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PROBLEM-SOLVING SKILLS EFFECTS ON MALE AND FEMALE ATTITUDE STUDENTS' IN PRACTICAL CHEMISTRY IN AWKA EDUCATION ZONE

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ABSTRACT
The study investigated on the effect of Problem Solving Skills Strategy on Male and Female students' Attitude on Practical Chemistry. Two research questions guided the study while three null hypotheses were tested. Quasi- Experimental research design was adopted. The sample of the study comprised 186 students drawn two out of 46 co-educational secondary schools in Awka Education Zone of Anambra State. One of the schools was randomly selected and assigned to experimental group while the other was assigned to control group. Practical Chemistry Attitude Scale (PCAT) was the instrument used to collect data for the study. The PCAT with 17 items was trial tested on an intact class of 40 students outside the study area. The reliability coefficient of PCAT was established to be 0.78 using Cronbach alpha. PCAT was administered to the students as pre-test questions and post-test for data collection. Mean and standard deviation were used to answer the research questions while Analysis of Covariance was used to test the null hypotheses at 0.05 level of significance. The result reveals that Problem-Solving Skill (PSS) strategy had significant effect on students' attitude in Chemistry. This implies that Problem-Solving skill enhance students' attitude in practical chemistry lessons. Based on the results of the study, it was recommended that Problem-solving skills should be adopted by Chemistry teachers for their practical lessons and other chemistry concept in the secondary schools so as enable students develop positive attitude towards chemistry subject.

Keywords: Problem-solving Skills, Practical Chemistry, Attitude

Introduction

Advancement in science and technology has become so dynamic that scientific knowledge is indispensable. The products of numerous scientific advancements find its application in almost all the field of life. It is pertinent that the masses should be able to use these products where they are relevant. To be able to use products requires some level of science literacy. Science literacy is the knowledge and understanding of scientific concept and processes required personal decision making, participation in civic and cultural affairs and economic productivity (Copraidy 2015). Not only it is important to science literate, it also necessary that developing countries like Nigeria should produce through her educational system scientist that solve societal problems and boost her economy. Thus there is need for mass literacy and education in science for better life

Science is the concerted human effort to better understand the history of the natural world and how natural world works with observable physical evidence, as the basis of the understanding. It is a knowledge acquired through observation of natural phenomena, and experimentation that tries to simulate natural processes under controlled conditions. Driel and Jone (2021) noted that science consists of ideas, facts, principles and theories which are embedded in knowledge and whose application of the knowledge give birth to technology. According to Jemimah, Kelly and Jamaal (2021), knowledge of science is very vital for the achievement of technological advancement of a nation and serves as agent of national development in general.

Science as an agent of national development has lent its relevance in the area of security, politics, agriculture, health, energy and education. Science has many branches and can be seen in various areas of life. The branches of science, according to Okoye and Igboabuchi (2017) include earth and space, social sciences, life science and physical science. Earth and Space is the foundation of astronomy and geo-science, while Social Science includes Sociology and Psychology among others. Life Science is the bedrock of functional biology, physiology, medicine, ecology, biochemistry, microbiology, and evolution. Finally, physical sciences include chemistry, mathematics, physics, geophysics and geology. This study is interested in a branch of physical science known as chemistry.

Chemistry is a branch of science that deals with the study of nature, composition and properties of matter, as well as the changes matters undergone under different conditions. Chemistry deals with the study of our environment and things that are happening around it. According to Chukwu (2015), Chemistry does not only explain the environment but also offers a lot of useful and important knowledge to humanity. Examples are in the area of industrial production of fertilizer, insecticides, food and drinks, clothing and textile materials and many other useful ideas and application, Chemistry provides a natural link between home and school and the means through which students understand the world around them. Chemistry education therefore, enables the child to understand the world around him and should be taught as such to portray its relevance to science education and training.

In spite of the importance of Chemistry to man, students' attitude in chemistry is still a thing to worry about. Over the years, research studies (Alabi, 2014; Copriady, 2015) have indicated that academic achievement of students who enroll in chemistry has not been encouraging. The poor performance of students in science subjects, particularly in chemistry, has assumed a serious dimension. Most students sees Chemistry as an abstract subject and subject that is reserved for male gender, not many students wish to study Chemistry in the tertiary institution except on the fact that Chemistry is a compulsory subject for those who may wish to study sciences in higher institution. All these point to the fact that secondary school students offering chemistry lack problem-solving skills.

Problem-solving is the act of defining a problem. This includes determining the cause of the problem,

identifying, prioritizing, selecting alternatives for a solution which are all tagged problem-solving skills (Zoe, 2020). Problem-solving skills (PSS) refers to the ability to identify a problem, determine its cause and figure out all possible solutions to solve the problem. According to Kim, Choi and Park (2018), PSS is the ability to use appropriate methods to tackle unexpected challenges in an organized manner. In a related manner, Ozdayi (2019) reported that if problem-solving skills is properly implemented students' attitude towards Chemistry can be enhanced.

Attitude is a manner of acting, feeling or thinking that shows one's disposition, opinion and mental set among others. In another definition, attitude is a psychological construct that is a mental and emotional entity that characterizes a person, their attitude to approach to something or their personal view. Attitude involves mindset, outlook and feelings. Students' learning attitude therefore, involves their mindset, outlook and feelings and can be productive if learners are able to understand and use the learnt knowledge outside the classroom. According to Najdi (2018), male and female learning attitude is the development of interest and positive character towards learning particular things or subjects. The author further advocated for developing a positive attitude towards learning of Chemistry among secondary schools, students' attitude and gender may directly be linked to the academic performance of students.

Gender issues in learning of sciences especially in Chemistry is a serious concern to researcher and it include all aspect concerns related to women's and men's lives and situation in the society, to the way they interrelate, their differences in access to and use of resources, intervention and politics. This therefore, calls for the need to teach Chemistry concept effectively, to better academic achievement by students in all schools.

Purpose of the Study

The purpose of the study was to investigate the effects of problem-solving skill on Gender and students' attitude in Chemistry concept, the study investigated the;

1. Effect of student's problem-solving skill on students' attitude toward Chemistry concept when compared with those taught with conventional teaching method
2. Find out the effect of problem-solving skill on the male and female student's attitude towards Chemistry concept.
3. Interaction effects of problem-solving skill and gender on the student's attitude towards Chemistry concept.

Research Questions

The following research questions guided the study

1. What are the mean attitude scores of students of student's taught Chemistry using Problem-solving skill and those taught using conventional method?
2. What are the mean attitude scores of male and female student's taught Chemistry concepts using Problem-solving skill?

Hypotheses

The following hypotheses were tested at 0.05 level of significance:

1. There is no significant difference between the mean attitude scores of students taught Chemistry using Problem-solving skill and those taught using the conventional method.
2. There is no significant difference in the mean attitude scores of male and female student's taught Chemistry using problem-solving skill.
3. There is no significant interaction effect of teaching methods and gender on student's mean attitude scores.

Method

Research Design

The study adopted a quasi- experimental research design. Specifically nonequivalent control- group design was used. Quasi-experimental is an experiment where random assignment of subject to experimental and control groups is not possible rather intact or pre-existing groups are used (Nworgu 2015). The researcher used two streams of a class as experimental and control groups respectively. This research design is considered suitable because participants were not randomly assigned to groups rather treatment condition was randomly assigned to two intact groups which were organized.

Area of the study

The area of the study was Awka Education Zone of Anambra State. Awka Education Zone consists of five local government areas namely; Awka north, Awka south, Njikoka , Anaocha and Dunukofia. The zone is the heart of Anambra state capital territory. It has basic modern facilities such as good roads and electricity. The people living in the zone have high value for education. The area has two universities and a teaching hospital with 61 public secondary schools. This study is better carried out here because it is an urban center, the seat of the government of the Anambra state. The people working there have value for qualitative education

Population of the Study

The population of the study comprised 2,927 senior secondary school year two (SS 2) Chemistry students in 61 public secondary schools (46 coeducational schools and 15 single-sex schools) in Awka Education Zone of Anambra State. (Source: post primary school services commission 2020/2023)

Sample and Sampling Technique

The sample for the study consisted of 186 senior secondary school (SS 2) Chemistry students drawn from four classes in two co-educational schools out of the 46 co-educational secondary schools in Awka Education Zone. Using a lucky dip, one of the schools was designed the experimental school and the other, control group. From the experimental schools, two intact classes were chosen with 45 males and 50 females giving a total of 95 students. From the control schools another two intact classes were chosen with 40 male and 51 female giving a total of 91 students. The classes were chosen that way so that the same chemistry teacher would teach them. This was done to check teacher's variables.

Instruments for Data Collection

The instrument used for data collection was Chemistry Attitude Test (CAT). CAT was

adapted from Attitude Towards Chemistry Among 11th Grade Students in High Schools in Greece by Karerina Salta, Chryssa Tzougraki (2003). It is a 30 items inventory. The original reliability index of the scale was 0.73. The researcher modified some of the statement to suit the researcher's purpose, she also included some negative contents of students' behaviour. The CAT was measured using on a four point scale of Strongly agree (SA), Agree (A), Disagree (D) and Strongly Disagree (DS) to enable the students indicates their level attitude towards Chemistry. It was also used for both pretest and posttest.

Validation of Instruments

The Chemistry Attitude Test (CAT) is a 29 items test sent to the expert in the Department of Science Education and Education Foundation in Nnamdi Azikiwe University, Awka for face validation. The expert were specifically requested to find out the suitability of the language used in the construction of the CAT with regards to the students level of understanding; and extent to which the statements on CAT assess Attitude of students in the areas of study. After the validation, some of the items were modified, reduced and some negatively response were included.

Reliability of the Instruments

The CAT were trial tested. CAT was administered on the same 40 SS2 students in the secondary school in Awka Education Zone in Anambra State. The original reliability index of sex abuse inventory was 0.90 but because it was adapted a new reliability was established using Cronbach Alpha method and the reliability index of 0.86 was obtained.

Experimental Procedure

The regular school teacher of the experimental group was used to teach the student in the experimental and then in the control group. The difference is that teachers in the experimental group were briefed on how to use the lesson plan prepared using problem-solving skill strategies.

They were also briefed on how to use the problem-solving skills like identifying a problem, defining a problem, analyzing a problem, proffering solution and finally drawing conclusion to the problem. This is to ensure that they were familiar with before using it to teach. Teacher in the control group were asked to use usual teaching technique.

The study lasted for 8 weeks. The treatment (teaching) was done according to the regular timetable by the research assistants who were the regular school teachers of the school used. The time table allotted one double period (80 minutes) and one single period (40 minutes) for Chemistry Attitude Test every week. These periods were used to teach the students for four weeks, where each topics lasted for one week. The CAT was administered to the students in the first week of the six weeks as pretest. This is to ascertain the previous knowledge the students have on the concept they were exposed to during the study. This took effect in both the control and experimental group. The pretest marks the beginning of the treatments in both the group, thereafter the school teacher took off with the treatment which lasted for four weeks. The 6th weeks in the study was used

for posttest for chemistry achievement. During these periods was a regular monitoring by the researcher on the research assistants. However, two weeks after the post- test the CAT was re-administered to the students to ascertain the change in attitude.

Control of Extraneous Variables

The following measures were taken to control the extraneous variables likely to adversely affect the conduct of the experiment and the result obtained thereof:

Pretest Interference: To ensure that there was no interference of pretest on the student during the posttest, the CAT used for pretest was reshuffled and reprinted using different paper color from that of pretest when used as posttest. This is to ensure that there is no pretest interference with the posttest.

Initial Group Difference: In order to ensure that the schools used are similar in characteristics and composition, Government schools and co-educational were used for both the experimental group and control group. However, beyond school characteristics and composition, other initial group difference and limitations inherent in experimental group and control groups were adjusted by using (ANCOVA) I n data analysis.

Hawthorne Effect: Hawthorn is as a result of students faking their behaviour when they perceive that they are being used in an experiment and this may affect the outcome of the study. The regular school class teachers were therefore used for the study.

Class Interaction: To ensure that the experiment subject did not interact, the school used in the study where mile apart.

Experimenter Bias: The regular Chemistry teacher were trained and used to teach students. This helped to curtail the effect of experimenter bias.

Method of Data Collection

The instrument for data collection was Chemistry Attitude Test (CAT). CAT was administered on the research participant (experimental and Control Groups) before the actual experiment began. The experiment started after the pretest and lasted for four weeks of eight lesson periods. Each lesson period was forty five minutes. At the end of the treatment, the items were reshuffled and administered again to the students as posttest. The Chemistry teachers in both experimental and control groups were used to administer CAT to their students.

Method of Data Analysis

Mean and Standard deviation scores were used to answer the research questions while two-way analysis of variance (ANCOVA) was used to test the hypotheses at 0.50 alpha levels. Two ways ANCOVA was used to analyse the experiment because the experiment has two variables, and there are three basic types of effect that are tested: Main effect of independent variable A, main Effect of independent variable B, and effect for the interaction of A and B. For the hypotheses, when the P-value was greater than 0.05, null hypotheses was rejected.

Results

Research Question 1: What are the mean Attitude scores of students taught Chemistry

concept using Problem-solving skill and those taught using conventional method?

Table 1: Mean Pretest and Posttest Attitude Scores of Students Taught using Problem-solving skill and Conventional Method

Method	**N**	**Pretest mean**	**Posttest mean**	**Gain mean**	**SD of pretest**	**SD of posttest**
CAT	95	39.32	77.57	38.34	9.89	7.50
Convectional	91	36.26	59.72	23.46	13.33	7.19

Table 1 shows that the group taught Chemistry concept using problem-solving skill has a gain in mean Attitude score of 38.34, while those taught using conventional method has gain in mean Attitude score of 23.46. This reveals that students taught Chemistry concept using problem-solving skills technique have higher mean Attitude gain scores in Chemistry than students taught using the conventional method. The use of problem-solving skills decreases the spread of scores among the students from pretest to posttest. The use of conventional method also decreases the spread of scores among the students.

Research Question 2: What are the mean Attitude scores of male and female students taught Chemistry concept using problem-solving skills?

Table 2: Mean Pretest and Posttest Attitude Scores of Male and Female Students Taught using Problem-Solving Skills

Gender	**N**	**Pretest mean**	**Posttest mean**	**Gain in mean**	**Pretest SD**	**Posttest SD**
Male	45	45.71	79.42	33.71	8.106	7.70
Female	50	33.40	75.90	42.50	7.431	6.97

Table 2: Shows that the male taught Chemistry concept using problem-solving skills have a gain in mean Attitude score of 33.71 , while the females have a gain in mean score of 42.50. Female students taught Chemistry concept using problem-solving skills have higher mean Attitude scores in practical chemistry than their male counterparts. The use of problem-solving skills decreases the spread scores in both male and female students.

Hypothesis 1: There is no significant difference between the mean Attitude scores of students taught Chemistry concept using problem-solving skills and those taught using conventional methods

Table 3: Analysis of Covariance for the test of Difference in Attitude of Students Taught Chemistry concept using Problem-Solving Skills and those Taught with Conventional Teaching Method

Source	SS	Df	Mean Square	F	P-value	Decision
Corrected Model	15675.358[a]	4	3918.839	79.203	.000	
Intercept	39553.507	1	39553.507	799.414	.000	
Pretest	412.084	1	412.084	8.329	.004	S
Gender	381.270	1	381.270	7.706	.006	S
Method	13221.419	1	13221.419	267.217	.000	S
Method* Gender	51.148	1	51.148	1.034	.311	NS
Error	8955.546	181	49.478			
Total	669268.000	186				
Corrected	24630.903	185				

Table 3: Shows that at 0.05 level of significance, there was significant main effect of the treatment in the Attitude scores of the students F(1,185) = 267.217, P-(0.000) < 0.05. Thus the null hypothesis is rejected. Therefore the effect of problem-solving skills on students' Attitude in chemistry concept is significant when compared with those taught using conventional method

Hypothesis 2: There is no significant difference in the mean Attitude scores of male and female students taught practical chemistry using problem-solving skills. Shows that at 0.05 level of significance, there was significant main effect of the treatment in the Attitude scores of the male and female students, F (1,185)= 7.706, P – (0.006). Therefore, the null hypothesis is rejected. Therefore there is no significant difference between the mean Attitude scores of male and female students taught chemistry concept using problem-solving skills.

Hypothesis 3: There is no significant interaction effect of teaching methods and gender on students 'Attitude in Chemistry concept. Table 3 also further that at 0.05 level of significance, there was no significant interaction effect of teaching method and gender on the Attitude scores of the students , F(1,185)= 1.034 P – (0.311) >0.05 . Therefore, the null hypothesis eight is not rejected. Therefore there is no significant interaction effect of teaching methods and gender on student's mean Attitude scores

Discussion

The findings of the study showed that the mean Attitude gain of students taught with problem-solving skills strategy was higher than that of those students taught with conventional method. The findings in table 3 showed that there was statistically significant difference in the mean Attitude score of students taught with problem-solving skills than those taught with conventional method of instruction. This finding is in line with that of Anass and Newman (2014) who reported that students perform better through the use of innovative method of problem-solving skills. In contrast to the findings of other researchers Ariniezca and Ikhsan (2020) reported that

problem-solving skills is neutral to student's positive Attitude towards Chemistry.

The result of the study on male and female student's mean Attitude score in chemistry concept revealed that male students had higher positive Attitude score in chemistry concept than their female counterpart. The finding is in contrast with Julius (2020) who carried out an experimental research on the relationship between self-concept, Problem solving – skills on student's Attitude on Algebraic problems in Kebbi state and found out that female students achieved more than male students in both the experimental and control groups. The study also revealed that female students performed better than the male counterparts in both the experimental and control groups in their level of Attitude. Singh and Gopalkrishnam (2021) investigated on problem solving-skill and students' attitude towards humanistic approach in mathematics through discussion method and lecture method observed no significant difference in the mean Attitude scores of male and female students which is not in line with this study.

The female students had higher positive Attitude scores than their male counterparts. The interaction effect of instructional methods and gender on students mean Attitude scores in chemistry concept was not significant .The findings of this study with respect to instructional method is in line with the findings of Abumchukwu (2018) who found no significant interaction effect between gender and instructional treatment on students' Attitude in chemistry. In line with the study, Adown (2016) found a significant interaction effect of treatment and gender on the effect of inquiry and laboratory approaches of teaching geometry on students Attitude. Contrary to the findings of this study, Julius (2020) in his study on student's interaction pattern on Attitude in chemistry, found no interaction effect of gender and instructional treatment on student's Attitude. Inyang (2021) also found no interaction effect between instructional method and gender on the effect of discourse patterns on students' Attitude in biology

Conclusion and Recommendation

The study established that Problem-Solving Skills is effective in arousing, sustaining and enhancing students' positive Attitude towards Chemistry. The following recommendations were made based on the findings.

1. Problem-Solving Skills should be adopted in the Chemistry curriculum delivery in the public secondary schools.
2. The ministry of education and other government policies should mandate and help the professional bodies in terms of providing adequate fund to ensure that the workshops and seminars do not end on paper. Curriculum planners should incorporate and lay emphasis on different Problem-Solving Skills as an alternative to conventional teaching method.

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