skills to make sound decisions on environmental issues. In the light of all these, it has become apparent that teachers failed to connect the schools with the realities of the community's needs and circumstances by concentrating only on available instructional strategies, which resulted in a deficiency in the way the subject is taught and learnt in schools.

Research Hypotheses

Three null hypotheses were tested at 0.05 level of significance.

Ho1: There is no significant main effect of treatment on pre-service teachers' environmental knowledge, attitudes and responsible behaviour.

Ho2: There is no significant effect of gender on pre-service teachers' environmental knowledge, attitudes and responsible behaviour.

Ho3: There is no significant interaction effect of treatment and gender on pre-service teachers' environmental knowledge, attitudes and responsible behaviour.

Methodology

This study adopted the pretest-posttest control group quasi-experimental design to determine the effects of place-based strategy on Social Studies Pre-service Teachers' Environmental Knowledge, Attitude and Responsible Behaviour in Colleges of Education in South-west, Nigeria. The independent variable was the mode of instruction which was manipulated at two levels: Place-based Learning Strategy (PlBS) and Conventional Lecture Strategy (CLS) (control). Gender (Male and Female) served as moderator variable, while Environmental knowledge, attitudes and Responsible Behavior served as dependent variables. The target population for this study comprised all 200level social studies pre-service teachers in all colleges of education in South-west, Nigeria. The choice of the 200 level students was based on the fact that students in this group have acquired adequate knowledge of environmental education concepts and civic, environmental behaviour in Social Studies. Participants for the study were chosen from six colleges of education from three states (Oyo, Ogun and Osun) out of the six States (Oyo, Lagos, Osun, Ondo, Ogun and Ekiti) in South- west, Nigeria. Out of the fourteen (14) public Colleges of education in the south west (5 Federal and 9 state owned Colleges), two Colleges of education from each of the three States were randomly selected. The Colleges were selected due to the fact that they offer Social Studies and has been in existence for at least 3years to cater for the level of the participants. Simple random sampling technique was employed in picking 60 students per institution totaling 360 respondents for the study.

Three instruments were used for the collection of data for this study; the first is the Knowledge of Environmental Concepts Test (KECT) which was a 30-item multiple-choice test that cuts across all the environmental concepts and issues selected for this study. It was used to assess students' knowledge in environmental concepts in Social Studies and their competence in applying such knowledge in solving immediate and future environmental problems. The reliability co-efficient of the KECT using the Kuder-Richardson KR 21 formula was 0.88.The second instrument was the Environmental Attitude Scale (EAS) which was a 25 – item scale and consisted of (i) fourteen items on environmental attitude, (ii) six items on environmental action (intention), and (iii) five items on environmental sensitivity. The 25 items on the scale are on a four-point Likert scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). This scale measured (a)

students' attainment of essential environmental attitudes; (b) the involvement of students in environmental intent or action to provide solutions to environmental issues for sustainable development; and (c) the development of a sense of responsibility for and urgency involving environmental problems and issues in the students' immediate environment. The reliability co-efficient of the attitude aspect of the scale using Cronbach Alpha was 0.81, while the reliability co-efficient for the environmental sensitivity and environment action was 0.78. This was subjected to further reliability tests. The third research instrument is the Environmental Responsible Behaviour Scale (ERBS) which was a questionnaire that consisted of open-ended questions about eco-management, consumer action and economic action, individual and public persuasion and political action. In this way, the students were asked to indicate four behaviours that they had demonstrated and/or had planned to help prevent and solve environmental problems and issues in the last 12 months. The reliability coefficient using Cronbach alpha yielded a reliability value of 0.76.

The data generated were analysed using the descriptive statistics of percentages, mean and standard deviation, and inferential statistics of Multivariate Analysis of Covariance (MANCOVA) using pretests as covariates. In addition, the Estimated Marginal Mean (EMM) was computed to show the mean scores of the groups. At the same time, Bonferroni Post hoc Analysis which is a statistical tool used in testing for multiple comparisons of dependent variables was used to detect the source of significant differences among the groups where they may exist. All hypotheses were tested at 0.05 level of significance.

Results

Table 1: Summary of the Descriptive Analysis of Variables involved in the Study

Group	Measures	Pre-test Score		Post-test Score	
		Mean	SD	Mean	SD
	EK	12.38	2.41	22.03	3.07
Place-Based	ERB	71.60	11.87	72.73	8.79
	EA	76.23	8.25	78.78	7.68
Lecture	EK	11.36	2.53	19.72	3.53
	ERB	69.32	10.35	66.82	13.17
	EA	77.39	8.66	72.43	7.13

For pre-service teachers in the Place-Based group, the pre-test and post-test scores on environmental knowledge (EK) are 12.38 and 22.03, with respective standard deviations of 2.41 and 3.07. Their pre-test and post-test scores on environmental responsible behaviour (ERB) are 71.60 and 72.73, with a standard deviation of 11.87 and 8.79. The pre-test and post-test scores on environmental attitude (EA) are 76.23 78.78 with standard deviation of 8.25 and 7.68. The Lecture group pre-service teachers have pre-test and post-test scores on environmental knowledge (EK) as 11.36 and 19.72 with respective standard deviation of 2.53 and 3.53; pre-test and post-test scores on environmental responsible behaviour (ERB) as 69.32 and 66.82 with standard deviation of 10.35 and 13.17 respectively, and pre-test and post-test scores on environmental attitude (EA) as 77.39 and 72.43 with standard deviation of 8.66 and 7.13 respectively.

Testing of Research Hypotheses

The research hypotheses formulated to guide the study were tested using the Multivariate Analysis of Covariance (MANCOVA) statistical technique at 0.05 alpha level.

Ho1: There is no significant main effect of treatment on Pre-service Teachers' Environmental Knowledge, Attitudes and Responsible Behaviour.

To test this hypothesis, post-test scores of students on environmental knowledge (EK), environmental responsible behaviour (ERB) and environmental attitude (EA) were subjected to a One-Way Multivariate Analysis of Covariance (MANCOVA). Also, the pre-test scores for these three dependent variables were used as covariates while strategy (Place-Based, and Lecture) were used as factor variables. The results are presented in Tables bellow

Table 2: Multivariate Tests of Main Effect of Treatments on Pre-Service Teachers' Environmental Knowledge, Attitudes and Responsible Behaviour

Effect		Value	F	Hypothesis df	Error df	*p*	η
Intercept	Pillai's Trace	.525	129.609	3.000	352.000	.000	.525
	Wilks' Lambda	.475	129.609	3.000	352.000	.000	.525
	Hotelling's Trace	1.105	129.609	3.000	352.000	.000	.525

	Roy's Largest Root	1.105	129.609	3.000	352.000	.000	.525
	Pillai's Trace	.361	66.291	3.000	352.000	.000	.361
	Wilks' Lambda	.639	66.291	3.000	352.000	.000	.361
EK-pre	Hotelling's Trace	.565	66.291	3.000	352.000	.000	.361
	Roy's Largest Root	.565	66.291	3.000	352.000	.000	.361
	Pillai's Trace	.009	1.042	3.000	352.000	.374	.009
	Wilks' Lambda	.991	1.042	3.000	352.000	.374	.009
EA-Pre	Hotelling's Trace	.009	1.042	3.000	352.000	.374	.009
	Roy's Largest Root	.009	1.042	3.000	352.000	.374	.009
	Pillai's Trace	.006	.650	3.000	352.000	.584	.006
	Wilks' Lambda	.994	.650	3.000	352.000	.584	.006
ERB-Pre	Hotelling's Trace	.006	.650	3.000	352.000	.584	.006
	Roy's Largest Root	.006	.650	3.000	352.000	.584	.006
	Pillai's Trace	.167	10.705	6.000	706.000	.000	.083
	Wilks' Lambda	.836	11.000	6.000	704.000	.000	.086
Treatment	Hotelling's Trace	.193	11.294	6.000	702.000	.000	.088
	Roy's Largest Root	.174	20.533	3.000	353.000	.000	.149

η= Eta Squared (Effect Size)

Table 2 shows the result of a one way between group multivariate analysis of covariance conducted to determine the main effect of treatment on pre-service teachers' environmental knowledge, attitudes and responsible behaviour. Environmental knowledge, attitudes and responsible behaviour served as three dependent variables. In comparison, the independent variable is the treatment (Place-Based Strategy and control), while pre-test scores on the three dependent variables were used as covariates. The result shows a statistically significant main effect of treatment on the combined dependent variables after controlling for pre-test scores on the three dependent variables, F (6, 704) = 11.000, p<.05;

Wilks'λ =.836; partial η^2 = .086. Experimental treatments accounted for 8.6% of the observed variance noticed in the dependent variable. Since the *p*-value is less than .05; the stated null hypothesis is rejected. Therefore, this result concludes a significant main effect of treatment on pre-service teachers' environmental knowledge, attitudes and responsible behaviour.

The result of the Univariate analysis of each dependent variable is presented in Table 3

Table 3: Univariate Tests of Between-Subjects Effect of Treatments on Pre-Service Teachers' Environmental Knowledge, Attitudes and Responsible Behaviour

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	*p*	η
Corrected Model	Post-test EK	1730.317	5	346.063	52.646	.000	.426
	Post-test ERB	2757.532	5	551.506	3.572	.004	.048
	Post-test EA	2019.941	5	403.988	5.886	.000	.077
Intercept	Post-test EK	536.565	1	536.565	81.626	.000	.187
	Post-test ERB	13344.310	1	13344.310	86.427	.000	.196
	Post-test EA	14816.435	1	14816.435	215.881	.000	.379
EK_pre	Post-test EK	1308.050	1	1308.050	198.990	.000	.360
	Post-test ERB	42.862	1	42.862	.278	.599	.001
	Post-test EA	.624	1	.624	.009	.924	.000
ERB_pre	Post-test EK	11.604	1	11.604	1.765	.185	.005
	Post-test ERB	6.857	1	6.857	.044	.833	.000
	Post-test EA	4.904	1	4.904	.071	.789	.000
EA_pre	Post-test EK	3.304	1	3.304	.503	.479	.001
	Post-test ERB	138.860	1	138.860	.899	.344	.003
	Post-test EA	118.342	1	118.342	1.724	.190	.005
Treatment	Post-test EK	164.110	2	82.055	12.483	.000	.066
	Post-test ERB	2534.915	2	1267.457	8.209	.000	.044
	Post-test EA	1718.498	2	859.249	12.520	.000	.066
Error	Post-test EK	2327.005	354	6.573			
	Post-test ERB	54657.623	354	154.400			
	Post-test EA	24295.881	354	68.632			
Total	Post-test EK	166280.000	360				
	Post-test ERB	1851220.000	360				
	Post-test EA	2079614.000	360				
Corrected Total	Post-test EK	4057.322	359				
	Post-test ERB	57415.156	359				
	Post-test EA	26315.822	359				

a. R Squared = .426 (Adjusted R Squared = .418)
b. R Squared = .048 (Adjusted R Squared = .035)
c. R Squared = .077 (Adjusted R Squared = .064)

Table 3 shows the results for the dependent variables considered separately. To reduce the chance of committing a Type 1 error, most especially when a number of separate analyses are performed, Bonferroni adjustment was adopted. This was done by dividing the original alpha level of .05 by 3 (number of dependent variable) . This gives new alpha level of 0.02. The effects to reach statistical significance, using a Bonferroni adjustment alpha of 0.02, are environmental knowledge (EK), F (2, 354) = 12.483, p = .000; partial η^2 = .066; environmental responsible behaviour (ERB), F (2, 354) = 8.209, p = .000; partial η^2 = .044; and environmental attitude (EA), F (2, 354) = 12.520, p = .000; partial η^2 = .066. The results of the post-hoc test and information on the estimated marginal mean of the groups are presented in Tables 4 and 5

Table 4: Estimated Marginal Mean of Post Test Scores of the Groups

Dependent Variable	Treatment	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Post-test EK	Lecture	20.345	.240	19.873	20.817
	Place-Based	22.019	.234	21.558	22.480
Post-test ERB	Lecture	66.707	1.163	64.419	68.994
	Place-Based	72.662	1.136	70.427	74.896
Post-test EA	Lecture	72.450	.776	70.925	73.976
	Place-Based	76.168	.758	74.678	77.657

The result in Table 4 shows that pre-service teachers in the place-based group had the highest post-test estimated mean score ($\overline{X}$ =22.02, SE=.23) on environmental knowledge, and this mean was found to be statistically significantly different from the estimated marginal mean score of pre-service teachers in control group ($\overline{X}$ =20.35, SE=.24) Likewise, pre-service teachers in the place-based group had the highest post-test estimated mean score ($\overline{X}$ =76.66, SE=1.14) on environmental responsible behaviour among the two groups, and this mean was also found to be statistically significantly

different from the estimated marginal mean score of pre-service teachers in control group ($\overline{X}$ =66.71, SE=1.16). As shown in this outcome, pre-service teachers in the place-based group demonstrated a higher and positive level of environmental knowledge, and environmental responsible behaviour after treatment significant higher and positive level than their counterparts in control group. This implies place-based strategy contributes significantly towards environmental knowledge and environmental responsible behaviour tendency of the pre-service teachers,

Ho2: There is no significant effect of gender on Pre-Service Teachers' Environmental Knowledge, Attitudes and Responsible Behaviour.

In order to test this hypothesis, post-test scores of pre-service teachers on environmental knowledge (EK), environmental responsible behaviour (ERB) and environmental attitude (EA) were subjected to a One-Way Multivariate Analysis of Covariance (MANCOVA). Also, the pre-test scores for these three dependent variables were also used as covariates while gender was used as factor variables. The results are presented in Table 5.

Table 5: Multivariate Tests of Effect of Gender on Pre-Service Teachers' Environmental Knowledge, Attitudes and Responsible Behaviour

Effect		Value	F	Hypothesis df	Error df	*p*	η
Intercept	Pillai's Trace	.460	100.064	3.000	353.000	.000	.460
	Wilks' Lambda	.540	100.064	3.000	353.000	.000	.460
	Hotelling's Trace	.850	100.064	3.000	353.000	.000	.460
	Roy's Largest Root	.850	100.064	3.000	353.000	.000	.460
EK_pre	Pillai's Trace	.392	75.853	3.000	353.000	.000	.392
	Wilks' Lambda	.608	75.853	3.000	353.000	.000	.392
	Hotelling's Trace	.645	75.853	3.000	353.000	.000	.392
	Roy's Largest Root	.645	75.853	3.000	353.000	.000	.392
EA_pre	Pillai's Trace	.009	1.078	3.000	353.000	.358	.009
	Wilks' Lambda	.991	1.078	3.000	353.000	.358	.009
	Hotelling's Trace	.009	1.078	3.000	353.000	.358	.009
	Roy's Largest Root	.009	1.078	3.000	353.000	.358	.009

	Pillai's Trace	.392	75.853	3.000	353.000	.000	.392
	Wilks' Lambda	.608	75.853	3.000	353.000	.000	.392
EK_pre	Hotelling's Trace	.645	75.853	3.000	353.000	.000	.392
	Roy's Largest Root	.645	75.853	3.000	353.000	.000	.392
	Pillai's Trace	.014	1.710	3.000	353.000	.165	.014
	Wilks' Lambda	.986	1.710	3.000	353.000	.165	.014
Gender	Hotelling's Trace	.015	1.710	3.000	353.000	.165	.014
	Roy's Largest Root	.015	1.710	3.000	353.000	.165	.014

Table 5 shows the result of a one way between group multivariate analysis of covariance conducted to determine the effect of gender on pre-service teachers' environmental knowledge, attitudes and responsible behaviour. The result shows that there was no statistically significant main effect of gender on the combined dependent variables after controlling for pre-test scores on the three dependent variables, F (3, 353) = 1.710, p>.05; Wilks'λ =.986; partial η^2 = .014. Pre-service teachers' gender accounted for only 1.4% of the observed variance noticed in the environmental knowledge, attitudes and responsible behaviour. Since the p-value (0.165) is greater than 0.05, the null hypothesis is therefore not rejected. Therefore, this result concludes that there was no significant effect of gender on pre-service teachers' environmental knowledge, attitudes and responsible behaviour.

Ho3: There is no significant interaction effect of treatment and gender on Pre-Service Teachers' Environmental Knowledge, Attitudes and Responsible Behaviour.

In order to test this hypothesis, post-test scores of pre-service teachers on environmental knowledge (EK), environmental responsible behaviour (ERB) and environmental attitude (EA) were subjected to a Two-Way Multivariate Analysis of Covariance (MANCOVA). Also, the pre-test scores for these three dependent variables were also used as covariates while strategy (treatment) and gender were used as factor variables. The results are presented in Table 6.

Table 6: Multivariate Tests of Interaction Effect of Treatment and Gender on Pre-Service Teachers' Environmental Knowledge, Attitudes and Responsible Behaviour

Effect		Value	F	Hypothesis df	Error df	*p*	η
Intercept	Pillai's Trace	.556	96.438	3.000	231.000	.000	.556
	Wilks' Lambda	.444	96.438	3.000	231.000	.000	.556
	Hotelling's Trace	1.252	96.438	3.000	231.000	.000	.556
	Roy's Largest Root	1.252	96.438	3.000	231.000	.000	.556
EK_pre	Pillai's Trace	.523	84.274	3.000	231.000	.000	.523
	Wilks' Lambda	.477	84.274	3.000	231.000	.000	.523
	Hotelling's Trace	1.094	84.274	3.000	231.000	.000	.523
	Roy's Largest Root	1.094	84.274	3.000	231.000	.000	.523
EA_pre	Pillai's Trace	.009	.718	3.000	231.000	.542	.009
	Wilks' Lambda	.991	.718	3.000	231.000	.542	.009
	Hotelling's Trace	.009	.718	3.000	231.000	.542	.009
	Roy's Largest Root	.009	.718	3.000	231.000	.542	.009
ERB_pre	Pillai's Trace	.007	.516	3.000	231.000	.671	.007
	Wilks' Lambda	.993	.516	3.000	231.000	.671	.007
	Hotelling's Trace	.007	.516	3.000	231.000	.671	.007
	Roy's Largest Root	.007	.516	3.000	231.000	.671	.007
Treatment * Gender	Pillai's Trace	.044	3.575	3.000	231.000	.015	.044
	Wilks' Lambda	.956	3.575	3.000	231.000	.015	.044
	Hotelling's Trace	.046	3.575	3.000	231.000	.015	.044
	Roy's Largest Root	.046	3.575	3.000	231.000	.015	.044

η= Eta Squared (Effect Size)

Table 6 shows the result of a two way between group multivariate analysis of covariance conducted to determine the interaction effect of treatment and gender on pre-service teachers' environmental knowledge, attitudes and responsible behaviour. The result shows a statistically significant interaction effect of treatment and gender on the combined dependent variables after controlling for pre-test scores on the three dependent variables, F (3, 231) = 3.575, $p<.05$; Wilks'λ =.956; partial η^2 = .044. Treatment and gender were able to account for 4.4% of the observed variance noticed in the dependent variable. Since the *p*-value is less than .05, the stated null hypothesis is rejected. Therefore, this result concludes that there was a significant interaction effect of treatment and gender on pre-service teachers' environmental knowledge, attitudes and responsible behaviour. The result of the Univariate analysis of each dependent variable is presented in Table 7

Table 7: Univariate Tests of Between-Subjects Interaction Effect of Treatment and Gender on Pre-Service Teachers' Environmental Knowledge, Attitudes and Responsible Behaviour

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	*p*	η
Corrected Model	Post-test EK	1163.773	6	193.962	45.096	.000	.537
	Post-test ERB	761.150	6	126.858	.884	.507	.022
	Post-test EA	674.098	6	112.350	1.465	.191	.036
Intercept	Post-test EK	370.653	1	370.653	86.176	.000	.270
	Post-test ERB	8749.150	1	8749.150	60.960	.000	.207
	Post-test EA	10124.616	1	10124.616	131.984	.000	.362
EK_pre	Post-test EK	1086.544	1	1086.544	252.619	.000	.520
	Post-test ERB	100.035	1	100.035	.697	.405	.003
	Post-test EA	2.954	1	2.954	.039	.845	.000
ERB_pre	Post-test EK	3.638	1	3.638	.846	.359	.004
	Post-test ERB	46.284	1	46.284	.322	.571	.001
	Post-test EA	21.874	1	21.874	.285	.594	.001
EA_pre	Post-test EK	3.274	1	3.274	.761	.384	.003
	Post-test ERB	149.991	1	149.991	1.045	.308	.004
	Post-test EA	57.884	1	57.884	.755	.386	.003
Treatment * Sex	Post-test EK	35.345	1	35.345	8.218	.005	.034
	Post-test ERB	34.283	1	34.283	.239	.625	.001
	Post-test EA	260.214	1	260.214	3.392	.067	.014
Error	Post-test EK	1002.160	233	4.301			
	Post-test ERB	33440.700	233	143.522			
	Post-test EA	17873.698	233	76.711			
Total	Post-test EK	118150.000	240				
	Post-test ERB	1294832.000	240				
	Post-test EA	1444127.000	240				
Corrected Total	Post-test EK	2165.933	239				
	Post-test ERB	34201.850	239				
	Post-test EA	18547.796	239				

a. R Squared = .537 (Adjusted R Squared = .525)
b. R Squared = .022 (Adjusted R Squared = -.003)
c. R Squared = .036 (Adjusted R Squared = .012)

Result in Table 7 shows that using Bonferroni adjustment effect to reach statistical significance at alpha level of 0.02, is environmental knowledge (EK), F (1, 233) = 8.218,

p = .005; partial η^2 = .034. The estimated marginal mean of the interaction is presented in Table 8

Table 8: Estimated Marginal Mean of Interaction of Treatment and Gender Post Test Scores

Dependent Variable	Treatment	Sex	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Post-test EK	Place-Based	Male	22.169	.270	21.637	22.701
		Female	22.638	.272	22.101	23.175
Post-test ERB	Place-Based	Male	73.681	1.559	70.609	76.754
		Female	71.540	1.574	68.439	74.642
Post-test EA	Place-Based	Male	75.841	1.140	73.595	78.087
		Female	76.645	1.151	74.378	78.913

Result in Table 8 shows that female pre-service teachers in place-based ($\overline{X}$ =22.64, SE=.27) groups had higher and significant estimated marginal post-test mean scores than their male ($\overline{X}$ =20.55, SE=.27) and ($\overline{X}$ =22.17, SE=.27) counterparts in the two groups in environmental knowledge. However, in environmental responsible behaviour, male pre-service teachers in place-based ($\overline{X}$ =73.68, SE=1.56) groups had higher estimated marginal post-test mean scores than females in place-based ($\overline{X}$ =71.54, SE=1.57) groups. In environmental attitude, female pre-service teachers in place-based group had higher estimated marginal post-test mean score ($\overline{X}$ =76.65, SE=1.15) than males ($\overline{X}$ =75.84, SE=1.14). It is shown in this result that female pre-service teachers in place-based groups demonstrated more environmental understanding than their male counterparts whereas male pre-service teachers in place-based groups exhibited a higher level of environmental responsible behaviour than their female counterparts.

Discussion of findings

For the first hypothesis for this study, the objective of which was to determine the main effects of treatment on pre-service teachers' environmental knowledge attitude and responsible behaviour, the outcome was that there was no significant main effect of

treatment on pre-service teachers' environmental knowledge, attitudes and responsible behaviour. As shown in this outcome, pre-service teachers in the place-based group demonstrated a higher and positive level of environmental knowledge and environmental responsible behaviour after treatment and also significant higher and positive level than their counterparts in control group. F(6,704)=11,000,p<.05); It has been discovered that sufficient environmental knowledge by students leads to students taking care of the environment and doing everything to control their actions against causing damage to the environment. It was noted that students who have high environmental knowledge will also be well aware of taking actions to preserve their environment. High environmental knowledge as exhibited by pre-service teachers to a large extent will increase their awareness of the environment (Sarikaya & Sarac, 2018, Borges,2019)

For the second hypothesis for the study, the objective of which was to ascertain the effect of gender on pre-service teachers' environmental knowledge, attitudes and responsible behaviour it was discovered that there was no significant effect of gender on pre-service teachers' environmental knowledge, attitudes and responsible behaviour. The result shows that there was no statistically significant main effect of gender on the combined dependent variables after controlling for pre-test scores on the three dependent variables, F (3, 353) = 1.710, p>.05; Wilks'λ =.986; partial η^2 = .014. Pre-service teachers' gender accounted for only 1.4% of the observed variance noticed in the environmental knowledge, attitudes and responsible behaviour. This is a small effect. Since the p-value (0.165) is greater than 0.05, the null hypothesis is therefore not rejected. Therefore, it was concluded that there was no significant effect of gender on pre-service teachers' environmental knowledge, attitudes and responsible behaviour. The influence of gender on environmental behaviour has received tremendous attention. Though it was claimed that females could understand relationships with nature better than males, however available evidence presents ambiguous results. At the same time, some experts found no correlation between gender and environmental behaviour; others found females to have better pro-environmental behavior (Gokman, 2021, Rusell,Gough & White-House,2018, Papavasileion, Nikolaou, Andreadakis, Xanthancou, Malzanos, & Kaila. 2019). The notion that female students showed more responsible behaviour for protecting the environment than male students have been variously discussed and examined by experts;

a decade survey of research on gender and environmental attitudes and behaviour was carried out with different findings, some of which are that females expressed significantly greater environmental concern than males, other studies found out no significant differences between males and females on environmental concern. However, none of the studies found that males had significantly greater environmental concern than females (Marcos-Merino,Corbacho-Cuello & Hermandex-Barco, 2020; El-Batri,Alumi,Zaki & Nafidi, 2019). A meta-analysis study showed that women are more concerned about environmental hazards because they are traditionally the caretakers and nurturers due to their role in child-bearing and child-rearing; they are assumed to be closer to nature and thus more inclined towards protecting the environment (Ucar & Canpolat,2019)

For the third hypothesis which objective was to determine the interaction effect of treatment and gender on pre-service teachers' environmental knowledge, attitudes and responsible behavior, it was discovered that there was no significant interaction effect of treatment and gender on pre-service teachers' environmental knowledge, attitudes and responsible behaviour. , ($F(3,231) = 3,575$, $p<.05$); It is shown in this result that female pre-service teachers in place-based groups demonstrated environmental understanding than their male counterparts, whereas male pre-service teachers in place-based groups exhibited a higher level of environmental responsible behaviour than their female counterparts. However, in environmental attitude, females in place-based group demonstrated more positive environmental attitude than their male counterparts. Studies by Abdul-Rasak, Kamarudin,Toriman,, Abd-Wahab, Md-Saad, & Bati, (2019) and Liao & Li (2019) have revealed that knowledge of the environment entails both individual's knowledge of ecological behaviour and factual knowledge about concepts, problems and issues. It has been certified that environmental knowledge is positively associated with pro-environmental attitudes and behavioural intention, that an increase in knowledge can raise peoples' attitude toward environmental awareness and concern. Studies on students have found positive relationships between knowledge, attitude and behavioural intentions. It has been reported that pre-service teachers' environmental knowledge has a positive influence on their pro-environmental intentions and behaviour. Conversely, the lack of environmental knowledge may hinder the adoption of pro-environmental behaviour or may even lead to wrong or inefficient decisions (Dikicigil & Gulersoy, 2020). On the issue of

gender, it has been established that there are differences in knowledge and environmental awareness between men and women. This is because women are always involved in responsibilities in the home environment while men are not often involved, women are also said to be involved in forest preservation and conservation, while men are mostly considered to be often involved in forest destruction through illegal logging in the forest (Keles, 2017).

Conclusion

On the tested hypothesis, it was found that place-based strategy has and can significantly improve the knowledge, attitudes and responsible behavior of learners, learners should be exposed to strategies that give them more power to fully engage and control the learning process, such as place-based and other similar strategies. Hence, place-based learning strategy is being put forward as a way of improving teaching and learning about environmental concepts, issues and problems in Social Studies in Nigerian schools

Recommendations

Based on the findings of this study, the following recommendations are hereby proffered;

1. Place-based learning strategy is hereby recommended in Social Studies teaching of environmental issues and concepts in Colleges of Education in Nigeria. Instead of focusing mainly on using Conventional Lecture Strategy by college teachers, they should endeavour to expose Pre-service Teachers to other strategies that would engage their higher-level thinking and collaborative skills.
2. Government at all levels and professional bodies such as the National Commission for Colleges of Education, National Union of Teachers, National Teachers' Institute, Ministries and Departments of Education, Social Studies Association of Nigeria and so on, should expose pre-service teachers to effective use of this strategy through seminars, conferences and workshops
3. Teacher Training Institutions should be encouraged to include place-based learning strategy in their curriculum and also endeavour to provide practical experience of this strategy to the Pre-service teachers

4. These strategies and similar ones should be taught in all formal and informal training institutions and programmes so that learners should be encouraged to constantly employ this strategy in their teaching to improve students' achievement in the teaching of Social Studies, especially in the area of environmental studies

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