**Effects Of Problem Solving Approach On Academic**

**Performance And Attitude Of Basic Science Students**

**With Varied Academic Abilities**

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**Abstract**

*Investigating the effects of problem solving approach on academic performance and attitude of basic science students with varied academic abilities was the objective of the study. Testing of the hypothesis were at P≤0.05 level of significance. The study was designed using the pre-test and post-test quasi experimental and control group. 19,671 JS III students from 54 junior secondary schools in Oyo Educational Zone formed the population for the study. A sample of 504 students selected by balloting was used for the study. Problem solving approach was used to teach Basic Science concepts to the experimental group while lecture method was used to teach the control group. The validated instruments used to harvest data were Basic Science Achievement Test (BSAT), Test of Practical Skills (TOPS) and Attitude of Students toward Basic Science Questionnaire (ATSBSQ). Analysis of data gathered was done using Cronbach Alpha Technique for reliability coefficient as follows: BSAT r= 0.69, TOPS r= 0.96, ATSBSQ r= 0.69. The result of the study revealed that: (1) students’ academic performance in basic science was enhanced via the use of problem solving approach (2) students with low ability showed improved academic performance in basic science using problem solving approach unlike high and medium ability students. Based on the findings of the study, the researcher recommended that problem solving approach should be included in basic science teacher training curriculum in order to be producing problem solving approach instructional experts. Funds should be made available by federal and state ministries of education to sponsor basic science teachers for in- service training in problem solving approach instructional strategy towards improving academic performance of students in schools.*

**Keywords:** Problem-solving Approach, Academic Performance, Attitude, Varied Academic Abilities.

**Introduction**

The methodical examination of our surroundings is science. Shuaibu (2008) defines science as a complex human endeavor that synthesizes a body of universal statements, hypotheses, laws, principles, or theories to explain the observable behaviors of the universe or a fraction of it that is predictive. Science is the methodical study of everything that can be investigated and validated, according to Ojo (2016). He considers it a corpus of knowledge and an environmental investigation. All of the preceding definitions show that science is a methodical study and style of thinking that explains natural occurrences. According to Colman (2014), scientific education helps students examine their biological and physical surroundings to make constructive changes that enhance society's quality of life. Science education should produce people who can utilize their knowledge, skills, and experiences to address real-world issues by using environmental resources to improve society. He adds that the quality of life of individuals in wealthy and developing countries is decided by science and technology development.

Based on the aforementioned, science and technology are predicted to help Nigeria recover economically and remain competitive in the 21st century. Thus, Nigeria must enhance its human capital to produce talented scientists, engineers, and technicians for future innovations. Engineers, scientists, and technicians taught today to be innovative and solve real-world issues will become innovators. These citizens may frame questions and issues, conduct investigations to harvest data, acquire and organize data, form conclusions, and apply understandings to new circumstances. Our scientific education programs must include students in many classroom and lab activities to accomplish this. According to Colman (2004), scientific education in industrialized countries aims to teach teachers creative problem-solving. These countries have long stressed the need of teaching kids higher-order thinking and problem-solving. This illustrates that instructors must give the framework for kids to study and develop autonomous critical thinking. The format encourages pupils to reason, analyze, evaluate, and form their own opinions, making them dynamic learners (Achuonye, 2010).Science education in Nigeria must focus on new approaches that encourage creative thinking in scientific problem-solving, one of the most important and useful skills pupils need (Howard-Jones, 2002). Critical thinkers are curious, open-minded, rational, and flexible (APA, 1990). Basic science classrooms and labs should be participatory and exciting, with varied equipment for students to use. Hands-on interaction is expected (Ojo 2016). Innovative teaching methods like problem-solving must be used. The idea that doing is better than telling is not overstated (Ojo 2016). Alake (2007) described problem solving teaching as finding the best answer to an unknown under certain circumstances and limits. Problem-solving improves creative critical thinking. Teachers provide problems within students' abilities and let them solve them. When students solve problems, they use inquiry, discovery, explanation, and process skills (Ojo, 2016). Problem-solving helps learners focus, link the exercise to real life, build process skills rather than information, and improve social skills (Alake, 2007).

Problem solving is an instructional method in which the teacher carefully designs and formulates real or hypothetical problems and incorporates them into his lessons so that students unconsciously conduct scientific investigations that require them to observe, measure, classify, formulate a working hypothesis, predict, record, communicate, experiment, and sometimes control variables. Bichi (2012). Student gains from problem-solving scientific instruction. Young (1984) lists three benefits: a problem draws the child's attention, it's readily connected to the actual world, and it stresses process skills over knowledge. Problem solving is active, involves children's interests, is hard, and motivates, according to Nott (1987). Scientists require children to solve problems to comprehend science because the skills and attitudes they learn are useful in real life.

**The Problems Solving Teaching Approach**

Problems solving is an instructional approach that combines the advantages of several other innovative science teaching methods. It encourages inquiry, gives room for scientific discovery and enhances acquisition of process skills and knowledge (Danladi, 2007). The procedure to use the problem s solving approach as advised by Bichi (2012) is as follows; the teacher should try to make his lesson problems based. It might surprised you how excited the students are when thy are faced with a puzzle, the teacher should make the students think for themselves. Dung, Dinguryil and Alkamu (2010) quoted Bichi (2009) to state that, when problems solving approach is used to teach students, they benefits immensely that include the following; a problem catches the students attention and that is an effective way of starting a lesson, a problem solving exercise can easily be related to real world, it emphasizes process skills, exposure to problems solving process early in life is an important prerequisite in the development of a creative scientist.

**Traditional or Conventional Teaching Strategy**

Traditional or conventional teaching strategies typically involve a one-way flow of information from the teacher to the students, with minimal interaction beyond note-taking and passive absorption of content. In this approach, students primarily act as recipients of knowledge, while the teacher assumes the role of the primary source of information. Opportunities for student inquiry, questioning, and discussion are often limited, leading to a predominantly teacher-centered learning environment. As noted by Ojo (2016), this method tends to prioritize the delivery of information over active engagement and critical thinking on the part of the students. Instead of fostering dialogue and collaboration, students are expected to absorb information passively, relying on the teacher as the sole authority figure. Consequently, there is little room for students to ask questions, express their thoughts, or engage in meaningful discussions about the subject matter.

Moreover, Gradzama (2012) highlights the inherent limitations of traditional teaching methods, particularly in catering to the diverse abilities and learning styles of students. The reliance on chalkboard and lecture-based instruction fails to account for variations in students' cognitive abilities, thereby neglecting the needs of slower learners who may require additional support and scaffolding. This approach tends to overlook the importance of differentiated instruction and personalized learning experiences, hindering the academic progress of students with diverse learning needs. In essence, the traditional chalkboard and talk method perpetuate a passive learning environment that fails to effectively engage students or accommodate their individual differences. Moving away from this conventional approach towards more student-centered and interactive teaching strategies is essential for promoting deeper understanding, critical thinking skills, and inclusive learning experiences for all students.

**Resources for Effective Use of Problems Solving Approach**

Any resources that enhance the attainment of desired goals in education is called teaching and learning resources (Ofoegbu 2009). Any establish school curriculum calls for methods of implementing it so as to achieve the aims and objectives at the various level (Ofoegbu, 2009) Igwe (2003) classified teaching and learning resources into two; human and non-human or material resources. Human resources are professional (teacher, lecturers and students) and non-professional (These are the members of staff that provide essential duties in the school system but does not have professional qualifications of the job they offer) Okwo and Ike (1995) and Igwe (2003) were all observed that the teacher remains the most important human resource because he is trained, has experiences and well versed in his subject matter. Also, Omiko (2012) categorized non-human resources used in teaching-learning process as, funds, infrastructure (science laboratories, classroom, zoological gardens, furniture, etc) and instructional materials.

**Learning Environment \ Laboratory Facilities as they Affect Teaching of Basic Science.**

Basic science learning involves helping the students describe occurrences in their biological and physical environment, inculcating in them how to think and reason logically, helping the students to identify and solve life problems. It also involves helping the students to develop physical and social skills (National teachers Institute, NTI, 2009). Attamah (2012) pointed out that a child first laboratory is his environment, and he is expected to be at home with his environment whether at school or in parents’ home being able to identify those things around him/her, not only identifying them but utilizing them appropriately. A learner learning science utilize utilizes all the available materials around his leaning environment as resource materials. The classroom, the school garden, etc (Egwu and Obioma, 2009). Laboratory facilities is very cogent in the teaching and learning of basic science. Laboratory is any environment outside the classroom that provides practical work to give first hand experiences to the learner (Okoli, 2006). Students are avail the opportunity to observe, measure, question, classify, hypothesize, and interpreting data, (Okoli, 2006).

Gender and Academic Performance in Science

Generally, in Africa and Nigeria in particular, women are regarded as body makers and kitchen masters rather than participants in science and technology. Researches on the effects of students’ gender on academic performance in science seem to have so far been inconclusive as findings of Ajayi and Osoko (2013) indicate that gender can influence students’ academic performance in science while Muhammad-Lawal (2015) reveals that gender factor has no impact in that regard Aigbomkan (2002) and Njoku (2004) reported that boys have higher levels of achievement than girls in science, technical and mathematical subjects. Researcher like Adya and Kasier (2005) submitted that women make up over half the workforce in the world and science and technology education are viable tools for empowering women and girls. Gender gap according to Eze and Kalu-Uche (2013) is a noticeable statistical difference in behavior or attitude between males and females child are socialized but the male into a highly gender-stereotyped culture under-representation and under-achievement in science is historical and has been brought about by many inter-related socio-cultural and interacting school factors which act jointly and singly to suppress female interest, enrolment, participations and achievement in science at various levels of Nigerian education system. Ndirika (2013) itemized those factors to include; sex-stereotyping, gender bias in curriculum materials, science teaching strategies used by teachers and sexual harassment of females.

**Students Attitudes to the Learning of Science**

Attitude is Highly germane to students’ learning (Omotayo; 2002). Many scholars have defined attitude in different ways. The experience one has with a person will determine how one will be relating with the person New information and experiences make people to form attitude and modify the old ones (Adesina and Okebukola, 2005). Okebukola (2009) observe that using innovative teaching approaches in basic science classes fosters students interaction with others. Many students develop wrong attitude to the learning of science because teachers are unable to satisfy their aspirations. Philport (1997) findings shows that there is positive effects between attitude and performance in the teaching of science. There is no positive correlation between gender and ability of students in cooperative work. (Uduosoro, 1999). Philport (1997) studies the relationship that exist between learners attitude towards cooperation competition and their attitude towards science teaching and reported that learners cooperative and competitive spirit was positively related to motivation.

**Statement of the Problem**

Many educators often operate under the assumption that all learners possess equal abilities, inadvertently neglecting the needs of slower learners who require additional attention. This oversight can impede the educational progress of those who struggle to keep pace. The Nigerian Integrated Science Project (NISP) recognizes the importance of addressing diverse learning needs by advocating for learner-centered teaching strategies. Specifically, the project mandates that sixty percent (60%) of classroom participation must originate from students in basic science classes, emphasizing the significance of active engagement in the learning process. Despite the emphasis on learner participation, there remains a gap in understanding whether teaching strategies geared towards encouraging student involvement positively impact academic performance. Consequently, this study aims to investigate the efficacy of employing a problem-solving approach in enhancing students' academic outcomes. Moreover, attitudes play a pivotal role in shaping students' educational experiences and performance. Therefore, this research will also explore the influence of attitudes on students' academic achievement in basic sciences when utilizing the problem-solving approach. By delving into these factors, the study seeks to provide insights into how instructional methods and student attitudes intersect to affect learning outcomes, thereby informing pedagogical practices for more inclusive and effective teaching strategies.

**Significance of the Study**

This research examines how a problem-solving method affects basic science students' academic performance and attitudes across a range of abilities. Specifically:

Comprehensive Understanding: The research shows how the problem-solving methodology affects students of different academic skills, revealing its efficacy in meeting various learning demands. Understanding its impacts across competence levels may help instructors customize educational tactics to meet students' needs.

Improvement in Academic Performance: Exploring the link between problem-solving and academic achievement shows the potential to boost learning across the board. Identifying differences in student ability may help improve teaching methods to support all students' academic success.

Attitude Development: The research examines how problem-solving affects basic science students' learning attitudes. It illuminates school psychology by measuring motivation, confidence, and curiosity. Understanding how instructional approaches impact attitudes may help students of different academic ability develop good learning attitudes.

Teaching implications: This research has practical consequences for education. The problem-solving approach's differential impacts may guide curriculum design, instructional delivery, and teacher preparation to promote inclusive and successful teaching. All students may benefit from more supportive and richer learning environments by adapting pedagogy to varied learning capacities and attitudes.

**Purpose of the study**

The study seeks

i. to reveal academic performance and attitude of JS students in basic science using problem solving Approach (PSA).

ii. to ascertain if the problems solving approach (PSA) would enhance the ability students to understand concepts taught in basic science.

iii. to find out academic abilities of various groups of learners based on performance and gender using problem solving approach (PSA).

**Research Hypotheses**

Six null hypotheses were formulated to be tested at p<0.05 level of significance

**H01**: There is no significant main effect of treatment on students’ achievement in basic science.

**H02**: There is no significant main effect of ability level on student’s achievement in basic science.

**H03**: There is no significant interaction effect of gender and ability levels on students’ achievement in basic science.

**H04**: There is no significant main effect of treatment on students’ attitude in basic science.

**H05**: There is no significant main effect of ability level on student’s attitude in basic science.

**H06**: There is no significant interaction effect of gender and ability levels on students’ attitude to basic science.

**Methodology**

The research used a survey methodology and descriptive methodologies to examine how a problem-solving approach affects academic performance and attitudes among basic science students of diverse ability. The study included 19,671 JS III students from 54 secondary schools in the Oyo Educational Zone of Oyo State. To guarantee equitable participation and representation across ability categories, 504 students were chosen by balloting from the whole population. The experimental group included Olivet Baptist High School, Oyo, and Ojongbodu Grammar School, Oyo, whereas the control group included Alaafin High School and Baptist Secondary School, Ilora. Pretest results divided students into high, moderate, and low ability groups. The experimental group included 264 students and the control group 220. The research included three instruments: the Basic Science Achievement Test (BSAT), the Test of Practical Skills (TOPS), and a questionnaire on students' basic science attitudes (ASTBS Q). Five Ph.D.-level head Lecturers from Emmanuel Alayande College of Education, Oyo approved these tools. To ensure the instrument's validity and reliability, a pilot study was performed with 176 JS III students. Item analysis determined difficulty and discrimination indices. Head professors validated the instruments to establish their validity. The experimental group got Problem Solving Instructional Package (PSIP), whereas the control group received typical lecture-based teaching. Both groups had diverse groupings. Participating schools all took a BSAT pretest and ASTBSQ questionnaire to evaluate fundamental scientific attitudes. Schools with more than two JS III courses used simple random sampling. ANCOVA was performed on pretest findings using SPSS version 23, and paired t-tests were used to establish score equivalence. Hypothesis testing utilizing BSAT scores was conducted at a significance level of p < 0.05.

**Data Analysis, Hypotheses Testing**

**H01:** There is no significant main effect of Treatment on Students’ Achievement in Basic Science.

**Table 1.1.1a:** Summary of Analysis of Covariance (ANCOVA) of Students’ Achievement in

Basic Science by Treatment (Problem Solving Approach and Conventional Method), Gender and Ability levels

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
| Corrected Model | 5316.321a | 12 | 443.027 | 36.203 | 0.00 | 0.469 |
| Intercept | 6375.033 | 1 | 6375.033 | 520.952 | 0.00 | 0.515 |
| pre\_achiev | 0.538 | 1 | 0.538 | 0.044 | 0.834 | 0.000 |
| **Main Effect** |  |  |  |  |  |  |
| Treatment | 4706.692 | 1 | 4706.692 | 384.619 | 0.00 | 0.439 |
| Gender | 22.056 | 1 | 22.056 | 1.802 | 0.18 | 0.004 |
| Ability levels | 0.098 | 2 | 0.049 | 0.004 | 0.996 | 0.000 |
| **2-Way Interaction Effects** |  |  |  |  |  |  |
| Treatment \* Gender | 33.043 | 1 | 33.043 | 2.7 | 0.101 | 0.005 |
| Treatment \* Ability Levels | 17.932 | 2 | 8.966 | 0.733 | 0.481 | 0.003 |
| Gender \* Ability Levels | 3.567 | 2 | 1.783 | 0.146 | 0.864 | 0.001 |
| **3-Way Interaction Effects** |  |  |  |  |  |  |
| Treatment \* Gender \* Ability Levels | 4.797 | 2 | 2.398 | 0.196 | 0.822 | 0.001 |
| Error | 6008.504 | 491 | 12.237 |  |  |  |
| Total | 410278 | 504 |  |  |  |  |
| Corrected Total | 11324.825 | 503 |  |  |  |  |
| a R Squared = .469 (Adjusted R Squared = .456) |  |  |  |  |  |  |

Table 1.1.1a is the summary of analysis of covariance (ANCOVA) of student’s post –test achievement scores in Basic science by Treatment (Problem Solving Approach and Conventional Method), Gender and Ability levels. The table showed that after adjusting for the covariance, (pre- test score in Basic science), the effect of treatment on student’s achievement to Basic Science was statistically significant, F(1,491) = 384.62, p < 0.05. Consequently, the null hypothesis which stated that there was no significant main effect of treatment on student’s achievement in Basic science was therefore rejected. The table further shows that the partial Eta square, (2 )was .44, was considered to be moderate effect size according to Cohen (1988). The results of estimated marginal means and pairwise comparison of student’s achievement in Basic science are presented in Tables 1.1.1b and 1.1.1c.

**Table 1.1.1b:** Estimated Marginal Means of Students’ Achievement in Basic science by Treatment (Problem Solving Approach and Conventional Method)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Treatment | Mean | Std. Error | 95% Confidence Interval | |
|  |  |  | Lower Bound | Upper Bound |
| Experimental | 31.238a | 0.235 | 30.776 | 31.7 |
| Control | 24.765a | 0.235 | 24.304 | 25.226 |
| a Covariates appearing in the model are evaluated at the following values: pre\_achiev = 11.70. | | | | |

**Table 1.1.1c:** Pairwise Comparison of Students’ Achievement in Basic science by Gender

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| (I) Gender | (J) Gender | Mean Difference (I-J) | Std. Error | Sig.a | 95% Confidence Interval for Differencea | |
|  |  |  |  |  | Lower Bound | Upper Bound |
| Male | Female | 0.443 | 0.33 | 0.18 | -0.205 | 1.091 |
| Female | Male | -0.44 | 0.33 | 0.18 | -1.091 | 0.205 |
| Based on estimated marginal means | |  |  |  |  |  |
| a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).  Table 1.1.1b showed that (Problem Solving Approach) which is the experimental group has the highest mean score = 31.24 and the control group(Conventional)with the mean score = 24.77 and the mean difference was statistically significant. Fig 1.1 showed the estimated marginal mean.  **Fig. 1.1:** Estimated Marginal Means of Students’ Achievement in Basic science by Treatment (Problem Solving Approach and Conventional Method)    **H02:**  There is no significant main effect of Ability level on student’s achievement in Basic science. Table 1.1.1a revealed the summary of the output  Table 1.1.1a shows that there was no significant main effect of Ability level on student’s achievement in Basic science, F(2,491) = 0.004, p> 0.05. Therefore, the stated null hypothesis that there is no significant main effect of Ability level on student’s achievement in Basic science was not rejected. The pairwise comparisons of the mean score in Table 1.1.2c show a mean difference among the three Ability levels but the difference were not statistically significant. Low ability students had highest mean has revealed in table 1.1.2b, followed by High ability students while Medium ability students had the least mean. Figure 1.2 showed the estimated marginal mean as summarized in table 1.1.2d  **Table 1.1.2a:** Estimated Marginal Means of Students’ Achievement in Basic science by  Ability levels   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Levels | Mean | Std. Error | 95% Confidence Interval | | |  |  |  | Lower Bound | Upper Bound | | Low Ability | 28.027a | 0.571 | 26.905 | 29.15 | | Medium Ability | 27.983a | 0.239 | 27.514 | 28.452 | | High Ability | 27.994a | 0.511 | 26.99 | 28.997 | | a Covariates appearing in the model are evaluated at the following values: pre\_achiev = 11.70. | | | | |   **Table 1.1.2b:** Pairwise Comparison of Students’ Achievement in Basic science by  Ability levels.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | (I) levels | (J) levels | Mean Difference (I-J) | Std. Error | Sig.a | 95% Confidence Interval for Differencea | | |  |  |  |  |  | Lower Bound | Upper Bound | | Low Ability | Medium Ability | 0.044 | 0.608 | 0.942 | -1.151 | 1.239 | |  | High Ability | 0.034 | 0.991 | 0.973 | -1.913 | 1.981 | | Medium Ability | Low Ability | -0.04 | 0.608 | 0.942 | -1.239 | 1.151 | |  | High Ability | -0.01 | 0.574 | 0.985 | -1.138 | 1.117 | | High Ability | Low Ability | -0.03 | 0.991 | 0.973 | -1.981 | 1.913 | |  | Medium Ability | 0.011 | 0.574 | 0.985 | -1.117 | 1.138 | | Based on estimated marginal means | |  |  |  |  |  | | a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments). | | | | | | |   **Fig. 1.2:** Estimated Marginal Means of Students’ Achievement in Basic science by Ability Level  **H03**: There is no significant interaction effect of gender and ability levels on students’ Achievement in Basic science.  Table 1.1.1a reveals no significant interaction effect of gender and ability level on student’s achievement in Basic science F(2,491) = .86, p > 0.05, The null hypothesis was therefore not rejected.  **Table 1.1.6:** Estimated Marginal Mean of Students’ Achievement in Basic science by  Gender and ability levels   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Gender | levels | Mean | Std. Error | 95% Confidence Interval | | |  |  |  |  | Lower Bound | Upper Bound | | Male | Low Ability | 28.288a | 0.642 | 27.027 | 29.55 | |  | Medium Ability | 28.091a | 0.369 | 27.365 | 28.817 | |  | High Ability | 28.290a | 0.6 | 27.111 | 29.469 | | Female | Low Ability | 27.766a | 0.661 | 26.467 | 29.066 | |  | Medium Ability | 27.876a | 0.302 | 27.283 | 28.468 | |  | High Ability | 27.698a | 0.586 | 26.545 | 28.85 | | a Covariates appearing in the model are evaluated at the following values: pre\_achiev = 11.70. | | | | | |   **H04**: There is no significant main effect of Treatment on Students’ Attitude in Basic Science.  **Table 1.2.1a:** Summary of Analysis of Covariance (ANCOVA) of Students’ Attitude in  Basic Science by Treatment (Problem Solving Approach and Conventional Method), Gender and Ability levels   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared | | Corrected Model | 11575.755a | 12 | 964.646 | 17.035 | 0.00 | 0.294 | | Intercept | 139963.2 | 1 | 139963.2 | 2471.665 | 0.00 | 0.834 | | pre\_attitude2 | 33.107 | 1 | 33.107 | 0.585 | 0.445 | 0.001 | | Treatment | 6383.985 | 1 | 6383.985 | 112.737 | 0.00 | 0.187 | | Gender | 654.526 | 1 | 654.526 | 11.559 | 0.001 | 0.023 | | Abilitylevels | 144.61 | 2 | 72.305 | 1.277 | 0.28 | 0.005 | | Treatment \* Gender | 1384.023 | 1 | 1384.023 | 24.441 | 0.00 | 0.047 | | Treatment \* Abilitylevels | 389.068 | 2 | 194.534 | 3.435 | 0.033 | 0.014 | | Gender \* Abilitylevels | 96.353 | 2 | 48.176 | 0.851 | 0.428 | 0.003 | | Treatment \* Gender \* Abilitylevels | 63.041 | 2 | 31.521 | 0.557 | 0.573 | 0.002 | | Error | 27803.91 | 491 | 56.627 |  |  |  | | Total | 2542553 | 504 |  |  |  |  | | Corrected Total | 39379.67 | 503 |  |  |  |  | | a R Squared = .294 (Adjusted R Squared = .277) | | | | |  |  |   Analysis of covariance (ANCOVA) of student’s post –test attitude in Basic science by Treatment (Problem Solving Approach and Conventional Method), Gender and Ability levels was summarized in table 1.2.1a. The table reveals that after adjusting for the covariance, (pre- attitude score in Basic science), the effect of treatment on student’s attitude to Basic Science was statistically significant, F(1,491) = 112.74, p < 0.05. Consequently, the null hypothesis which stated that there was no significant main effect of treatment on student’s attitude in Basic science was therefore rejected. The table further shows that The partial Eta square, (2 )of .19 is a low effect size according to Cohen (1988). Tables 1.2.1b and 1.2.1c showed results of estimated marginal means and pairwise comparison of student’s attitude in Basic science.  **Table 1.2.1b:** Estimated Marginal Means of Students’ Achievement in Basic science by Treatment (Problem Solving Approach and Conventional Method)   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Treatment | Mean | Std. Error | 95% Confidence Interval | | |  |  |  | Lower Bound | Upper Bound | | Experimental | 74.343a | 0.503 | 73.354 | 75.332 | | Control | 66.798a | 0.501 | 65.813 | 67.782 | | a Covariates appearing in the model are evaluated at the following values: pre\_attitude2 = 24.20. | | | | |   **Table 1.2.1c:**Pairwise Comparison of Students’ attitude in Basic science by Treatment (Problem Solving Approach and Conventional Method)   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | (I) Treatment | (J) Treatment | Mean Difference (I-J) | Std. Error | Sig.b | 95% Confidence Interval for Differenceb | | |  |  |  |  |  | Lower Bound | Upper Bound | | Experimental | Control | 7.546\* | 0.711 | 0.00 | 6.149 | 8.942 | | Control | Experimental | -7.546\* | 0.711 | 0.00 | -8.942 | -6.149 | | Based on estimated marginal means | | | |  |  |  | | \* The mean difference is significant at the .05 level. | | | | | |  | | b Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments). | | | | | | |   Problem Solving Approach which is the experimental group has the highest mean score = 74.34 while Conventional group which is the control group has the mean score = 66.80 and the mean difference between the two was statistically significant as shown in table 4.2.1b. Fig 1.3 revealed the estimated marginal mean score.  **Fig. 1.3:** Estimated Marginal Means of Students’ Attitude in Basic science by Treatment(Problem Solving Approach and Conventional Method)  **H05:**  There is no significant main effect of Ability level on student’s attitude in Basic science. Table 1.2.1a showed the summary of the output  The main effect of Ability level on student’s attitude in Basic science was statistically significant as revealed by table 1.2.1a, F(2,491) = 3.44, p< 0.05. The null hypothesis was therefore rejected. The pairwise comparisons of the mean score in Table 1.2.2c show a mean difference among the three Ability levels. Table 1.2.2b further showed that Low ability students had highest mean, followed by High ability students while Medium ability students had the least mean. The estimated marginal mean score in Table 1.2.2b was further shown in Figure 1.3.  **Table 1.2.2b:** Estimated Marginal Means of Students’ Attitude in Basic science by  Ability levels   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Ability Levels | Mean | Std. Error | 95% Confidence Interval | | |  |  |  | Lower Bound | Upper Bound | | Low Ability | 71.073a | 0.673 | 69.751 | 72.395 | | Medium Ability | 69.841a | 0.512 | 68.834 | 70.848 | | High Ability | 70.797a | 0.647 | 69.526 | 72.068 | | a Covariates appearing in the model are evaluated at the following values: pre\_attitude2 = 24.20. | | | | |   **Table 1.2.2c:** Pairwise Comparison of Students’ attitude in Basic science by Ability levels (low, medium and high)   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | (I) levels | (J) levels | Mean Difference (I-J) | Std. Error | Sig.a | 95% Confidence Interval for Differencea | | |  |  |  |  |  | Lower Bound | Upper Bound | | Low Ability | Medium Ability | 1.232 | 0.846 | 0.146 | -0.43 | 2.894 | |  | High Ability | 0.277 | 0.933 | 0.767 | -1.557 | 2.111 | | Medium Ability | Low Ability | -1.232 | 0.846 | 0.146 | -2.894 | 0.43 | |  | High Ability | -0.955 | 0.826 | 0.248 | -2.577 | 0.667 | | High Ability | Low Ability | -0.277 | 0.933 | 0.767 | -2.111 | 1.557 | |  | Medium Ability | 0.955 | 0.826 | 0.248 | -0.667 | 2.577 | | Based on estimated marginal means | | | |  |  |  | | a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments). | | | | | | |   **Fig. 1.4:** Estimated Marginal Means of Students’ Attitude in Basic science by Ability levels  **H05**: There is no significant interaction effect of gender and ability levels on students’ attitude in Basic science.  Table 1.2.1a reveals no significant interaction effect of gender and ability level on student’s achievement in Basic science F(2,491) = .86, p > 0.05, The null hypothesis was therefore not rejected.  **Table 1.2.2d:** Estimated Marginal Mean of Students’ Attitude in Basic science by  Gender and ability levels   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Gender | levels | Mean | Std. Error | 95% Confidence Interval | | |  |  |  |  | Lower Bound | Upper Bound | | Male | Low Ability | 71.946a | 0.983 | 70.014 | 73.878 | |  | Medium Ability | 71.651a | 0.793 | 70.092 | 73.21 | |  | High Ability | 71.736a | 0.994 | 69.783 | 73.69 | | Female | Low Ability | 70.201a | 0.919 | 68.395 | 72.006 | |  | Medium Ability | 68.031a | 0.649 | 66.756 | 69.307 | |  | High Ability | 69.857a | 0.828 | 68.231 | 71.483 | | a Covariates appearing in the model are evaluated at the following values: pre\_attitude2 = 24.20. | | | | | |   **Fig. 1.5:** Estimated Marginal Means of Students’ Attitude in Basic science by Ability levels and Gender.  **Conclusion**  This study has provided substantial evidence supporting the efficacy of the problem-solving approach in enhancing the academic performance and attitudes towards basic science among students of varied academic abilities. The data indicates that students who participated in the problem-solving based curriculum not only demonstrated significant improvements in their academic results but also exhibited a more positive attitude towards science compared to their peers in the control group, who followed a traditional lecture-based instruction. The differentiation in learning gains between the high, middle, and low ability groups suggests that problem-solving activities can be tailored effectively to meet the diverse needs of students, fostering an inclusive educational environment where every student has the opportunity to succeed.  **Recommendations**  Given the positive outcomes observed, it is recommended that educational stakeholders consider the wider implementation of problem-solving instructional strategies within the science curriculum. Schools should provide professional development opportunities for teachers to master these approaches and integrate them into their daily teaching practices. Additionally, curriculum developers are encouraged to design and promote materials that support problem-solving methods, including the development of diverse, real-world problems that can engage students across ability levels. Furthermore, future research should explore the longitudinal impact of these teaching strategies on student learning and investigate their applicability in other subject areas to provide a comprehensive educational approach.  **References**  Acheounye, K. (2010) Stimulating Higher Order Thinking Skills in Nigeria Students. Journal of the Science Teacher association of Nigeria, 45 (1&2) 85 - 92.  Adesina, B.A & Okebukola, P.A.O (2005) Mastery Science Process Skills and their Effective us in the Teaching of Scince. An Educology of Science Education in Nigeria.  Adya, M & Kaiser, K.M. (2005) Early Determinants of Women in the IT Workforce: A Model of Girls’ career choices. Information Technology people 18: 230-259.  Aigboimian, D.O. (2002) Science for All: Implication for the Teacher and National Dev elopement, Benin City; Ambik Press.  Ajayi, O.A & Osoko, I.V. (2013) Effects of Practical Assisted Instructional Strategy on Students’ Achievement in Biology. Journal of Resourcefulness and Distinction 6 (1), 17 – 32.  Alake, E.M. (2007) Process Skills and Problems Solving Approach to the Teaching of Saving Your Energy Integrated Science Education Series No 6 N.A Udofia & Dauda (Eds) Jos Akin Press 55 – 58.  American Psychology Association (APA, 1990) Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instrument. The Delphi Report, New York DE, Author.  Attamah, C.G. (2012) Learning Environment: A Major Factor in Implementing UBE |curriculum in Basic Science 53rd Annual Conference Proceeding of STAN 178 – 189.  Bichi, S.S. (2009) Problem Solving Approach to the Teaching of Energy ISE Series No 7 N.A Udofia & D.M. Dauda (Eds) Jos Akin Press 24 – 29.  Bichi, S.S (2012) The Use of Problems Solving Teaching Strategy to Teach Components of Blood and their Functions in Approaches to the Teaching of You as a Living Thing D.M. Ngufoan & N.A. Udofoa (Eds).  Colman, U.B. (2014) Enhancing Students Creativity Through Innovative Science, Technology and Mathematics Teaching 55th Annual Conference Proceedings of STAN 61 – 74.  Danladi, S. (2003) Effects of Science Process on Students Achievement in Chemistry. A Study of SS II in Gumel Educational Zone of Jigawa State. Unpublished M.SC (Ed) Thesis University of Jos, Plateu State.  Danladi, I. (2009) Problem Solving Approach in Approaches to the Teaching of You and Environment ISE Series No 7, N.A. Udofia & D.M Dauda (Eds) Jos Akin Press 24 – 27.  Dung, M.D, Dugurgil, A.P & Alkamu, M. (2010) Sing Song Approach to the Teaching of You and Environment ISE Series No 7 N.A. Udofia & D.M. Dauda (Eds) Jos Akin Press 114 – 117.  Egwu, S. & Obioma . G. (2009) Embracing 9-Year Basic Education Curriculum Up;ift UBE <http://www.Vanguard.com>  Eze, G.N. & Kalu-uche N. (2013) Strategies for Closing the Gender Gap in Science & Technology Classrooms in Nigeria Secondary Schools: Teachers Perception of Gender Mainstreaming International Journal of Education & Social Research 3 (8), 9 – 16.  Federal Government of Nigeria (FGN, 2004) National Policy on Education (4th Edition), Lagos NERDC Press.  Federal Ministry of Education (2009) 9-year Basic Education Curriculum, Basic Science for JS 1 – 3 NERDC, Abuja.  Federal Ministry of Education (2008) Teacher Handbook for the 9-year Basic Education Curriculum, Basic Science for Juniors secondary, NERDC, Abuja.  Gadzama, B.I (2012) Effects of Science Process Skill Approach on Academic Performance and Attitude of Integrated Science Students with Varied Abilities Unpulished M.Sc (Ed) Thesis Ahmadu Bello University, Zaria.  Howard-Jones, P.A. (2002) A Dual State of Creative Cognition for Supporting Strategies that Foster Creativity in the Classroom. International Journal of Technology and Design education. 12, 215 - 226.  Igwe, J.O. (2003) Principles of Science and Science Teaching in Nigeria: An Introduction Enugu: Jones Communications Publishers.  Muhammad-Lawal F.K. (2015) Relationship Between Qualifying Examination (Q.E) and National Examination Council (NECO) Results in Biology in Selected Schools of Kano Metropolis Journal of Science and Mathematics Education, 1 (1) 42 – 46.  National Teachers Institute (2009) Manual for Re-training of Primary Schools Teachers on Primary Science, Kaduna.  Ndirika, M.C. (2013) Investigating Gender Disparity in Science Enrolment and Achievement in Abia State 54th Annual Conference Proceedings of STAN 292 – 296.  Ofoegbu, T.O. (2009) Teaching and Learning Resources in V.M.O. Ivowi et al (Eds) Curriculum Theory and Practice Published by Curriculum Organization of Nigeria (CON).  Ojo, O.O. (2016) Energy and Appliances in the Home; Forms of Energy; Effects of Problems Solving Approach on Pupils’ Performance in Approaches to the Teaching of Living & Non-Living Components of the Environment & (SE Series 6,7 & 8 I.B. Pollyn et al (Eds) Omoku Mind.Quest publisher 48-53.  Ojo. O.O. (2018) Learners-Centred Teaching Strategies: Factors Influencing their Effectiveness in Basic Science Classes being Seminar Paper Presented at Federal College of Education (Sp), Oyo.  Ojo, O.O. (2016) Compressive Basic Science for Junior Secondary 1, Oyo Adetunji Printing Press.  Okebukola, P.A.O (2009) Effect of Some Constructivist Instructional Approaches on Students Achievement and Retention in Study of Biology in Nigeria Journal of STAN 4 (1x2) 44 – 53.  Okwo, F.A & Ike, G.A (1995) Educational technology: Basic Concepts and Issues, Nsukka University Trust Publishers Omiko,  Omiko, A. (2012) Resources for Effective Implementation of the UBE in Nigeria: Challenges and remedies. 53rd Annual conference Proceedings of STAN 34-39.  Omiko, A (2014) Creativity Oriented Science and Technology Curriculum for Secondary Schools in Nigeria: Implication for Skills Acquisition and National Development 55th Annual Conference Proceedings of STAN 47 – 54.  Omotayo, K.A. (2002) Correlation of Attitude Towards Science and Academic Achievement of Secondary School Students in Science Subject Journal of Teacher Education NCCE, Abuja 10 (1).  Philot, R. (1997) Science Curriculum in Australian Science Teacher Journal. Journal of Adolescent and Adult Literacy 47 (5) 364-368.  Udofia, N.A & Dauda, D.M. (2010) Comparing the Objectives, Themes and Sub-Themes Curricula of Junior Secondary School Udofia N.A (Ed) JSTAN 44 (1 & 2) 36-48.  Uduosoro, P.O. (1999) UBE: Issues, Problems and Prospects of Compulsory, Free and Qualitative Education in Nigeria Onitsha: Nigeria Educational Publishers Vol.1. | | | | | | |