JOURNAL OF SCIENCE, TECHNOLOGY AND EDUCATION (JSTE) VOL. 4. NO. 11

JSTE PUBLICATIONS, 2020 www.nsukjste.com

ISSN: 2651-5539

EFFECTS OF CROSSWORD-PICTURE PUZZLE LEARNING STRATEGY AND LEARNING STYLES ON STUDENTS' ACHIEVEMENT IN BASIC SCIENCE IN BENUE STATE, NIGERIA

[1]Samuel, I. R. & [2]Pindar M, G.

Corresponding Author: ruthsa124@gmail.com

Department of Science, Technology and Mathematics Education, Nasarawa State University, Keffi, Nigeria

Citation: Samuel I. R. & Pindar M. G. (2020). Effects of crossword-picture puzzle learning strategy and learning styles on students' achievement in basic science in Benue State, Nigeria. *Journal of Science, Technology and Education (JSTE)*; http://nsukjste.com. 4:11;pp 124-131

Abstract

This study investigated the effect Crossword-Picture Puzzle learning strategy and learning styles on students' achievement in Basic Science. Quasi experimental procedure was adopted for this study. Four research questions and four null hypotheses guided the study. The population of this study comprised 2321 Junior Secondary School students in North Senatorial District of Benue State, Nigeria. The sample consisted of 83 (38 students for the experimental groups and 45 students for the control groups) JSS 2 Basic Science students randomly selected from two schools in North Senatorial District of Benue State, Nigeria. Index of Learning Style Questionnaire (ILSQ) and Basic Science Achievement Test (BSAT) were the instruments used to gather data for this study. Test-retest approach was used to establish the reliability of ILSQ and the results obtained were subjected to Pearson Product Moment Correlation. The result showed that ILSQ has a reliability coefficient of 0.82. The results obtained from BSAT were subjected to Kuder-Richardson formula -21 (KR_{21}) and the result showed a reliability coefficient of 0.88. Data collected were analyzed using mean and standard deviation to answer the research questions and ANCOVA was used to test the hypotheses at 0.05 level of significance. The result obtained revealed that there was significant difference in the mean achievement scores of students exposed to Crossword-Picture Puzzle learning strategy and Conventional method. Students in the Crossword-Picture Puzzle learning strategy achieved more than the Control group. Also, findings from this study revealed that the Basic Science students with the four (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) learning style differed significantly in their achievement after being exposed to Crossword Picture Puzzle and Conventional method. Based on the findings of this study, the following recommendations are made. Crossword-picture puzzle should be adopted in secondary schools to improve students' achievement in Basic Science, teachers should incorporate the use of game especially puzzle game for effective Basic Science delivery, because of the potential benefits of educational games to foster learning during classroom instructional process and teachers of Basic Science should find out about the learning styles of their students and bear these varied styles in mind when planning and executing instruction in Basic Science classes.

Keywords: Achievement, Basic Science, Crossword-Picture Puzzle, learning strategy, learning styles

Introduction

Basic Science is a core subject in junior secondary School Curriculum which has the potential role of laying the foundation for subjects like Physics, Chemistry and Biology at the later stage of education. Reports from examination bodies have shown that students record low achievement in the subject (Federal Ministry of Education, Research Statistics and Planning Section, 2011). This has been attributed to the use of inappropriate method to teach this subject. Since academic achievement is still declining, scholars have thus recommended the use of other instructional strategies that could help students learn collaboratively, acquire problem solving skills and improve students' achievement. Basic Science is one of the major subjects offered by all students in junior secondary schools in Nigeria. The number of students offering Basic Science is more than the number of teachers employed to teach the subject in various schools. Class size is large. This increases teachers' workload resulting in teachers' ineffectiveness. In addition, teaching Basic Science has been associated with the perennial problems of lack of class activities, instructional resources and appropriate strategies to teach subject (Samuel, 2017). The ultimate goal of teaching or educational experiences both in and out of school is to enable the individual to meet new situations of various degrees of relatedness and similarities more effective. The challenges in teaching is to create experiences that involve the student and support his own thinking, mode of learning, explanation, communication and application of the scientific models needed to make sense of these experiences. To equip Nigerian citizens to live in this fast changing world of the 21st century, the educational system should undergo a radical reorientation. For decades, one of the most persistent problems which teachers have struggled to solve has been how to achieve maximum results with minimum but effective medium of instruction. There has been a need to change emphasis on teaching by the teacher to learning by the learner. Thus, rather than be a teacher-centred activity, instruction has become learner-centred. Teachers need to ascertain what their students wish to know and how it is relevant to their life and work and how they learn best. Hence, for effective teaching and learning to take place, there must be a correlation between teacher's instructional strategies and students' learning styles (Akinbobola, 2011b).

Students have their differences in learning styles and the function of the teacher is to identify these leaning styles and find appropriate instructional strategies that will match the preferred styles in order to enhance effective teaching and learning process. Learning style is the adoption of a habitual and distinct mode of acquiring knowledge. Riding and Rayner (1998) defined learning style as a tendency to approach cognitive tasks with a preferred mental set. Gregorc (1979) describes learning style as consisting of distinctive behaviours which serve as indicators of how a person learns from and adapts to his/her environment. It also gives clues as to how a person's mind operates. Dunn (1990) describes

learning style as the way each learner begins to concentrate, process and retain new and difficult information. Learning style also represents both inherited characteristics and environmental influences. Keefe and Monk (1986) viewed learning style as being characteristic of the cognitive, affective, and physiological behaviours that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment. Sternburg (1990) indicates that an individual's learning style can be compared to his/her ability and is therefore not etched in stone at birth.

A learning style model classifies students according to where they fit on a number of scales pertaining to the ways they receive and process information (Zywno & Waalen, 2002). This study focuses on the learning style model developed by Felder and Soloman (1998). These are Sensing/Intuitive, Visual/Verbal, Active/Reflective and Sequential/Global. The Sensing/Intuitive learning style deals with the way information is perceived. Sensing learners get information through their senses. They solve problem by well-established methods but dislike complication. They are oriented towards procedures and facts and are practical. The learning styles of those who prefer sensing are characterized by a preference for direct, concrete experience; moderate to high degrees of structure; linear, sequential learning; and often, a need to know why before doing something. They lack confidence in their intellectual abilities and uncomfortable with abstract ideas. The path to educational excellence for sensing learners is usually from a practice-to-theory route. Intuitive learners get information through imagination, reflection and memory (Felder, 1988). They are innovative, creative, independent, conceptual and oriented towards theories and meaning but dislike repetition. Intuitives love the world of concepts, ideas, and abstractions. Their path to excellence is from theory- to- practice and they often prefer open-ended instruction to highly structured instruction. They usually demonstrate a high degree of autonomy in their learning and value knowledge for its own sake. They prefer diversity in ideas.

The Visual/Verbal learning style deals with the way information is presented. Visual learners get more information from visual images (schematics, graphs, diagrams, pictures and demonstrations). Verbal learners prefer written or spoken explanations and formulae. They learn information best by hearing, explanation and discussion (Akinbobola, 2011a). The Active/Reflective learning style deals with the way information is processed. Active learners learn best through participation, working in a group, trying things out and require body movement and action for optional results. Reflective learners understand lesson best by thinking about it quietly and prefer working alone. The Sequential/Global learning style deals with understanding. Sequential learners gain understanding in an orderly manner in linear steps and go through logical stepwise path in finding solutions to problems. Global learners learn in

large jumps. They solve complex problems quickly once they have grasp of the big picture (Zywno & Waalen, 2002).

However, the emphasis of educational researchers is on child-centred, active learning. This is the more reason why teaching-learning processes should be devoid of teachers dominating the class with ordinary mouth presentation of learning tasks. Multi-various teaching and learning approaches that attract students' attention, interest and most sense organs find their effectiveness in enhancing students' learning outcomes and also in the areas of science teaching and learning. One of these approaches that supports students' inclusive education and learning outcomes is the use of educational puzzles. Advocating for in-class activities and non-traditional teaching aids that can be effectively harnessed, researchers recommended the use of such activities and teaching strategy such as puzzle games to be adopted in the teaching and learning of science (Leong, 2005; Saunders and Christopher, 2003).

Educational games have inherent potential to arouse and sustain interest in learning, excite learners, generate new ideas in learners, teach difficult science concepts, develop critical thinking, remove fatigue, foster social interaction, recall information easily and generally help learners with low achievement potential. Studies have shown the relevance of using puzzles to teach and learn science. As many studies reveal the use of puzzles being effective (Scott, 2006; Idowu & Ige, 2007; Kendall, Parks & Sperer, 2008), other studies showed its limitation (Hill, 2003). As identified by Scott (2002), puzzles find their applications in science learning to introduce new ideas, test skills; pose problems that make learners ask challenging questions, help slow learners, can be used as classroom resources and develop students' manipulative skills. Olagunju and Babayemi (2014) examined the effect of crossword-picture puzzle (CPP) teaching strategy and gender on students' achievement in Basic Science. Results of the study revealed that crossword-picture puzzle (CPP) teaching strategy and gender had significant effect on students' achievement in Basic Science. Babayemi and Akinsola (2014) examined the effects of crossword-picture puzzle (CPP) and mental ability on students' achievement in Basic Science. Results of the study showed that crossword-picture puzzle (CPP) and mental ability had significant effect on students' achievement in Basic Science. Ogundiwin (2013) examined the effects of Pre-theoretic Intuition Quiz and Puzzle-based Critical Thinking Motivation Strategies on Students' Learning Outcomes in Selected Environmental Concepts in Biology. Result of the study revealed that Pre-theoretic Intuition Quiz and Puzzle-based Critical Thinking Motivation Strategies had significant effect on students' achievement in Biology. Bowers (2006) identified different types of puzzle. These are Wooden puzzles, Jigsaw puzzles, Crossword puzzles, Logic Puzzles (Word puzzles or Mechanical puzzles), Pattern puzzles (which can be colors, shapes, numbers, letters or any combination of

them), Riddles and Brain Teasers, Mazes and Picture puzzles while Cardenas-Nelson and Connolly (2011) identified three types of picture puzzles namely: Spot-the-changes puzzles, Knot puzzles and Cut-Up puzzles. Out of these puzzle types, Crossword puzzle and Picture puzzle (Spot-the-changes puzzles) were used for the purpose of this study and this is called 'Crossword-Picture Puzzle Learning Strategy'.

Statement of Problem

Basic Science is a subject joining several subjects into a single course and offered by all students at junior secondary schools in Nigeria as a compulsory subject. Students that offer science as their career derive their foundational scientific knowledge from Basic Science. As important as the subject is, reports from examination bodies have shown that students record low achievement and problem solving skills in the subject. Any strategy that concentrates on talking about the problems instead of solving the problems is grossly inadequate for effective Basic Science delivery. All students have different learning styles and the function of the teacher is to identify these leaning styles and find appropriate instructional strategies that will match the preferred styles in order to enhance effective teaching and learning process. Scholars have thus recommended the use of instructional strategies that could help students learn; engage in thought-provoking activities and acquire problem solving skills. One of such strategies is Crossword-Picture Puzzle Teaching strategy. Therefore, this study determined the effects of Crossword-Picture Puzzle learning strategy and learning styles on students' achievement in Basic Science in Benue State, Nigeria.

Research Questions

The following questions guided the study:

1. What is the mean achievement scores of Basic Science students with Sensing/Intuitive learning style when exposed to crossword picture puzzle and conventional method?
2. What is the mean achievement scores of Basic Science students with Active/Reflective learning style when exposed to crossword picture puzzle and conventional method?
3. What is the mean achievement scores of Basic Science students with Visual/Verbal learning style when exposed to crossword picture puzzle and conventional method?
4. What is the mean achievement scores of Basic Science students with Sequential/Global learning style when exposed to crossword picture puzzle and conventional method?

Research Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance.

H_{O1}: There is no significant difference in the mean achievement scores of Basic Science students with Sensing/Intuitive learning style exposed to crossword picture puzzle and conventional method.

H_{O2}: There is no significant difference in the mean achievement scores of Basic Science students with Active/Reflective learning style exposed to crossword picture puzzle and conventional method.

H_{O3}: There is no significant difference in the mean achievement scores of Basic Science students with Visual/Verbal learning style exposed to crossword picture puzzle and conventional method.

H_{O4}: There is no significant difference in the mean achievement scores of Basic Science students with Sequential/Global learning style exposed to crossword picture puzzle and conventional method.

Methodology

Quasi experimental procedure was adopted for this study. Only public junior secondary schools in North Senatorial District of Benue State, Nigeria were used for the study. The study covered eight junior secondary schools in North Senatorial District, Benue State, Nigeria. The content coverage was limited to six concepts in the JSS 2 Basic Science curriculum following thematic approach to content organization: You and The Environment (Drug Abuse); Living things and Non-living things (Habitat, Respiration, changes in matter); Science and Development (Information and Communication Technology); You and Energy (Heat Energy). A pretest, posttest, control group, quasi-experimental design was used to collect data for this study. The population of this study comprised 2321 junior secondary school students in North Senatorial District of Benue State, Nigeria. Simple randomly procedure was used to select two schools from North Senatorial District of Benue State, Nigeria. One intact class was randomly selected from each school and assigned as the experimental (Crossword-Picture Puzzle learning strategy) group and the control (Conventional) group. The sample was made up of 83 (38 students for the experimental groups and 45 students for the control groups).

Index of Learning Style Questionnaire (ILSQ) and Basic Science Achievement Test (BSAT) were the instruments used to gather data for this study. The ILSQ was adapted from Felder and Solomon (1998) and consisted of 44 items with options A and B. The students were required to choose options that apply frequently to their learning styles. The questionnaire was used to determine students' individual learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global). The BSAT consisted of 30 multiple choice items with five options A-D in the content coverage was limited to six concepts in the JSS 2 Basic Science curriculum following thematic approach to content organization: You and The Environment (Drug Abuse); Living things and Non-living things

(Habitat, Respiration, changes in matter); Science and Development (Information and Communication Technology); You and Energy (Heat Energy) and were constructed by the researchers. Each item had four options with only one correct answer and the correct answer was scored 2 marks. The validation of ILSQ was ascertained by three psychologists while that of BSAT was ascertained by three science educators. The instruments were trial tested with 35 students in a school that was not used for the main study. Test-retest approach was used to establish the reliability of ILSQ and the results obtained were subjected to Pearson Product Moment Correlation. The result showed that ILSQ has a reliability coefficient of 0.82. The results obtained from BSAT were subjected to Kuder-Richardson formula -21 (KR_{21}) and the result showed a reliability coefficient of 0.88.

The researchers prepared Learning Guide for Crossword-Picture Puzzle Learning Strategy (LGCPPLS) and Teachers' Instructional Guide for Conventional Lecture Method (control) (TIGCLM). These instruments contained the lessons for the eight weeks of treatment. Research assistants who were seasoned Basic Science teachers of the sampled schools and trained for two weeks. Training was done step by step using the teaching guides on Crossword Picture Puzzle learning strategy and Conventional Lecture Method. During the first week of the experiment, Index of Learning Style Questionnaire (ILSQ) was used to determine students' individual learning styles (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) and a pretest was administered. The treatment was carried out on the experimental and control groups. During this period, students were taught six selected concepts in Basic Science using a double period lasting for 80 minutes for eight weeks. The last one week was used for the administration of posttest after treatment using Basic Science achievement test. This makes a total of twelve (12) weeks.

The treatment group involved two phases (following Learning Guide for Crossword Picture Puzzle Learning Strategy, LGCPPLS) -inquiry, question and answer and games (crossword and picture puzzles). For inquiry, question and answer, questions were asked from students to help students understand a given idea, concept, principle, etc. Students were divided into small groups of 4-5 members. Students followed written instructions, manipulated apparatus, and classified quantities, took measurements of quantities, recorded observations, inferred from results and reported activities individually. In phase 2 which was game (Crossword and Picture Puzzles), students were divided into small groups of 4-5 members, followed verbal instruction on games, manipulated games, recorded score in games and winner of games recognized. The control group involved conventional method (lecture method). The teacher followed Teachers' Instructional Guide for Conventional Lecture Method, TIGCLM. Data collected were analyzed using means and standard deviation to answer the

research questions and ANCOVA was used to test the hypotheses at 0.05 level of significance.

Result

Research Questions

Means and SDs for achievement scores with respect to Sensing/Intuitive, Visual/Verbal, Active/Reflective and Sequential/Global learning styles and total scores of experimental and control groups is presented in Table 1.

Table 1: Means and Standard Deviations of Scores for the Different Sub-groups

Variable	**Experimental Group**			**Control Group**		
Learning styles	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**
Sensing/Intuitive	10	16.51	1.28	10	13.33	1.15
Visual/Verbal	13	15.92	1.22	10	12.41	1.11
Active/Reflective	8	16.32	1.43	12	13.15	1.04
Sequential/Global	7	14.87	1.46	13	12.17	0.97
Total	**38**			**45**		

Table 1 shows that the mean achievement scores of Basic Science students with Sensing/Intuitive learning style when exposed to crossword picture puzzle is 16.51 and the conventional method 13.33. The mean achievement scores of Basic Science students with Visual/Verbal learning style when exposed to crossword picture puzzle is 15.92 and the conventional method is 12.41. The mean achievement scores of Basic Science students with Active/Reflective learning style when exposed to crossword picture puzzle is 16.32 and the conventional method 13.15. The mean achievement scores of Basic Science students with Sequential/Global learning style when exposed to crossword picture puzzle is 14.87 and the conventional method is 12.17.

Hypothesis One

There is no significant difference in the mean achievement scores of Basic Science students with Sensing/Intuitive learning style exposed to crossword picture puzzle and conventional method.

The data to test for this hypothesis is presented in Table 2.

Table 2: ANCOVA Result of Basic Science Students with Sensing/Intuitive Learning Style exposed to Crossword Picture Puzzle and Conventional Method

Sources of Variation	Sum of Square	df	Mean Square	F.cal	P<.05	Decision
Covariate pretest	95.26	1	95.26	3.26	0.06	NS
Main effect	2446.71	1	415.57	44.86	0.00	S
Explained	3144.89	1	185.50	31.76	0.00	S
Residual	2570.20	17	22.91			
Total	8257.06	20	57.31			

S=Significant at P<.05 alpha level

The result of the effect of treatment on students' achievement in Basic Science as shown in Table 2 was significant at p<.05 alpha level (F=44.86, p<.05). Hence, the hypothesis is rejected. This implies that the Basic Science students with Sensing/Intuitive learning style differ significantly in their enhancement of achievement after being exposed to Crossword Picture Puzzle and Conventional Method

.

Hypothesis Two

There is no significant difference in the mean achievement scores of Basic Science students with Visual/Verbal learning style exposed to crossword picture puzzle and conventional method.

The data to test for this hypothesis is presented in Table 3.

Table 3: ANCOVA Result of Basic Science Students with Visual/Verbal Learning Style exposed to Crossword Picture Puzzle and Conventional Method

Sources of Variation	Sum of Square	df	Mean Square	F.cal	P<.05	Decision
Covariate pretest	12.61	1	12.61	2.10	0.07	NS
Main effect	1224.44	1	441.74	28.76	0.00	S
Explained	1124.40	1	303.56	20.78	0.00	S
Residual	1201.52	17	19.23			
Total	3562.97	20	33.47			

S=Significant at P<.05 alpha level

The result of the effect of treatment on students' achievement in Basic Science as shown in Table 3 was significant at p<.05 alpha level (F=28.76, p<.05). Hence, the hypothesis is rejected. This implies that the Basic Science students with Visual/Verbal learning style differ significantly in their enhancement of achievement after being exposed to Crossword Picture Puzzle and Conventional Method.

Hypothesis Three

There is no significant difference in the mean achievement scores of Basic Science students with Active/Reflective learning style exposed to crossword picture puzzle and conventional method.

The data to test for this hypothesis is presented in Table 4.

Table 4: ANCOVA Result of Basic Science Students with Active/Reflective Learning Style exposed to Crossword Picture Puzzle and Conventional Method

Sources of Variation	Sum of Square	df	Mean Square	F.cal	P<.05	Decision
Covariate pretest	27.46	1	27.46	2.26	0.07	NS
Main effect	362.94	1	210.38	26.52	0.00	S
Explained	367.90	1	230.49	19.78	0.00	S
Residual	501.87	17	18.21			
Total	1260.17	20	23.26			

S=Significant at P<.05 alpha level

The result of the effect of treatment on students' achievement in Basic Science as shown in Table 4 was significant at p<.05 alpha level (F=26.52, p<.05). Hence, the hypothesis is rejected. This implies that the Basic Science students with Active/Reflective learning style differ significantly in their enhancement of achievement after being exposed to Crossword Picture Puzzle and Conventional Method.

Hypothesis Four

There is no significant difference in the mean achievement scores of Basic Science students with Sequential/Global learning style exposed to crossword picture puzzle and conventional method.

The data to test for this hypothesis is presented in Table 5.

Table 5

ANCOVA Result of Basic Science Students with Sequential/Global Learning Style exposed to Crossword Picture Puzzle and Conventional Method

Sources of Variation	Sum of Square	df	Mean Square	F.cal	P<.05	Decision
Covariate pretest	24.76	1	24.76	2.31	0.07	NS
Main effect	364.92	1	213.08	29.72	0.00	S
Explained	360.97	1	240.39	18.98	0.00	S
Residual	501.87	17	12.18			
Total	1260.17	20	22.63			

S=Significant at P<.05 alpha level

The result of the effect of treatment on students' achievement in Basic Science as shown in Table 5 was significant at p<.05 alpha level (F=29.72, p<.05). Hence, the hypothesis is rejected. This implies that the Basic Science students with Sequential/Global learning style differ significantly in their enhancement of achievement after being exposed to Crossword Picture Puzzle and Conventional Method.

Discussion

The result obtained revealed that there was significant difference in the mean achievement scores of students exposed to Crossword-Picture Puzzle learning strategy and Conventional method. Students in the Crossword-Picture Puzzle learning strategy group achieved more than Conventional method group. This is in agreement with the findings of Olagunju and Babayemi (2014), Babayemi and Akinsola (2014), Ogundiwin (2013) and Bowers (2006) who in their different researches observed that the use of Crossword-Picture Puzzle strategy enhanced the academic achievement of students. The reason for the improved achievement could be because, the games aroused and sustained the students' interest in learning, aid in generating new ideas in learners and develop critical thinking, removed fatigue, fostered social interaction, aided in the recall of information easily and helped learners with low achievement potential.

Also, findings from this study revealed that the Basic Science students with the four (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) learning style differed significantly in their enhancement of achievement after being exposed to Crossword-Picture Puzzle and Conventional method. This finding agrees with that of Akinbobola (2015) and Akinbobola (2011a) who found out that students with the four (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) learning style differed significantly in their enhancement of achievement after being exposed to Guided Discovery, Demonstration Method and Conventional method.

Conclusion

The result obtained revealed that there was significant difference in the mean achievement scores of students exposed to Crossword-Picture Puzzle learning strategy and Conventional method. Students in the Crossword-Picture Puzzle learning strategy achieved more than the Conventional method group. Also, findings from this study revealed that the Basic Science students with the four (Sensing/Intuitive, Active/Reflective, Visual/Verbal and Sequential/Global) learning style differed significantly in their achievement after being exposed to Crossword-Picture Puzzle and Conventional method.

Recommendation

Based on the findings of this study, the following recommendations are made.

1. Crossword-Picture Puzzle learning strategy should be adopted in secondary schools to improve students' achievement in Basic Science,
2. Teachers should incorporate the use of games especially puzzle game for effective Basic Science delivery, because of the potential benefits of educational game to foster learning during classroom instructional process
3. Teachers of Basic Science should find out about the learning styles of their students and

bear these varied styles in mind when planning and executing instruction in Basic Science classes.

References

Akinbobola, A. O. (2011a). Visual, auditory and kinaesthetic learning styles and students' achievement in Nigerian senior secondary school physics. *IRCAB Journal of Arts and Education*, 1(1), 140-146.

Akinbobola, A. O. (2015). Effects of Learning Styles and Instructional Strategies on Students' Achievement in Nigerian Senior Secondary School Physics. *International Journal of Advances in Physics Theories and Applications*, 41, 20-29.

Babayemi, J. O, Akinsola, M. K (2014). Effects of Crossword-Picture Puzzle Teaching Strategy and Mental Ability on Students' Achievement in Basic Science in Southwestern Nigeria. IOSR *Journal of Research & Method in Education (IOSR-JRME)*, 4 (4:3), 08-13.

Bowers, A. (2006). Teaching with Puzzles. *http://www.education.more4kids.info*

Cardenas-Nelson, E. J. & Connolly, J. (2011). Know the Types of Picture Puzzles.http://www.dummies.com/howto/content/know-the-types-of-picture-puzzles.htm

Dunn, R. (1990). Understanding the Dunn and Dunn learning styles model and the need for individual diagnosis and prescription. Reading, Writing and Learning Disabilities, 6,223-247.

Federal Ministry of Education (2011) Research Statistics and Planning Section. Abuja, Nigeria.

Felder, R. M. & Soloman, B. A. (1998). Index of learning styles. Online version of the questionnaire, available at North Carolina State University, http://www2.ncsu.edu/unity/lockers/users/f/felderpublic/ILSdir/ILS-a.htm. Retrieved 20/7/2008.

Felder, R. M. (1988). Learning and teaching styles in engineering education. *Journal of Engineering Education*, 78(7), 674681.

Gregorc, A. F. (1979). Learning/teaching styles: Potent forces behind them. Educational Leadership, 36,234-236.

Hill, J. M. D. (2003). Puzzles and Games: addressing different learning styles in teaching operating system concept. ACM Press. 182-186.

Idowu, C. B., & Ige, A. (2007). Science Teachers' Assessment of Puzzle Games in the Teaching of Environmental Concepts of Integrated Science. *Journal of Science Education*, 4(1), 12-17.

Keefe, J. W. & Monk, J. S. (1986). Learning styles profile. Reston, VA: National Association of Secondary School Principals.

Kendalls, G., Parks, A., & Sperer, C. (2008). A Survey of NP-Complete Puzzles. *International Computer Games Association Journal*, 31(1): 13-84

Leong, L. (2005). Improving Students' Interest in Learning: Some Positive Techniques. *Journal of Information Systems Education*, 16 (2): 129-132.

Ogundiwin, O. A. 2013. Effects of Pre-theoretic Intuition Quiz and Puzzle-based Critical Thinking Motivation Strategies on Students' Learning Outcomes in Selected Environmental Concepts in Biology. *Unpublished Ph.D Thesis*, university of Ibadan.

Olagunju, A. M., & Babayemi, J. O. (2014). Effects of crossword-picture puzzle teaching strategy and gender on students' achievement in Basic Science. Journal of Education and Leadership Development, 6(1), 43-54.

Riding, R. & Rayner, S. (1998). Cognitive styles and learning strategies. London: David Fulton Publishers.

Samuel, I. R. (2017). Assessment of basic science teachers' pedagogical practice and students' achievement in Keffi Educational Zone, Nasarawa State, Nigeria. *Unpublished Masters*

Dissertation, Nasarawa State University, Keffi.

Saunders, G., & Christophers, J. E. (2003). Teaching outside the box: A look at the use of some non-traditional teaching models in accounting principles courses. *The Journal of American Academy of Business* 3(1&2):162-165.

Scott, K. (2002). Ten Ways to Use puzzles in Math Education. http://www.scottkin.com/thinggames/index

Scott, K. (2006). What is Puzzle? http://www.scottkin.com/thinggames/index

Sternburg, R. J. (1990). Thinking styles. Keys to understanding students' performance. Phi Delta Kappan, 71(5), 366-371.

Zywno, M. S. & Waalen, J. K. (2002). The effect of individual learning styles on students' outcomes in technology-enabled education. *Global Journal of Engineering Education*, 6(1), 1-10.