SPATIAL LEARNING STRATEGIES AND ACADEMIC ACHIEVEMENT OF SOCIAL STUDIES STUDENTS IN SUSTAINABLE DEVELOPMENT CONCEPTS

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Abstract

This study investigated the relative effects of two spatial learning strategies (framing and concept mapping) on academic achievement of Junior Secondary School (JSS) Social Studies in sustainable development concepts. In addition, the interaction effects of locus of control and gender on academic achievement were also investigated. The study adopted a pretest, post-test, control group quasi-experimental design. One hundred and twenty-two (122) JSS II students in three intact classes from three secondary schools were randomly assigned to the treatment and the control groups. Based on data from the Sustainable Development Achievement Test (SDAT) and Rotter's Locus of Control Scale (RLCS), seven hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The results revealed there was no significant main effect of treatment on the students' achievement scores (F (2,109) = 1.687, P > 0.05). Nevertheless, the multiple classification analysis (MCA) revealed that the students exposed to sustainable development concepts, through the framing strategy, had the highest academic achievement with 16.54 adjusted mean post-test achievement score, followed by the concept mapping group with 15.82 and, lastly, the conventional with 14.89. Recommendations were made based on the findings.

Keywords: Spatial learning strategies, Concept mapping, Framing, Gender, Locus of control

Background to the Study

Education is a potent means of promoting sustainable environment and development. Chapter 36 of Agenda 21 of the United Nations Conference on Environment and Development (UNCED) says education is "critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making" (United Nations, 1992: 320). Accumulated research supports Agenda 21 (Ogunyemi & Ifegbesan, 2011; Esa, 2016; Liarakou, Gavrilakis & Flogaitis, 2016; Ifegbesan, Ogunyemi & Rampedi, 2017). However, the challenge has remained how to fashion "innovative approaches in education in order to contribute to the societal transition towards sustainability through both the formal education system and non-formal and informal learning settings" (Lambrechts & Hindson, 2016: 6). The evidence suggests that, with the poor implementation of school-based environmental education programmes (Ogunyemi, 2005; Ogunyemi & Ifegbesan, 2011), increased efforts are required in trying out innovative strategies for enhancing knowledge and understanding about sustainable development issues. In fact, Sund and Lysgaard (2013: 1599) counsel that "without a connection to educational philosophy, Environmental and Sustainability Education (ESE) research can result in normative statements that may essentially be regarded as mis-educative".

Education for Sustainable Development (ESD) or Sustainability Education aims at extending the traditional Environment Education (EE) to encompass the 'total environment' – including the human actors, the flora and fauna, as well as economics, culture, politics and other significant elements of human existence (Ogunyemi, 2005). Flint (2013: 28) views sustainability "as a philosophy, or ethic, affording people awareness of the consequences of

actions and encouraging them to think broadly across issues, disciplines, and boundaries". Houtsonen (2004) identifies the three oft-mentioned elements of sustainable development (SD) as ecological sustainability, economic sustainability and socio-cultural sustainability. Maurice (2008) however adds two other elements; namely, political sustainability and resource sustainability. Maurice insists that political sustainability is essential to overall sustainability; claiming that, to accomplish sustainable development, people must be in control and conflict must be avoided; and that there is need for people-centred democracy and stable political system to be established. Maurice goes further to explain resource sustainability in terms of sustainable use of the resources that are available on the planet Earth. These include energy, air, soil, mineral, water and the living organic material. The present study focuses on four categories of SD which are Environmental, Socio-cultural, Economic and Political Sustainability from which eight sub-concepts available in junior secondary social studies curriculum were generated. These are malnutrition, preventable diseases, environmental pollution, ozone layer, level of income, unemployment, democracy and rule of law.

Social Studies is one of the carrier subjects for SD concepts and education for sustainable development at the school level (Ogunyemi, 2005; Ogunyemi & Ifegbesan, 2011; Nnabuo & Asodike 2013). The focus of social studies is the dimensions and consequences of interactions humans have with themselves as well as their social, cultural, economic, technological and other ramifications of the environment (Ogunyemi & Ifegbesan, 2011). The school subject therefore has great potentials for the promotion of EE/ESD as they are both concerned with the 'total environment'.

Nevertheless, sustainable development falls among category of fields of learning whose subject matter appears, in the words of Novak (1989), conceptually opaque as it may sometimes be difficult to pin down its core messages. This has given rise to suggestion of the use of constructivist or metacognitive strategies in EE/ESD as a way of overcoming "ecophobia" or "the dissociation students often experience when they are barraged with example after example of environmental abuses and impending catastrophes" (Umholtz, 2013).

Metacognitive strategies promote higher order thinking which involves active control over the cognitive processes involved in learning (Livingston, 1997; Mahdavi, 2014). Metacognition, in the words of van Velzen (2016: 13), makes learning more "synonymous with the understanding and application of subject matter through declarative knowledge (i.e., knowing facts, concepts, and principles), procedural knowledge (e.g., knowing how to perform subtraction, multiplication, and division regarding mathematics), and conditional knowledge (e.g., applying the correct tense in sentences)". Among the major categories of metacognitive strategies are spatial learning strategies such as frames and concept maps (West, Farmer & Wolff, 1991; Ahlberg, 2004; Clark, 2013).

Spatial learning strategies involve the use of visual models and pictures. The visual situations must be explained and it is believed that written explanations do more poorly than actually using visual models and pictures. Frames involve visual arrangements that enable substantial amount of information to be put in form of grid, framework, spatial or matrix. On the other hand, concept maps consist of nodes or cells that contain concepts, items or links. The links are labeled and denote direction with an arrow symbol to develop understanding of body of knowledge and

explore prior knowledge, new information and relationship (Livingston, 1997).

The current study on spatial learning strategies focused on concept maps and framing strategies because of their presumed appropriateness in teaching and learning social studies and sustainable development concepts (Alberg, 2004; Ambruster & Gabberandson, 1987). In addition, two moderator variables of interest to the study were gender and locus of control. The role of the gender has continued to produce inconclusive results in the available literature on students' academic achievement (Rena, 2009; Zembari & Blume, 2012; Linver, Davis-Kean, & Eccles, 2012). Similarly, locus of control has been widely applied to investigate what motivates individuals (internally or externally) to draw maximally in specific activities such as classroom teaching and learning (Martin, Richardson, Bergen, Roeger & Allison, 2005; Manichander, 2014).

Several studies have looked into the effectiveness of various metacognitive strategies, like graphic organizer, framing, rehearsal concept mapping, imagery, mnemonics, and chunking and organising (Igwe, 2002; Orji, 1998; Windsor, 2013; Conceicao, Samuel & Biniecki, 2017). However, most of the available reports focused on science-related fields. In addition, previous efforts had done little, particularly within the Nigerian environment, to investigate the relative effectiveness of these strategies in relation to ESD concepts in junior secondary school social studies.

Statement of Problem

This study investigated the effects of concept mapping and framing strategies on academic achievement of Junior Secondary School Social Studies students in sustainable development concepts in Oyo State. The study also examined the interaction effects of gender and locus of control on the students' academic achievement in the concepts.

Hypotheses

The following null hypotheses were tested in the study:

H_{O1}: There is no significant difference in the mean post-test achievement scores of students exposed to sustainable development concepts under the different instructional strategies.

H_{O2}: There is no significant difference between the mean post-test achievement scores of male and female students exposed to sustainable development concepts under the different instructional strategies.

H_{O3}: There is no significant difference between the mean post-test achievement scores of internal and external locus of control students exposed to sustainable development concepts under the different instructional strategies.

H_{O4}: There is no significant interaction effect of treatment and gender on the mean post-test achievement scores of students exposed to sustainable development concepts under the different instructional strategies.

H_{O5}: There is no significant interaction effect of treatment and locus of control on the mean post-test achievement scores of students exposed to sustainable development concepts under the different instructional strategies.

H_{O6}: There is no significant interaction effect of gender and locus of control on the mean post-test achievement scores of students exposed to sustainable development concepts under the different instructional strategies.

H_{O7}: There is no significant interaction effect of treatment, gender and locus of control on mean post-test achievement scores of students exposed to

sustainable development concepts under the different instructional strategies.

Methodology

The study adopted the pretest-posttest, control group quasi-experimental design. The target population consisted of junior secondary School two (JSS2) students in three Local Government Areas of Oyo State, selected through a multi-stage stratified, random sampling technique. Three tutors who volunteered to use the methods (concept mapping, framing strategies and conventional lecture) in teaching the eight SD concepts were trained in the week preceding the main experiment. A teacher's manual, consisting two elements for each of the strategies was provided. First are the notes for teachers as guides on the steps to be taken in implementing concept mapping and framing strategies. Secondly, the manual also contains the completed concept maps and frames on the sustainable development concepts.

The two measuring instruments used are Sustainable Development Achievement Test (SDAT) and Rotter's Locus of Control Scale (RLCS). The achievement test consists of 40 multiple-type objective test items which cover the eight concepts taught in the study. Only items with discriminating power of more than 0.30 and difficulty index of 0.40-0.60 were retained and a reliability coefficient of 0.727 was obtained. The RLCS consists of twenty nine (29) items, representing internal locus of control and external locus of control. The instrument was adopted from Rotter (1966) as applied by Orji (1998) and revalidated to obtain a reliability coefficient of 0.953.

Data were analysed using descriptive and inferential statistics. The descriptive statistics (mean and standard deviation) were used to show estimates of the scores recorded according to treatment groups, gender, and locus of control patterns. The seven hypotheses raised were tested at 0.05 level of significance. The analysis of covariance (ANCOVA) statistic was used with pre-test scores as covariates. Multiple classification analysis (MCA) and the Sidak post-hoc analysis were also used to assess and explain the source and direction of obtained significant effects. The statistical Package for Social Science (SPSS) version 16.0 was used to analyse the data.

Results

Descriptive findings showed that students exposed to framing strategies recorded a mean post-test achievement score of 14.94, which is the highest, followed by the students exposed to concept mapping strategy who recorded a mean post-test achievement score of 14.83, while the students exposed to conventional method recorded the least post mean post-test achievement score of 13.48. The descriptive findings also showed that male students recorded higher mean achievement score of 14.85 while the female recorded 14.19. Evidence from the descriptive data also shows that external locus of control students recorded higher post-test achievement score of 14.97 than the internal students who recorded a mean score of 14.00.

Table 1 below presents the summary of analysis of covariance of students' achievement according to treatment, gender and locus of control

Table 4: Summary of Analysis of Covariance of Students' Achievement according to Treatment, Gender and Locus of Control

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig. of F
Main Effects	904.937	1	904.937	71.084	.000
Covariates (pre-test)	53.705	1	53.705	4.219	.042
Treatment	42.952	2	21.476	1.687	.190
Gender	1.691	1	1.691	.133	.716

Locus of Control (LOC)	5.250	1	5.250	.412	.522
2 Way Interactions					
Treatment x Gender	40.033	2	20.017	1.572	.212
Treatment x LOC	11.521	2	5.760	.452	.637
Gender x LOC	44.129	1	44.129	3.466	.065
3 Way Interactions					
Treatment x Gender x LOC	36.485	2	18.243	1.433	.243
Explained	256.836	12	21.403	1.681	.081
Residual	1387.631	109	12.731		
Corrected Total	1644.467	121			

***** *Denotes significant F at .05 level, R Squared = .156 (Adjusted R Squared = .063)*

The result in Table 1 indicates that there is no significant main effect of treatment on the students' achievement scores ($F_{(2,109)} = 1.687$, $P > 0.05$). This implies that the post-test mean achievement scores of the students exposed to the sustainable development concepts through the different teaching strategies are not significantly different. Therefore, hypothesis (Ho_1) cannot be rejected. Evidence from the Multiple Classification Analysis (MCA) of students' achievement scores according to treatment, gender and locus of control reveals that, with a grand mean of 14.540, the students under the framing strategy recorded the highest adjusted mean post-test achievement score of 16.54 (i.e. 14.54 + 2.00). The students in the concept mapping strategy group recorded the next higher adjusted post-test mean achievement score of 15.82 while the students taught with the conventional method recorded the least adjusted post-test mean achievement score of 14.89. This outcome thus reveals that, although not significantly different from the others, the students taught using the framing strategy recorded the highest post-test mean achievement score in sustainable development concepts. This appears consistent with the findings from the descriptive analysis on differences in the three treatment groups.

The result of the main effect of gender in Table 1 shows no significant main effect of gender on the students' achievement scores in sustainable development concepts ($F_{(1,109)} = 0.133$, $P > 0.05$). The result implies that the post-test mean achievement scores of male and female students exposed to the different teaching strategies are not significantly different. Therefore, hypothesis two (Ho_2) is not rejected. The MCA shows that, with a grand mean of 14.54, the male students recorded higher adjusted mean post-test achievement score of 15.63 (i.e. 14.54 + 1.09) than the female students who had 15.46. This outcome reveals that the male students with the better post-test mean achievement score recorded better academic achievement in sustainable development concepts than their female counterparts as earlier explained under descriptive analysis.

The result of the main effect of locus of control recorded in Table 1 reveals no significant main effect of locus of control on the students' achievement scores in sustainable development concepts ($F_{(1,109)} = 0.412$, $P > 0.05$). The finding implies that the mean post-test achievement scores of internal and external students taught with the different teaching strategies are not significantly different. Therefore, hypothesis three (Ho_3) cannot be rejected. The result of the multiple classification analysis (MCA) reveals that, with a grand mean of 14.54, the external students recorded higher adjusted post-test mean achievement score of 15.71 (i.e. 14.54 + 1.17) than the internal students who recorded adjusted post-test mean achievement score of 15.39.

The result of the 2-way interaction effect of treatment and gender recorded in Table 1 reveals no significant interaction effect of treatment and gender on the students' achievement scores in sustainable development concepts ($F_{(2,109)} = 0.52$, $P > 0.05$). This outcome implies that students' mean post-test achievement scores in sustainable development concepts under the different teaching strategies do not vary significantly between male and female students. Hence, hypothesis four (Ho_4) is not rejected.

The result of the 2-way interaction effect of treatment and locus of control in Table 1 also shows no significant interaction effect of treatment and locus of control on the students' achievement scores in sustainable development concepts ($F_{(2,109)} = 1.572$, $P > 0.05$). This outcome implies that the mean students' post-test achievement scores in sustainable development concepts under different teaching strategies do not significantly differ between students with internal and external locus of control patterns. Therefore, hypothesis five (Ho_5) is not rejected.

The result of the 2-way interaction effect of gender and locus of control recorded in Table 1 reveals no significant interaction effect of gender and locus of control on the students' achievement scores in sustainable development concepts ($F_{(1,109)} = 3.446$, $P > 0.05$). This result implies that the effect of gender (male, female) on the students' post-test mean achievement scores in sustainable development concepts is not sensitive to their locus of control (internal, external) patterns. Hence, hypothesis six (Ho_6) is not rejected.

The result of the 3-way interaction effect of treatment, gender and locus of control recorded in Table 4 shows no significant interaction effect on students' achievement scores in sustainable development concepts ($F_{(2,109)} = 1.433$, $P > 0.05$). This result shows that there is no significant difference in students' post-test group achievement in sustainable development concepts under the different teaching strategies among all the possible gender-locus of control combinations: boys-internal; girls-internal; boys-external and girls-external. Hence, hypothesis seven (Ho_7) is not rejected.

Discussion of Findings

The results of tests in all the seven hypotheses revealed that there were no significant differences in the students' achievement in the main treatment outcomes as well as in the 2-way and 3-way interaction outcomes of the moderating variables. The different modes of instruction were framing strategy, concept mapping strategy and conventional method while the moderating variables were locus of control and gender. However, the students taught with framing strategy recorded the highest adjusted post-test achievement score when the grand means were compared, followed by the students taught with the concept mapping and, lastly, the students exposed to the conventional method. The moderate differences, as observed in the descriptive analyses, suggest that the spatial learning strategies (framing and concept mapping) recorded relatively higher mean post-test achievement scores than the conventional strategy. However, these differences were not statistically significant.

The finding of moderate differences indicates some level of agreement with earlier researchers that spatial learning strategies (framing and concept mapping) could improve students' academic achievement by enhancing their metacognitve capacity (Igwe, 2002; Orji, 1998; Windsor, 2013; Conceicao, Samuel & Biniecki, 2017). For instance, ~~For instance,~~ Igwe (2002) submitted that metacognitive strategies yield positive effects and increased achievement over other teaching

methods. Also, Reiska, Soika, Mollits, Rannikmae and Soobard (2015) concluded that students' exposure to learning through concept maps encourage them to create more propositions inside the "everyday life" cluster than inside the "subject" cluster or between these two clusters.

However, the non-significance of the differences found in the academic achievement of the students runs contrary to some previous findings. For instance, Awofala and Nneji (2013) reported that framing and team-assisted instructional strategies were more effective in promoting students achievement in mathematics. The finding that there was no significant difference between achievement scores of internal and external locus of control students is also not in agreement with the report of Grantz (2006) who concluded that locus of control is significantly related to academic achievement and that internals performed better than externals. Gisela (2011) had also reported significant differences in the academic achievement of male and female students in different areas of learning and the non-significant results of post-test scores according to gender in this study imply that the treatments may have been equally effective for both sexes (male and female) with no clear advantage to either.

Conclusion

The subject matter of education for sustainable development appeals almost equally to citizens – young or old - everywhere in the world. We all want pollution-free air; clean water devoid of causative agents of preventable diseases and neighbourhoods that are free from pollutants such as wastes and debris. We equally desire an effective political authority who can effectively coordinate activities that engineer a health-supporting environment and manage our collective resources to achieve our endless desire for improved quality of life. This transformative perspective to the 'total environment', in brief, provides the context for teaching learners about sustainable development concepts as experimented in this study.

A number of plausible explanations can be provided for the findings of the study. First, differences in academic achievements of students taught by the spatial learning and conventional strategies may not have been statistically significant because the issues involved are daily discussed both within and outside the school system and learners could have gained additional insight into the subject matter while our experiment was in progress. Another possible reason for the non-significance of the differences in academic achievement of the students is the short duration of the study (four weeks of teaching), which may not have given sufficient room for adequate practical application of the spatial learning strategies to remove what Novak (1989) calls conceptual opaqueness. Therefore, it is suggested that further investigation be conducted into the variables of this study, taking cognizance of these and other limitations, with a view to confirming or refuting its findings.

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