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SCIENCE PROCESS SKILLS AND INTEREST IN BIOLOGY TOWARDS INPUTS TO AN ENHANCED STUDENT'S COGNITIVE PERFORMANCE

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ABSTRACT

This study investigated the science process skills and interest towards inputs to an enhanced students cognitive performance among secondary schools in Katsina zonal education quality assurance, the population of the study comprises of 1,903 1227 male and 676 female students, the purposive sampling technique was used to select two schools from coeducational schools two objectives reframed into two research questions and two null hypothesis were analyzed. The study adopted pretest posttest non randomized quasi experimental design using two intact classes of 97 students for the experimental group and 85 students for control group two instruments science process skills and biology interest

Introduction

Scientific process skills are very important for every individual. Science is now an integral part of our lives (Sadhana, 2017) as such, science process skills are always used in everyday life (Safaah, Muslim & Liliawati, 2017). It is expedient that classroom instructional strategies should give students the opportunity to explore learning materials and develop these skills as widely as possible. This is because science process skills are the most important skills for any scientific inquiry. Opportunity can be given to students if the learning environment is arranged in such a way that they can engage in science activities to improve their science process skills. However, the results of the studies of science educators are still lacking in incorporating lesson plans (Safaah, Muslim & Liliawati, 2017).

Students' academic achievement is the most vital yardstick used in measuring the effectiveness of instructional strategies and the school system as a whole. Academic achievement is the extent to which a student completes his or her tasks and studies (Scott, 2012). It is a measure of students' knowledge of a studied content usually in test, assignment or examination scores. Parents and other stakeholders outside academic discourse usually use students' academic achievement to rate the effectiveness of the school system and the teachers' instructional strategies. The ideal is that, the school designs learning objectives while the teachers help all the students to achieve these objectives. Poor academic achievement would mean that, there is problem in either in the classroom instructional practices, the learning environment or the school system as whole and vise visa for good academic achievement. The effectiveness of any instructional strategy manifests in the students' academic achievement and/or performance.

Objective of the study

1. Find out the Impact of Science Process Skills between male and female students in Senior Secondary Schools in Katsina Z.E.Q.A.
2. To determined the impact of science process skills on interest between male and female students in Senior Secondary Schools in Katsina Z.E.Q.A.

Research Questions

1. What is the difference between male and female Senior Secondary Students' in Biology exposed to Science Process Skills?

questionnaire with reliability of (r=0.736) were used to collect data the research questions were answered using mean and standard deviation while the null hypothesis were tested at 0.05 level of significance using independent t-test. The result of the study revealed that there is significant difference in the mean science process skills and interest, there is no significance difference in the mean science process skills, and interest scores of male and female students, it was therefore concluded that science process skills and interest have significant effect on student's cognitive performance. It was recommended that teachers of biology should expose students to science process skills so as to improve student's cognitive performance.

Keywords: Science Process Skills, Interest, Cognitive Performance.

2. What is the difference between male and female Senior Secondary Students' interest exposed to Science Process Skills?

Research Hypotheses

***Ho*$_1$:** There is no significant difference between male and female Senior Secondary Students' taught biology using Science Process Skills.

***Ho*$_2$:** There is no significant difference between male and female Senior Secondary Students' interest exposed to Science Process Skills.

Literature Review

Science Process Skills at Secondary School Level

Science process skills have always been part of curriculum for secondary schools. They are the basis for scientific enquiry which forms the behavior of scientists. Science process skills are like the road to scientific discovery and technological advancement of a nation. Tobin and Capie (1982) in Bulent (2015) defined science process skills as "identifying a problem, formulating a hypothesis about the problem, making valid predictions, identifying and defining variables, designing an experiment to test the hypotheses, gathering and analyzing data and presenting rational findings that support the data". According to Kane, Mishra and Dutta (2016), science process skills are skills that focus on the learning process to develop students' skills in understanding the knowledge or concepts, independently discovering and developing necessary facts, concepts, and values. Science process skills are therefore the basis in understanding the nature of the world. The development of students' science process skills is an inter-disciplinary matter. Secondary school subjects especially the science subjects (Biology, Chemistry and Physics) overlap each other in common concepts. Topics such as energy, properties of matter, particle structure of matter, motion, change and living systems are associate subjects thematically and they are the source of creation and development of interdisciplinary relations (Hodosyováa, Útlaa, Vanyováa, Vnukováa & Lapitková, 2015). The teaching of science as interdisciplinary subjects in secondary schools is not only aimed at developing the cognitive domains (knowledge) of students but also the psychomotor domain (science process skills) as well as the affective domain (attitude and interest in doing science). An effective teaching of science will therefore require methods that will develop all the domains of learning including the science process skills.

Categories of Science Process Skills

Science process skills are grouped into two categories; the basic science process skills and integrative science process skills. In practice, these categories are inseparable because they are developed as the learner practices science and carry out a scientific enquiry. (Aydogdu, 2015).

Basic Science Process Skills

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Basic Process Skills (BSPS) are: observing, classifying, measuring, communicating, inferring and predicting (Joseph, Cecilia & Anthonia, 2017). These skills are discussed hereunder;

Observation: Observation is the most basic and fundamental of all science process skills. Every scientific discovery starts from sensation of a problem. A scientist must be able to observe the things in the environment before any other thing can follow.

Classifying: Classification is the act of grouping on the basis of similarity. Classifying as a basic science process skill involve placing living and non-living things with similar features into groups. Students need to know how to classify, because students often need to group objects or organisms based on one or more common features. Classifying skill allows students to understand the differences and similarities between items of study (Deriloi, 2019). For instance, students might classify plant samples in various ways (color, bloom date, location, quantity, genus, and so forth) to find patterns for early flowering.

Communicating: Communicating refers to the act of transmitting information so as to make a knowledge known to others, Communicating can involve presenting information to others in a variety of ways, including written text, oral discussions, symbols, metaphors, and demonstrations (Deriloi, 2019). Communication also includes being able to communicate information through charts, graphs, and other models.

Measuring: Measuring skill shall be mastered as well which describes the spatial relationships by using various tools such as microscopes, lens, scales and many other devices, which the learner should learn using them skillfully (Aydogdu, 2015). During an inquiry activity, students need to accurately take measurements, collect data, and record data. This process helps identify problems in data collection (Joseph, et al., 2017).

Inferring: An inference is a reasonable, but tentative, conclusion or explanation about objects, organisms, events, or causes based on one's prior knowledge. Inference involve giving an explanation for a particular object or substance in quantitative terms (Zeidan & Jayosi, 2014). Inferring allows students to make educated assumptions or conclusions based on reasonable explanations when a complete set of data is not present (Joseph, et al., 2017). **Predicting:** Prediction involve making known about something in the nearest future using the prior knowledge. According to Zeidan and Jayosi (2014), Prediction refers to forecasting a future occurrence based on past observation or the extension of data. Predicting as a basic science process skill allows scientist to form a hypothesis, ask relevant questions, and begin studying in a particular direction. Predicting allows students to extend limited experiments to further studies, such as extrapolating what will occur in further studies based on a limited experiment (McComas, 2014). Students need to know how to use current knowledge and data patterns to make educated guesses on probable outcomes of investigations.

Integrative Science Process Skills

Integrated science process skills are more advance skills for scientific enquiry. According to Joseph et al. (2017), the integrated science process skills are the terminal skills for solving problems or doing science experiments. These skills include constructing hypotheses, designing investigations, experimenting, identifying variables, defining variables, tabulating and graphing data and interpreting data (Safaah, Muslim & Liliawati, 2017).

Constructing Hypotheses or Hypothesizing: Hypothesis is a statement of guess. It is a tentative statement devoid of bias which guide a scientist before embarking on research. Stating tentative generalization of observations or inferences that may be used to explain a relatively larger number of events but that is subject to immediate or eventual testing by one or more experiments (Aydogdu, 2015). Before an investigation is carried out, stating the proposed solutions or expected outcomes for experiments is necessary. Scientist do so using their previous experience which is similar to the current problem. These proposed solutions to a problem must be testable. Scientists' hypothesis about why events happen as they do and are based on inferences regarding investigations.

Experimenting: Experimenting involves testing a hypothesis through the manipulation and control of independent variables and noting the effects on a dependent variable. If a biologist hypothesizes that, the rate of growth of microbes depends on the nature of agar culture. The experiment here is to test weather

different agar culture will have effect on growth of microbes. Students need to be equipped with the skills of experimenting because science is all about inquiry into nature.

Identifying and Defining Variables: Identification of variables is one of the integrated science process skills. It involves stating the changeable factors that can affect an experiment. Defining the variable simply means manipulating and controlling properties that relate to situations/events for the purpose of determining causation, explaining how to measure a variable in an experiment. It is important to change only the variable being tested and keep the rest constant. The one being manipulated is the independent variable; the one being measured to determine its response is the dependent variable; and all variables that do not change and may be potential independent variables are constants. According to Vashishtha (2017), identifying variable involve **s**tating the factors or variables which affect an experiment. In biology, temperature can affect an experiment involving microbial growth and agar culture. It is important to manipulate the variables being tested and keep all other variable constant. The variable being manipulated is the independent variable while the variable being measured is the dependent variable.

Presentation of Data (Tabulating and Graphing Data): Arriving at explanations, inference, or hypotheses from data that have been graphed or placed in a table. Students' ability to create a testable hypothesis, design an experiment, create appropriate graph from data, interpret data and infer plausible reasons for failed experiments requires the application of the integrated science process skills. These skills must be nurtured among the students in a systematic manner so that they become scientifically literate in their life. Intellectual abilities such as curiosity, creativity, problems solving, decision making are intertwined with nature of process skills.

Methodology

This study used quasi-experimental and control group design involving pre-test and post-test. The study has two groups: experimental group (EG) and Control Group (CG). Experimental Group was treated using Inquiry-Based Instruction (X1) while the Control Group was taught using conventional (Lecture) method (X0) for a period of six weeks. Prior to the application of treatment to the groups, a pretest (O1) was conducted to determine the entry level of the two groups. A posttest (O2) was conducted after the treatment to determine the effect of the independent variable on the dependent variables.

This research work focuses on students offering biology in Katsina Zonal Education Quality Assurance. The population of the study comprises the entire SSII students from Katsina Zonal Education Quality Assurance, a total number of 182 115 males and 67 females. Hence the choice of SSII were believe to be academically more stable.

To obtain sample for this study, a purposive sampling technique was used to select two schools from the list of coeducational schools. This was because; gender was used as a variable in the study so as to check the effect of the treatment on both male and female students. Intact classes were used in the study; as such, a single class with the entire number of students from each school was randomly allocated as experimental and control groups.

Table 1: Sample size of the study

S/N	Groups	Schools	No of students		Total
			Male	Female	182
1	Experimental	GSSS Kofar Kaura	62	35	97
2	Control	GDSSS Kofar Yandaka	53	32	85

In this study, three instruments namely: Science Process Skills Checklist (SPSC), Biology Interest Questionnaire (BIQ) were used as instructionals for data collection. SPSC measured the students' cognitive performance for Biology, the researcher developed fifteen checklist questions that assesses students' Basic Science Process Skills at six levels, each item on SPSC was scored two points making a maximum obtainable score of 30 marks. BIQ was designed to measure the students' affective domain for Biology. BIQ was a 15-items four-point Likert type scale instrument adopted from Ukor and Isah (2015). BIQ is calibrated on four points scale containing Strongly agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The scoring procedure was done as follows: SA = 4points, A = 3points, D = 2points and SD = 1point. This scoring procedure was adopted because all the items are positive. The minimum and maximum obtainable points in this scale are 15 and 60 respectively.

Result

RQ1: What is the difference between male and female Senior Secondary Students' in Biology exposed to Science Process Skills?

Table 2: Mean and Standard Deviations of Male and Female Students' Exposed to Science Process Skills

GENDER	N	Mean	Std. Deviation	Std. Error Mean	Mean D/F
MALE	62	69.08	13.60	1.72	15.97
FEMALE	35	68.11	14.35	2.42	

The Table 2 above presents Mean and Standard Deviations of science process skills scores of male and female students in Experimental Group. Results indicated that male students taught biology using science process skills method have a mean science process skill of 69.08 and a standard deviation of 13.60, while female students taught biology using science process skills method have a mean science process skill of 68.11 and a standard deviation of 14.35 with a mean difference of 15.97.

RQ2: What is the difference between male and female Senior Secondary Students' interest exposed to Science Process Skills?

Table 3: Mean Rank and Sum of Rank of Interest score of Male and Female Students Exposed to Science Process Skills

Gender	N	Mean Rank	Sum of Ranks	Mean D/F
Male	53	50.23	3114.50	3.42
Female	32	46.81	1638.50	
Total	85			

In Table 4.5, the male students taught biology using science process skills method had a mean interest of 50.23 with a sum of ranks of 3114.50, while their female counterpart had a mean rank interest of 46.81 and sum of ranks of 1638.50. The mean rank difference observed between the two groups is 3.42.

H01: There is no significant difference between male and female Senior Secondary Students' taught biology using Science Process Skills.

Table 4: Independent t-test of significant difference of male and female Senior Secondary School Students' exposed to Science Process Skills.

Gender	N	Mean	Std. Deviation	T	Df	P-Value	Decision
Male	62	69.08	13.604	5.44	95	0.06	Not significant
Female	35	68.11	14.35				

The result from the table presented t-test analysis of Posttest students' Science Process Skills scores in Experimental Group by gender. Result shows that the t-value calculated was found to be 5.44 and p-value obtained was 0.06 which is greater than 0.05. Therefore, there is no significant difference in the mean Science Process Skills scores of students after treatment. The hypothesis is retained. The null hypothesis which states that, there is no significant difference of male and female Senior Secondary School Students' exposed to Science Process Skills is therefore retained.

H02: There is no significant difference between male and female Senior Secondary Students' interest exposed to Science Process Skills.

Table 5: Mann-Whitney U-test of Male and Female Students' Interest Exposed to Science Process Skills

Gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	p-value	Remark
Male	53	50.23	3114.50	1008.500	0.55	Not significant
Female	32	46.81	1638.50			

The result from the table presents Mann-Whitney U-test of Male and Female Students' Interest Exposed to Science Process Skills. From the results, U-test is 1008.500, p-value is 0.55 which is greater than 0.05. Since the p-value is greater than the alpha value, there is no significant interest difference between the male and female student's interest exposed to science process skill after the treatment. Therefore, the null hypothesis

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which states that, there is no significant difference of male and female Senior Secondary School Students' interest exposed to science process skill is retained.

Discussion

The first finding of this study revealed that, there was no significant difference in the Science Process Skills acquired by male and female students taught biology using science process skill method. That is, both male and female students equally acquire science process skills when science process skills method was used.
The second finding of the study revealed that there was no significant difference in the mean interest of male and female students taught biology using science process skill method.

Conclusion

Based on the findings of this study it is concluded that Students' low interest and performance in some aspect of biology has not been encouraging. The major cause of the poor performances in biology was traced to the misuse of instructional strategies to teach the subject. However, this study provides an empirical evidence to support the efficacy of science process skill method as efficient enough to improve students' cognitive performance. It was revealed that, science process skill method facilitates students' cognitive performance better than the traditional lecture methods.
It is revealed that, science process skill method enhances students' skills acquisition, interest and cognitive performance better than the lecture method. However, science process skill method is gender friendly in enhancing female students' science process skills acquisition, interest and cognitive performance. It is hereby concluded that, science process skill method have significant effect on the students' Science Process Skills, Interest and cognitive performance in Biology.

Recommendation

Based on the findings of this study, the following are hereby recommended:

1. Teachers of biology should expose students to science process skills so as to improve students' cognitive performance.
2. Teachers should be encouraged and/or mandated to attend workshops and seminars to acquaint themselves with requisite skills to use science process skills in classrooms.
3. Curriculum planners should design curriculum in such a way that, science process skills learning strategies can be used to fully implement biology curriculum.
4. Textbook writers should lay emphasis on students' activities that will promote the incorporation of science process skills in biology textbook.

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