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Research Paper

Scientific literacy of undergraduate Science Education students in the University ofCalabar Cross River State Nigeria.

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ABSTRACT: *The purpose of this study to determine the level of scientific literacy of Science Education undergraduate students at The University of Calabar Cross River State Nigeria. And also to investigate the contributions of sex, unit and level of study to the level of scientific literacy of the students. A total of fifty undergraduate students from 1st, 2nd 3rd and final years, participated in the study. The instrument used for this investigation, was the Basic Scientific Literacy Questionnaire (BSLQ) Basic Scientific Literacy Questionnaire (BSLQ) developed by Richard Carrier in 2001, which consisted of twenty-four (24) 'True' and 'False' questions. The instrument was found to be reliable with Cronbach Alpha value of 0.65. The contributions of the variables sex, age range and level of study to the level of scientific literacy, were also analyzed and these were done via Independent Sample t-tests, Analysis of Variance (ANOVA) . A confidence level of 95 % was the set level for all of the analyses conducted. It was found that overall, Science Education undergraduate students are at a 'poor' level of scientific literacy. There were no statistically significant differences in the level of scientific literacy based on sex year of study and unit of student.*

Keywords: *scientific literacy Science Education student; University of Calabar*

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I. INTRODUCTION

The society nowadays is dominated by new technologies .For an individual to become active and responsible citizen, acquisition of knowledge and understanding of the problems faced by mankind is necessary. Science Education equips individuals with the development of the ability of understanding of the most effective way to use science in daily life and social responsibility. Science Education can play a beneficial role in the knowledge of the surrounding world. One of the most important objectives of Science Education is the development of scientific literacy. Information and scientific literacy are essential at a time when scientific developments influence the political scene and vice versa.(Drago&Mihb, 2016)

Scientific literacy is multidimensional. Some are of the opinion that being scientifically literate, is just a matter of using science, rather than doing science. This position is reemphasized by the numerous references made to scientific literacy, as what the common citizen should know about Science (Hazen, 2002; Ogunkola, 2013

Scientific literacy is related to approaches to achieving science literacy and that there is no universally accepted definition of science literacy . Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity(Leah, Jelisa.&Babalola 2014).

The National Science Education Standards (2016) defines scientific literacy asthe knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivityThe OECD PISA Framework (2015) defines scientific literacy as "the ability to engage with science-related issues, and with the ideas of science, as a reflective citizenA scientifically literate person, therefore, is willing to engage in reasoned discourse about science and technology which requires the competencies to:Explain phenomena scientifically – recognize, offer and evaluate explanations for a range of natural and technological phenomena..Evaluate and design of scientific inquiry – describe and appraise scientific investigations and propose ways of addressing questions scientifically.data and evidence scientifically – analyze and evaluate data, claims and arguments in a variety of representation ns and draw appropriate scientific conclusions.

According to the United States National Center for Education Statistics, "scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. A scientifically literate person is defined as one who has the capacity to:

- Understand, experiments, and reason as well as interpret scientific facts and their meaning.
- Ask, find, or determine answers to questions derived from curiosity about everyday experiences.
- Describe, explain, and predict natural phenomena.
- Read articles with understanding of science in the popular press and engage in social conversation about the validity of the conclusions.
- Identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed.
- Evaluate the quality of scientific information on the basis of its source and the methods used to generate it.

Pose and evaluate argument based on evidence and to apply conclusions from such arguments appropriately.National Academy of Science. (1995),.National Science Education Standards.
Research Council.(2000) and National Research Council. (2012

Turgut (2007) defines scientific literacy as "the basic knowledge and skills needed by an individual to participate in democratic processes". The term "scientific literacy" was introduced at the end of the 1950s b (Hurd, 1958). Scientific literacy is "making a decision which includes responsibility for science and technology, and having the intellectual knowledge and skills for cognitive movement (Comfort, 2009). Scientific literacy is the ability to live in a satisfying manner in harmony with the cultural environment.

Scientific literacy as a talent that enables people to think logically in the event of possible personal, political, or economic problems in their lives Scientific literacy includes understanding scientific concepts and supporting cultural and economic production and the decision-making process. Scientific literacy has been defined firstly as being familiar with natural life and knowing both its diversity and unity (Viorel and Viorel, 2015) In addition, it includes understanding the main concepts and principles of science, becoming aware of the relationship between science, mathematics and technology, comprehending that science, mathematics and technology are the production of human beings and recognizing their power and limitations in various fields, having the capacity for scientific thinking, and using science and the way of scientific thinking for personal and societal objectives. In attempting to make the concept of scientific literacy more explicit, 4 some studies such as studies by Shamos, (2012); and Bybee (2008) identified three different types and levels of scientific literacy as follows;

1.Practical scientific Literacy: Possession of the kind of scientific knowledge that can be
used to help solve practical problems such as health and survival issues.

2.Practical scientific Literacy: Possession ofscientific knowledge required to enable the citizen to become more aware of science and science – related issues so that he and his representatives would bring common sense to bear upon such issues and thus participate more fully in the democratic process of an increasingly technological society

3.Cultural Scientific Literacy: motivated by a desire to know something about science as a major human achievement….it is to science what art appreciation is to art.Scientific literacy can be defined as employing skills, attitudes, values and knowledge which are associated with science for critical thinking, problem-solving and decision-making processes, and being a lifelong learner.

II. COMPONENTS OF SCIENTIFIC LITERACY

Scientific literacy is made up of three major components: the scientific knowledge,knowledge of the nature of science, and methods of science. Scientific knowledge deals with knowledge of science and what science actually is. 'Knowledge of science' involves understanding the fundamental scientific concepts as they relate to the natural world; whereas knowledge about science comprise understanding inquiry and the nature of scientific explanations (Bybee, McCrae $ Laurie 2009).

. Characteristics of science depicting what nature of science is by Sterling, Aitken, Schools ,Berube, Calhoun, Schools and Hagan, 2010) is given below

1. Scientific knowledge is tentative.
2. Scientific knowledge is empirically based.
3. Scientific knowledge is subjective.
4. Scientific knowledge is a product of the scientist's imagination and creativity.
5. Scientific knowledge is a product of observation and inference.
6. Scientists use a variety of methods in conducting scientific investigation and generating knowledge.
7. Scientific knowledge is socially and culturally embedded.

Citizens being scientifically literate, would enable them to understand and formulate informed opinions on global topics such as food security, genetic engineering, renewable energy systems, climate change and space

exploration just to name a few. Nigerians that are scientifically literate will be able to ask, find, or determine answers to questions derived from curiosity about everyday experiences. Scientific literacy entails being able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions. Scientific literacy implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed. A literate citizen should be able to evaluate the quality of scientific information on the basis of its source and the methods used to generate it. Scientific literacy also implies the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately. (National Science Education Standards,
Citizens being scientifically literate, would enable them to understand and formulate informed opinions on global topics such as food security, genetic engineering, renewable energy systems, climate change and space exploration just to name a few. Nigerians have a part to play in addressing these issues, in an effort to move from developing nation to a developed nation... From the secondary school level to the university level,

Increasing emphasis is being placed on cultivating successful crops of scientifically literate persons. In spite of all this, are the students scientifically literate? Or is there a failing grade when it comes to whether the undergraduate chemistry students are scientifically literate or not? It is therefore against this back drop, that research investigating the level of scientific literacy among Science Education students at the undergraduate level, at The University of the Calabar was conducted.

The following objectives guided this study:

1. To find out the overall level of scientific literacy of undergraduate Science Education students?
2. To investigate if there exist any significant difference in the level of scientific literacy of Science Education undergraduate students based on their:

a. Sex?
b. Level of study?
c. Unit?

III. METHODOLOGY

This research investigated the level of scientific literacy of Undergraduate Science Education students at the University Calabar..Descriptive survey research design was employed the study. The targetpopulation included all the Science Education students in the University of Calabar..The Cronbach's Alpha reliability coefficient calculated for the Basic Scientific LiteracyQuestionnaire was 0.65 .A total of fifty (50) Science Education undergraduate students were chosen at randomfrom the population, 1st, 2nd, 3rd and final years to participate in the pilot study. Of the 50students, twenty (20) were males and thirty(30) were females. The instrument selected to carry out this study, was the twenty-four (24) 'True' orFalse' item Basic Scientific Literacy Questionnaire (BSLQ) developed by Richard Carrier(Carrier, 2001). The questions were based on the three components of scientific literacy. The
final questionnaire which was adopted to be administered to the participants, consisted of two sections, Section A and Section B.
The former section was designed to compile essential demographic information which included sex, unit, level of study; while the latter section was the actual BSLQ. The items required students to place a tick in the column labeled 'T' if they thought that the statement was true, or a tick in the column labeled 'F' if they found the statement to be false.

Scoring, Ranking of Scientific Literacy Level and Data Analysis

The items on the BSLQ were scored using '1' for each correct answer and '0' foreach incorrect answer. The number of correct answers were tallied and expressed as a total out of twenty-four.

In addressing research question 1, these frequencies were analyzed and then used to create arating system for the overall level of scientific literacy for each student. A score between 0-6was assigned 'Very Poor', 7-12 'Poor', 13-18 'Good' and 19-24 'Very Good'.

With regard to research question 2, Independent Sample t-tests were performed to identify if there were any significant differences in the level of scientific literacy of the Science Education students, based on their unit(Biology, Chemistry, Physics and Mathematics), sex (male and female) and year (1, 2, 3, 4).
This t-test was performed as it is the appropriate analysis to be done, when comparingtwo means. 1st, 2nd and final
year was also analyzed and this was done by way of performing the One-way ANOVA test.
A 95 % confidence level was the set level used in all statistical analyses.

IV. RESULTS& DISCUSSION

Table 1 . Score, Rating & Frequency of Level of Scientific Literacy.**1 Scorerating of frequency of level of scientific literacy**

Score	**Rating**	**Rating of description**	**Frequency**	**percentage**
0-6 **7-1**2. **13-1**8 **19-2**4	**1** 2. **3** **4**	**Very poor** **poor** **good** **Very good**	**0** **30** **19** **1**	**0** **60** **3**8 2.

Table 1 above showed that 0% of students sored between 0=6 points of the items they responded to with a grading of very poor.. That same Table showed that 60% of students scored between **7-1**2,**3**8% scored between **13-1**8 and 2% for**19-**2**4.**

Table 2 Independent t test of the difference between sex and science education students.

Sex	N	MEAN	**Std. Deviation**	t- Cal
Male Female	20 30	12..10 11.73	2.07 2. 86	0.49

Significant at 0.05 ,t- critical 2.01, df=48

Analysis of data using independent t test in Table 2 revealed that the calculated t value of 0.49 while the critical value was 2.01 with 48 degree of freedom at .05 level of confidence. The null hypothesis which stated there is no significant difference in the scientificliteracy of undergraduate science education students with respect to sex was retained. This is so as the calculated value of 0.49 Was lower than the critical value of 2.01.

Table 3 Analysis of Anova of the Comparison of the Distribution of Level of Scientific Literacy based on Level of Study.

ANOVA					
SOURCES	**Sum of Squares**	df	**Mean Square**	**F**	**Sig.**
Between Groups	4.677	3	1.5392	0.30193	0.823814 .
Between Groups	219. 2121	43	5.098		
Total	223. 8298	46			

The one way analysis of variance in Table 3 showed that the F value was 0.30 whereas the p value was 0.823814 at 0.05 significant levels. The null hypothesis which sought to find out if there is a significant difference in the scientific literacy of science education students with respect to year of study was retained. .This is so as the calculated F0.30193 value was lower than the p value of 0.823814 .

Table 4 Comparison of the Distribution of Level of Scientific Literacy based on unit

ANOVA					
SOURCES	**Sum of Squares**	df	**Mean Square**	**F**	**Sig.**
Between Groups	40.750505	3	13.535	1..29252	0.288267
Between Groups	43.4295	46	10.5093		
Total	524.18	49			

The one way analysis of variance in Table 4 showed an F value of 1.29252 whereas the p value was 0.288267 at 0.05 significant levels. The null hypothesis which sought to find out if there is a significant difference in the scientific literacy of science education students with respect to unit of study was retained. .This is so as the calculated value F of 1.29252 was lower than the p value of 0.823814 .

Sixty percentages of the students scored ' poor grade' 7-12. This is an indicator that there is serious and urgent need for improvement in reaching the highest level of scientific literacy as it relates to the nature ofscience in order to effectively engage in scientific processes and practices . All the hypotheses raised to guide

the study were not significant. Science Education students of the University of Calabar do not have scientific literacy. Sex did not affect their scientific literacy, their unit of study Biology, Chemistry, Mathematics, and Physics did not influence their scientific literacy.Year of study did not also influence their scientific literacy .This is so as the final year students did not perform better than even year one students in their test for scientific literacy. It is very shocking and disheartening that final year Science Education students are lacking behind in scientific literacy .Little wonder why. Nigeria is advancing in science and technology at a snail speed.

V. CONCLUSION

In this study, it was found that the majority of Science Education undergraduate students at TUniversity of Calabarare at a 'poor' level of scientific literacy. Statistics showed that there was no significant difference in the level of scientific literacy based on sex, year of study and unit of study. The overall scientific literacy of University of Calabar Science Education is in poor state..

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