VOL. 04 NO. 8,
MAY, 2024
E-ISSN 3026-8893
P-ISSN 3027-1061



African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Education Research and Library Practice (JERLP)

THE MAIN EFFECTS OF GUIDED INQUIRY AND PROBLEM SOLVING FOR BRIDGING THE GAP BETWEEN THE LOW, MEDIUM AND HIGH ABILITY STUDENTS AND THEIR GENDER AMONG UNITY COLLEGES IN NORTH CENTRAL, NIGERIA

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Abstract

The study determined the main effects of Guided inquiry and Problem solving for bridging the gap between the low, medium and high ability students and their gender among unity colleges in north central, Nigeria. The study adopted two experimental groups and one control group of 2x2x3 factorial research design. Sample consists 373 (male = 198 and female 175) JSS 111 students. Basic science and Technology Students Achievement Test (BSTSAT) was used for data collection while guided inquiry, Problem solving and Traditional approaches were used as treatment instrument. Pearson Product Movement Correlation (PPMC) was used to determine the reliability coefficient of BSTSAT. The reliability coefficient of 0.86 was obtained Data were analyzed using Analysis of Variance (ANOVA). The ANCOVA) and Sidak Post-Hoc Multiple Comparison (SPMC). Results revealed that, significant differences were established in the post-test mean scores of GI, PSA and Traditional method. The value F (2, 369) = 99.77, P= (0.01) < 0.05, indicates a significant difference between the mean of the guided inquiry, problem-solving and traditional method group achievement in Basic Science and Technology. The treatment favouring GI and PSA Also, no significant difference were found in the post-test mean scores of high, medium and low ability students taught with GI and PSA but significant difference exist between GI, PSA and TA. While GI and PSA were gender friendly. Based on these findings, the following recommended were made: that Guided inquiry and Problem solving should be incorporated into the teaching method

adopted to Basic science and Technology since they have the capability to enhance the students' academic achievement and Basic science and Technology teachers be encouraged to use guided inquiry and problem solving instruction to provide equal opportunity to students of different ability.

Keywords: Achievement, Guided Inquiry, Problem Solving, Ability Level, Gender.

Introduction

Education is a process by which the individual can develop his capabilities by acquiring knowledge, skills, values and attitude for the benefit of the individual and society. Nigeria educational philosophy also makes provision of equal opportunities for all citizens of the nation at the basic, secondary and tertiary levels both inside and outside the formal school system, National policy on Education (FGN, 2020) The United Nations Human Rights Declaration recognizes education as a right for every individual to receive from elementary to the highest level. The National policy on Education in Nigeria (FGN, 2020) acknowledges that the major objective of education as the bedrock of a nation is meant to ensure proper administration, management and implementation of the education system to provide direction for education activities

Nigeria, being a developing country, has been in continuous search for ways to become a developed country. This explains the reason why the government came up with the 6-3-3-4 policy on education. The 6-3-3-4 concept of education allows the child to spend six years at the primary level, three years at the junior secondary school level, another three years at the senior secondary level, and four years at the tertiary level. This educational system was structured and designed to bring functionality in the system by producing graduates that make use of their head, heart and hands. The 6-3-3-4 system of education is job oriented because its emphasis is on manual activities, technical proficiency and respect for dignity of labour and economic efficiency.

Several reviews made modification on the Basic science and Technology curriculum, reviews such as those of the Science Teachers' Association of Nigeria (STAN) have attempted to integrate all subjects regarded as necessary for giving learners the fundamental knowledge of science and training learners to be architect of their learning through child-centered teaching strategies (Ozoji 2018) that the among goals of science education in Nigeria is to produce scientists for national development and to service studies in technology and the cause of technological development.

The study of Basic science and Technology gives students and teachers a chance to look at how science is essential to their development. It enables human organization to build huge industries through industrial science which can helped to improve living standards and brought wealth and prosperity. However, with the introduction of Basic Science and Technology in our schools, the discipline has been faced with many

challenges because there is public outcry about the poor performance of students. . There are different methods and techniques of teaching Basic Science, like the other school subjects, the technique appropriate for a particular subject matter for a specific level may be inappropriate elsewhere, this is because varieties of factors combine to determine how effective or otherwise a method is. The effective teaching of Basic Science and Technology could be measured by examining the methods of teaching applied by teacher concerning the performance of students in school examinations, such techniques include inquiry which may be guided or unguided, problem solving strategy, cooperative method, guided discovery method, laboratory activity method, concept mapping method and many others (Ada, 2014).

The guided inquiry technique is an instructional delivery approach that enables students discover how much knowledge they already have contribute to their own future learning and explore their potentials through creativity, freedom and discussions. Kuhlthau (2010) sees Guided inquiry as a combination of activities that involves objects, drawings, charts, specimens and concept maps, posing questions, carrying out investigations in the laboratory, proposing explanations, collecting data and comparing proposed descriptions with new data under the guidance of the teacher

The Problem solving technique is a student centered approach where the teacher and students play an equally active role in teaching and learning process. The teachers' primary function is to coach and facilitates student learning and overall comprehension of material while the students construct new ideals and concept based on their past knowledge. Brooks and Brooks (2011) stressed that students are in charge of the learning process in problem – based solving techniques while the teacher provides students with a suitable environment to construct knowledge. The problem solving approach equips the students the ability to solve any problem confronting them in the process of learning. Also Akinolu and Fandogan (2012) had it that when exposed science students to problem based solving techniques, students' academic achievement is significantly improved.

It is well known that every student has a different way of learning and progresses at different speeds. Thus, while some students may find the learning task easy to complete, others may find it difficult to understand. The weakness of students in Basic Science and Technology generally was linked to the fact that candidates lack basic concepts and not able to link Basic science and Technology concepts to real life situation (Lakpini and Atadoga 2012). However ability level varied and can be determined in three levels (i) High achievers, (ii) middle/average achievers and (iii) low achievers. . Kaya (2015) assert that with the traditional teaching method, the gap between the achievements of high, medium and low ability students continue to widen. Thus, there is need to explore more approaches that will improve students achievement at all levels and instruction could be organized so that all students in the class can achieve at a high level. Only the high ability students benefit from the traditional teaching method. Therefore, there is a need for innovative instructional strategies to provide equal

achievement opportunities for high, medium and low ability students (Kaya 2015) no matter their gender.

Gender issues in science education as it affects achievement remains unresolved because there is no consistent result. Several studies (Abubakar & Adegboyega, 2012; Abdu-Raheem, 2012; Doris, et - al, 2012; Josiah & Adejoke, 2014; Oluwagbohunmi, 2014) have carried out research study on gender academic achievement relatedness of gender in many school subjects at all levels of education in different countries with different reports. Though, differences do exist in nature, gender differences in educational attainment may be caused by several variables not limited to socio-economic status (Rotich, *et – al.* 2014), poor quality of teacher, students' interest, Students' attitude (Olasehinde & Olatoye, 2014), political and social conditions, the pattern of assessment, as well as school type (Anderson, 2012) are all contributing factors to under achievement associated with gender.

Empirical studies on students' ability levels have been conflicting. Some reported high abilities performed better than medium, while some reported otherwise. For instance Sunday, *et-al*. (2021), Achugbu and Eke, (2020),Madhuri and Rani (2018), Olaniyan, *et-al.* (2015) and Atomatofa, (2014) that there are significant difference in mean achievement scores of high and low ability students as a result of treatment while some authors suggests that ability level is significantly related to academic achievement Liu, et- al (2019), Hanson, (2010) and Okobiah, (2012), suggested that difference between low-medium and high achieving students are closely linked to instructional methods used in delivering the curriculum

In Nigeria, emphasis has not been laid on innovative strategies that can bridge gap between the high, medium, and low ability students. In addition, very few empirical studies exist in Nigeria regarding the use of Guided inquiry and Problem solving strategies in Basic science and Technology. Thus, much remain to be empirically studied on the effects of Guided inquiry and Problem solving approaches on students' ability levels and gender in Basic science and Technology education among the unity colleges in north central Nigeria

Research Questions

1. What are the main effects of Guided Inquiry and Problem Solving approaches on Basic Science and Technology *Mean* ($\bar{x}$) achievement scores of students in Unity Colleges?
2. What are the interaction effect between instructional approaches (GI, PSA) and Gender on Basic Science and Technology *Mean* ($\bar{x}$) achievement scores among students in Unity Colleges?

Research Hypotheses

The following null hypotheses were formulated and will be tested at 0.05 level of significance

1. **Ho_1**: There is no significant difference in main effect of Guided Inquiry and Problem Solving approaches on Basic Science and Technology *Mean* ($\bar{x}$) achievement scores among High, Medium and Low students in Unity Colleges

2. **Ho_2:** There is no significant difference in the main effect of Gender on Basic science and Technology *Mean* ($\bar{x}$) achievement scores of High, Medium, and Low of Basic Science and Technology instructional approach students taught with Guided Inquiry and problem-solving approaches

Methodology

Research Design*:* This study adopted Factorial 2x2x3 research design. Three levels of independent variables (two treatments and one control group), three groups of academic ability (low, medium, and high) and gender were employed in this study. The two experimental groups Guided inquiry (GI) and Problem solving approach (PSA) and one control group (Traditional teaching method) BSTSAT was administered as pre-test before treatment and posttest after treatment. The experimental group 1 was subjected to treatment using Guided inquiry method (GI), the experimental group 2 was subjected to treatment using Problem solving approach (PSA) and the control group was taught using the conventional traditional method. The design layout is as shown in Figure 1

Figure 1: ***Factorial Design Layout***

Group	*Academic Ability*	*Instructional Approaches*	*Dependent Variable*	*Instructional Approach*	*Dependent Variable*
1	*High*	*GIA*	*Post-Test, Post Post-Test (BSTSAT Score)*	*GIA*	*Post-Test, Post Post Test (BSTSAT Score)*
2	*Medium*	*GIA*	*Post-Test, Post Post-Test (BSTSAT Score)*	*GIA*	
3	*Low*	*GIA*	*Post-Test, Post Post-Test (BSTSAT Score)*	*GIA*	
4	*High*	*PSA*	*Post-Test, Post Post-Test (BSTSAT Score)*		
5	*Medium*	*PSA*	*Post-Test, Post Post-Test (BSTSAT Score)*		
6	*Low*	*PSA*	*Post-Test, Post Post-Test (BSTSAT Score)*		
7	*High*	*TA*	*Post-Test, Post Post-Test (BSTSAT Score)*		
8	*Medium*	*TA*	*Post-Test, Post Post-Test (BSTSAT Score)*		
9	*Low*	*TA*	*Post-Test, Post Post-Test (BATSAT Score)*		

Sample and Sampling Technique

The sample for the study was made up of 373 (male = 198 and female 175) students. A multi-stage sampling technique was used to select the samples for the study. Multi-stage sampling technique for a population that is divided as the North-central states are: First, stratified sampling technique (7 states strata) from unity colleges. Secondly, a purposive sampling technique was used to select one third of the schools from (three states) in the North-central states. thirdly, random sampling was used to select the students in the streams of JSS3 classes available in the school was further divided into 3 classes for Experiment 1, Experiment 2 and Control Groups. Finally Subjects were stratified into different ability levels based on their performance in the previous examination.

The criteria for high ability students were based on students whose previous average in the

Basic science and Technology examination fell within the first 25% (1st quartile), the medium ability students' score within the middle 50% while the low ability level students fell within the lower 25%.

Research Instruments: it consist of three instruments, that covered topics from the Family Traits (Cell, Family Tree, Hereditary Traits and Inheritance)

Treatment instruments

Three (3) treatment instruments were developed by the researcher, these are Basic Science and Technology Guided Inquiry Lesson Plan (GILP) The lesson plan was designed based on the 5E learning cycle which are; Engage, Explore, Explain, Elaborate, and Evaluate. Basic Science and Technology Problem-solving Lesson Plan (PSLP) based on PSLP Teaching and Learning cycle which are: Understand the Problem, Explore the Curriculum and Resolve the Problem and Conventional (lecture) Method Lesson Plan.

Test instruments

The instrument for data collection is Basic Science and Technology Students' Achievement Test (BSTSAT) The BSTSAT has 50 multiple choice objective items adopted from the past Junior Secondary School Certificate Examination (BECE). The BSTSAT is completely based on JSS curriculum on concepts of Family Traits (Cell, Family Tree, Hereditary Traits and Inheritance). These topics are selected from the Junior Secondary School II1 (JSSIII) Basic Science and Technology syllabus. Each question has multiple-choice with four options (A-D) as possible answers to the question. Students are required to choose the correct answer by ticking on the letter (A-D) that corresponds to the right answer. Only one of the four options is the correct answer.

Experimental procedure

Basic science and Technology Students Achievement Test (BSTSAT) was given as pre-test. The main objective of administering the pre-test is to ascertain the academic equivalent of the students in Basic science and Technology before the commencement of the experiment. Treatment followed after and lasted for four weeks based on school timetable and scheme of work. Immediately after treatment post -test was conducted

Results

Three statistical tools employed to analyze the scores obtained from the selected samples in the study. *Mean* ($\bar{x}$) and Standard deviation (s) were used to answer the research questions. The null hypotheses were analyzed using Analysis of Variance (ANOVA) and Analysis of Co- variance (ANCOVA), Sidak Post-Hoc Multiple Comparison (SPMC) and Students Package for Social Sciences (SPSS) version 23.0. Descriptive charts were used to describe the research questions and null hypotheses.

Pretest results

Pretest data was collected and analyze using Analysis of Variance (ANOVA) to determine the equivalence of the students in the Guided Inquiry, Problem-Solving, and Traditional groups in terms of their Basic Science and Technology students' achievement before treatment as presented in Table 1 and .2

Table 1: Pretest ANOVA Results of Guided Inquiry, Problem-Solving and Traditional Strategy

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2796.331	2	1398.165	20.206	.000
Within Groups	25602.125	370	69.195		
Total	28398.456	**372**			

Table 1: shows the pretest results of the three groups (guided inquiry, problem-solving, and traditional method) before the treatment. The result indicated a significant difference between the three groups F (2, 370) = 20.206, P (0.00) < 0.05. This indicates the three groups were not equivalent in their Basic Science and Technology students' achievement at the baseline or pretest before the treatment. Therefore, the pretest will be used as a covariant in the post-test data analysis because of the significant difference obtained above, analysis of covariance (ANCOVA was used for testing the hypothesis).

Table.2: Pretest ANOVA Results of High, Medium, and Low-ability students taught with Guided Inquiry, Problem-Solving, and Traditional Strategy

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	9951.330	8	1243.916	24.545	.000
Within Groups	18447.126	364	50.679		
Total	28398.456	**372**			

Table: 2 shows the pretest results of the three groups (guided inquiry, problem-solving, and traditional method) before the treatment. The result indicated a significant difference between the three groups F (8, 364) = 24.545, P (0.00) < 0.05. Therefore, the pretest will be used as a covariant in the post-test data analysis because of the significant difference obtained above, analysis of covariance (ANCOVA was used for testing the hypothesis).

Research Question One: What are the main effects of Guided Inquiry and problem-solving approaches on Basic Science and Technology *Mean* ($\bar{x}$) achievement scores of students in Unity Colleges? The mean and standard deviation were employed to answer this research question; the results are presented in Table.3.

Table 3. Comparison of the Mean and Standard Deviation of Pretest and Post-test results for Guided Inquiry and Problem Solving and Traditional Method in Basic Science and Technology students' Achievement

Group		Pretest		Post-test		Mean Gain
		Mean	**SD**	**Mean**	**SD**	
Guided Inquiry	143	23.43	8.45	61.59	5.37	38.16
Problem-solving	120	18.29	5.77	41.91	7.81	23.62
Traditional Method	110	22.96	8.48	36.09	13.43	13.49

The result in Table 3 indicates the mean and standard deviation of the pretest and post-test of Guided Inquiry, problem-solving and Traditional methods. The pretest mean of the three groups were 23.43, 18.81 and 22.96 respectively, while the post-test standards were 61.59, 41.91 and 36.09 respectively. The three groups improved on their Basic Science and Technology students' achievement. However, students that learn with Guided Inquiry method strategy had the highest mean gain of 61.59, and the problem-solving strategies mean 57.49, while the traditional method has the least mean gain of 48.27. Therefore, Guided Inquiry, and problem-solving strategies are more effective in enhancing students' achievement in Basic Science and Technology.

Research Question Two: What are the interaction effect between instructional approaches (GI, PSA) and Gender on Basic Science and Technology *Mean* ($\bar{x}$) achievement scores among students in Unity Colleges? To answer this research question, the line graph was employed and the results are presented in Figure1.

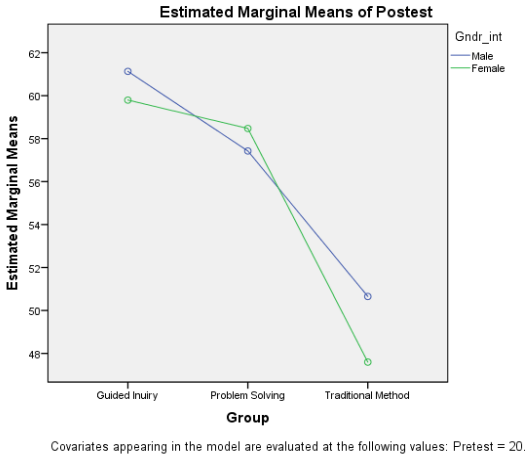


Figure4.1: Interaction effect of Instructional approach (GI, PS and T) and Gender on Basic Science and Technology students' achievement

Figure.1 shows that there are interaction effects between the instructional approach (Guided Inquiry, Problem Solving, and Traditional and students' Basic Science and Technology achievement. The results suggested that the instructional approach (Guided inquiry, Problem solving approaches and traditional teaching strategy) and students' gender (male and female) interact in a manner that could influence academic achievement in Basic Science and Technology among the students. The graph shows that the Female of Problem solving approach perform better than their male counterpart in guided inquiry

Hypothesis One (Ho_1): There is no significant difference in the main effect of Guided Inquiry and problem-solving approaches on Basic Science and Technology *Mean* ($\bar{x}$) achievement scores among students in Unity Colleges. To test this formulated hypothesis, an Analysis of Co-variance was used and the findings presented in Table 4

Table 4: ANCOVA Result for Guided Inquiry, Problem-Solving, and Traditional method in Basic Science and Technology students' Achievement

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	14029.748[a]	3	4676.583	121.677	.000	.497
Intercept	135102.014	1	135102.014	3515.124	.000	.905
Pretest	2774.140	1	2774.140	72.178	.000	.164
Group	7669.288	2	3834.644	99.771	.000	.351
Error	14182.327	369	38.434			
Total	1212320.000	373				
Corrected Total	28212.075	372				
a. R Squared = .497 (Adjusted R Squared = .493)						

Results in Table 4 shows post-test findings of guided inquiry, problem-solving and traditional strategies. The value F (2, 369) = 99.77, P= (0.01) < 0.05, indicates a significant difference between the mean of the guided inquiry, problem-solving and traditional method group achievement in Basic Science and Technology. Therefore, the hypothesis was rejected. The partial eta square (n^2) (.351) shows that about 35.1% of total variances in the Basic Science and Technology students' achievement scores (dependent variable) is due to the effect of instructional strategies. To determine the significant difference, Sidak multiple comparisons was conducted and the result is presented in Table 4.b.

Table 4.b Sidak Post-Hoc Multiple Comparison of Achievement of Basic science and Technology Students Taught Basic science and Technology with Guided Inquiry, Problem Solving and Those Taught with Traditional Method

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Guided inquiry	Problem-Solving	2.514*	.784	.004	.633	4.394
	Traditional Method	11.339*	.820	.000	9.373	13.305
	Guided Inquiry	-2.514*	.784	.004	-4.394	-.633

Problem-solving	Traditional Method	8.826*	.817	.000	6.865	10.786
Traditional	Guided Inquiry	-11.339*	.820	.000	-13.305	-9.373
Method	Problem-solving	-8.826*	.817	.000	-10.786	-6.865

Sidak post-hoc analysis on Table 4.b indicated that the observed significant difference was between the group taught using guided inquiry learning group and Problem-solving learning group with the mean difference of 2.51, P-value of .004 which was significant at 0.05 level. There was a significant difference between guided inquiry learning group and those taught with traditional group, the mean difference is 11.34, *P*-value of .000, which is also significant at 0.05 levels. The mean differences are in favour of the guided inquiry learning group. Similarly, there was a significant difference between problem-based learning group and the traditional group with the mean difference of 8.83, p=0.00, the mean difference is in favour of the problem-solving learning group. Therefore, the guided inquiry and problem-solving groups did better than the traditional group. However, the group that contributed most to making it significant was guided inquiry because of its higher mean differences of 11.34 compared with other groups.

Hypothesis Two (Ho_2): There is no significant difference in the main effect of Gender on Basic science and Technology *Mean* ($\bar{x}$) achievement scores of High, Medium, and Low of Basic Science and Technology instructional approach students taught with Guided Inquiry and problem-solving approaches.

Table 5 ANCOVA Result for guided inquiry, Problem-Solving, and Traditional method in Basic Science and Technology students' Achievement

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	14380.859[a]	6	2396.810	63.424	.000	.510
Intercept	134445.693	1	134445.693	3557.686	.000	.907
Pretest (covariant)	2772.847	1	2772.847	73.375	.000	.167
Gender	8020.399	5	1604.080	42.447	.000	.367
Error	13831.216	366	37.790			
Total	1212320.000	373				
Corrected Total	28212.075	372				

a. R Squared = .510 (Adjusted R Squared = .502)

Results in Table 5 (a) shows post-test findings of guided inquiry, problem-solving and traditional strategies on Basic science and Technology achievement. The value F (5, 366) = 42.44, P= (0.01) < 0.05, indicates a significant difference between the mean score of the guided inquiry, problem-solving and Traditional instructional approach. Therefore, the hypothesis was rejected. The partial eta square (n^2) (.367) shows that 36.7% of total variances in Basic science and technology achievement scores (dependent variable) can be explained by the effect of treatment with the instructional strategies. To determine the direction of the significant difference, Sidak Post-Hoc Multiple Comparison was conducted as presented in Table 5b

Table 5b Sidak Post-Hoc Multiple Comparison of Achievement of Basic science and Technology Students Taught with guided inquiry, Problem Solving and Those Taught with Traditional Method

(I) Gender	(J) Gender	Mean Difference (I-J)	Std. Error	Sig.[b]
Guided Inquiry Male	Guided Inquiry Female	1.338	1.028	.194
	Problem Solving Male	3.707*	1.057	.001
	Problem Solving Female	2.658*	1.119	.018
	Traditional Method Male	10.481*	1.095	.000
	Traditional Method Female	13.535*	1.157	.000
Guided Inquiry Female	Guided Inquiry Male	-1.338	1.028	.194
	Problem Solving Male	2.369*	1.069	.027
	Traditional Method Male	9.143*	1.108	.000
	Traditional Method Female	12.198*	1.169	.000
Problem Solving Male	Guided Inquiry Male	-3.707*	1.057	.001
	Traditional Method Male	6.774*	1.104	.000
	Traditional Method Female	9.829*	1.163	.000
Problem Solving Female	Guided Inquiry Male	-2.658*	1.119	.018
	Traditional Method Male	7.823*	1.148	.000
	Traditional Method Female	10.877*	1.202	.000
Traditional Method Male	Guided Inquiry Male	-10.481*	1.095	.000
	Traditional Method Female	3.054*	1.177	.010

Sidak post-hoc analysis on Table 5b indicated that the observed significant difference was between the male student taught with guided inquiry and the male and female students taught

with problem-solving and traditional method with the mean difference as follows; Problem Solving Male 3.707, Problem Solving Female 2.658, Traditional Method Male 10.481, and Traditional Method Female 13.535. Significant differences exist between the performance of female students taught with guided inquiry and Problem Solving Male, Traditional Method Male, and Traditional Method Female with the mean difference of 2.369, 9.143, and 12.198, respectively in Basic science and technology achievement.

A significant difference also exists between the performance of male students taught with Problem Solving, Traditional Method Male, and Traditional Method Female with the mean difference of 6.774, and 9.829, respectively. Similarly, a significant difference exists between problem-solving Females and Traditional Method Males, and Traditional Method Females with a mean difference of 7.82, and 10.88, respectively. This indicates that the male and female of the guided inquiry and problem solving groups perform better in Basic science and technology achievement than the control group. Consequently, problem-solving is more gender friendly because there was no significant difference between the male and female students taught with it

Discussion of results

Hypothesis one indicate that there is a significant difference between the mean of the guided inquiry, problem-solving and traditional method group achievement in Basic Science and Technology. Therefore, the hypothesis was rejected. The result is in agreement with the findings of Ekomaye (2019), Emmanuel (2019) on the effect of Guided inquiry teaching method (GITM) and Problem solving on secondary school students' achievement that the experimental group had higher mean achievement scores in post- test than the control group. Similarly, Oyasola and Adegoke (2021), Achugbu and Eke, (2020), on the impact of instructional strategies on students' academic achievement in Basic science and result of the study revealed that the treatment innovative teaching strategies had significant effects on academic achievement of experimental group than the control group.

Hypothesis two on the main effect of gender on Basic science and Technology, *Mean (*$\bar{x}$) achievement scores of High, Medium and Low and Instructional approaches on students taught with Guided inquiry and Problem solving approaches , the result indicates a significant differences between the mean score of the guided inquiry, problem solving and instructional approach. Therefore the hypothesis was rejected. Sidak post-hoc analysis indicated that the observed significant difference between the male students taught with guided inquiry and the male and female students taught with problem solving and Traditional method with the mean difference are due to interaction effect of the instructional strategy employed: Problem solving male, Problem solving female, Traditional method Male and Traditional method female significance different exist between the performance of female students taught with Guided inquiry and Problem solving male, Traditional method male and Traditional method female with the mean difference respectively. The significance different also exist between the performance of male students taught with Problem solving and Traditional method male and

Traditional method female with the mean difference respectively. Similarly a significant difference exists between problem solving female and Traditional method male and female with mean difference respectively.

The result is similar with Shelly and Maggie, (2012) that there was a significant difference between the male and female students in term of perception and confidence ability when both exposed to Problem solving approach, also Obaunge, (2021) and Ezeike and Okigbo (2021) reported that there is a significant difference between the male and female problem solving abilities on mathematics in favour of male students over the female students but from findings of Echie and Owo (2019) that gender did not significantly influence students' achievement in Basic science in private school when both exposed to guided inquiry on gender difference in achievement of Basic science,

Conclusion

This study revealed that Guided inquiry and Problem solving approaches enhanced students' achievement and more gender friendly in Basic science and Technology. Guided inquiry and problem solving generates more learning outcome than the Traditional teaching method. Guided inquiry and Problem solving approaches improved high, medium and low ability students' achievement equally. This can serve as a medium of bridging the gaps between low, medium and high ability students in Basic science and Technology among the unity colleges in North central, Nigeria

Recommendations

Based on the findings of this study, it is recommended that the Guided inquiry and Problem solving should be incorporated into the teaching method adopted to Basic science and Technology since they have the capability to enhance the students' academic achievement. Guided inquiry and Problem solving approaches should be encouraged as it allows the learners to construct the materials to be learned and the task to be performed, select the relevant information and interpret it to attained desired learning outcomes

Reference

Abubakar, R. B. & Adegboyega, B. I. (2012). Age and gender as determinants of academic Achievements in college mathematics. *Asian Journal of Natural & Applied Science. 1(2), 121–127*

Abdu-Raheem, B. O. (2012). Gender differences and students' academic achievement and Retention in social studies among Junior Secondary Schools in Ekiti State, Nigeria. Euro *Journal of education studies*, 4(1), 155–161.

Achugbu C.U and Eke J.A (2020), Effect of problem solving instructional technique on secondary school students' achievement in chemistry in Anambra State. Nigeria. *International Journal of humanities & social studies* pg 421-428

Ada, N. (2014). Curriculum and instruction: An Introduction to general methods and principle of teaching.. Pg 53 – 68

Akinolu, O. & Fandogan, R. (2012). The effects of problem-based active learning in science education on students' academic achievement, attitude and concept learning. *Eurasia Journal Mathematics, Science, Technology Education: 71-81*

Anderson, E. W. (2012). Is there a crisis for boys? Gender differences in student academic Achievement and teacher training characteristics in the Gulf Co-operation Council Countries. Theses and Dissertation Paper 1394

Atomatofa, R. O. (2014), Effects of Instructional Strategies and Gender on Basic-Science Students' Achievement in Nigeria Delta State College of Physical Education, Monogram, Nigeria Psychological *Studies www.worldofresearches.com World of Researches* Publication Ac. J. Psy. Stud; 3, (1), 80-86.

Brooks, J.G. & Brooks, M.G. (2011). Comparing the impacts of a problem based computer Assisted Instruction and the direct teaching method on students' science achievement. *Journal of Science Education and Technology pg, 147 – 153*

Doris, A., O'Neil, D., & Sweetman, O. (2012). Gender, single-sex schooling and maths Achievement. ZA discussion Paper No. 6917.

Echie, G. G., & Owo, W. J. (2019), Gender differences in basic science achievement of private junior secondary school students in Obio/Akpor local government area, Rivers State Ignatius Ajuru University of Education Rumuolumeni, Port Harcourt, Nigeria. *International Journal of Scientific Research in Education;* 12(2), 320-332

Ekomaye C.O. (2019), The effect of guided inquiry teaching method (GITM) on secondary School students' achievement in light and sound waves. *International Journal of Scientific Research*, pg 40 – 52

Emmanuel, A. (2019), Effect of problem base learning strategy on upper basic two students achievement in basic science in markurdi metropolis, Benue state, Nigeria *journal of science, technology, mathematic and education* (JOSMED) 231 -243

Ezeike U. N. and Okigbo, C. E. (2021), Effect of problem solving strategy on secondary school students' achievement in chemistry in onitsha education zone. *International journal of innovative research and advanced study (IJIRAS),56 - 75*

Federal Government of Nigeria (2020), *The National Policy on Education Lagos:* NERDC press Ltd Nigeria

Hanson, J. (2010). How does academic ability affect educational and labour market pathways in Canada? OECD *Education Working Papers, No. 30, OECD Publishing*.

Josiah, O., & Adejoke, E. O. (2014). Effect of gender, age and mathematics anxiety on college Students' achievement in algebra. *America Journal Education Research*, 2(7), 474–476.

Kaya, S. (2015). The effect of the type of achievement grouping on students' question generation in science. Australian Educational Researcher, 42, 429-441.

Kuhlthau, C. C. (2010). Guided Inquiry: School Libraries in the 21st Century. Journal of School Libraries Worldwide 16(1): 17-28.

Lakpini, M. A. & Atadoga, M. M. (2012) Effect of conceptual change strategy on academic achievement, Retention and attitude of Senior Secondary School (SSII) Biology of varied ability levels in Zaria, Kaduna Nigeria

Liu, X, Gao, X & Ping, S. (2019), Post – 1990s College students academic sustainability: the role of negative emotions, achievements goals and self-efficacy on academic performance. Sustainability, 11 (3.775)

Madhuri, H. & Rani, D. (2018), Effect of problem solving ability on achievement and gender of Mathematics students in senior secondary School University, Rohtak (India) Research Scholar Published Online: *International Journal of Multidisciplinary,* 111 – 120

Obunge, J. I. (2021), Gender difference and problem solving abilities in mathematics among senior Secondary school students, Port-Harcourt, Rivers State, Nig. *International Journal of women in Technical Education and Employment*,164 -169

Okobiah, E. O (2012). The teacher factor in enhancing quality assurance in the teaching/learning of social studies. *Review of European Studies* 4 (4) 20-32

Olaniyan A.O, Omoseno E.O & Nwankewo, L.I (2015) Effect of polya problem-solving model on SSS performance in current *Electricity Europen Journal of Science and Maths Education* 97-104

Oluwagbohunmi, M. F. (2014). Gender issues in classroom interaction and students' Achievement In social studies. *Intern. J. Inov. Res Dev*., 3(5), 742–745.

Olasehinde, K. J., & Olatoye, R. A. (2014). Comparison of male and female Senior Secondary School students' learning outcomes in science in Katsina State, Nigeria. Mediterranean *Journal of Social Sciences, 5(2), 517–523.*

Oyasola, S. O & Adegoke, A. I (2021), Impacts of innovative instructional strategies on Junior Secondary School One Students' achievement in Basic Science. *Trailblazer International Journal of Educational Research* pg. 62 – 70

Ozoji, B.E. (2018). Effects of concept mapping technique on students' cognitive development in Nigeria: Implications for science and technology instruction. Stemplanet 1 (1), 55-64

Rotich, S.K., Rono, K.J., & Mutisya, S.M. (2014). University education of the Maasai Girls in Kenya at crossroad: A viewpoint of the role of local leaders and socio- cultural factors. The *International Journal Social Science Human Invention*, 1(1), 51-61.

Shelly L. W. & Maggie Z. (2012), Gender differences in University students' perceptions and confidence in problem-solving abilities University of Let Bridge, Let Bridge, AB,

Sunday A, Opara, M .F & Bardi. (2021) effect of inquiry based learning on Secondary School Students Misconception of Science Concepts & academic achievement in Science.