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Investigation into the Scientific Literacy Level of the Nigerian University Undergraduates

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Research Article

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ABSTRACT

Aim: This study investigates the scientific literacy level of Nigerian university undergraduates paying special attention to the science knowledge, science process and skill, thinking/reasoning skill, as well as application of science to technology.
Study Design: Descriptive research design of the survey type was employed in gathering the data for this study.
Place and Duration of Study: The study was carried out in the department of curriculum studies Ekiti State University, Ado Ekiti, Nigeria and Department of Science and Technical Education, Faculty of Education, Adekunle Ajasin University, Akunbga Akoko, Ondo State Nigeria, between 2005 to 2008.
Methodology: Two hundred and ninety- seven respondents selected through multistage sampling technique, took part in this study. An instrument made up of 110 items was used in the study. To pilot this study, five research questions and three hypotheses were raised and tested.
Results: The result obtained revealed that the scientific literacy level of the respondents were very low. The hypotheses testing yielded an insignificant result for sex influence on scientific literacy level of the respondents and a significant relationship was observed between scientific literacy level of the respondents and their interest in science. Also a significant difference was observed in the scientific literacy of respondents with respect to the type of secondary schools they attended.

Keywords: Scientific literacy; science education goals; products of science curriculum; science curriculum.

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1. INTRODUCTION

Thomas and Durant (1987) identified a range of arguments for promoting scientific literacy. Among them is enhancement of democracy; promoting more democratic decision-making by encouraging people to exercise their democratic rights. Thomas and Durant also identified several strands of argument that increasing scientific literacy would be of major benefit to science itself, providing greater support for scientific research, which involved at least a minimum level of general knowledge about what scientists does, as well as valuing what scientists do. A scientifically literate population, with a rational view of the world, a predisposition to think critically and the capacity to appraise scientific evidences, is much more likely to challenge the priorities of scientific research and the direction of technological innovations (Hudson, 1994). Scientifically literate individuals have access to a wide range of employment opportunities and are better prepared to respond to the introduction of new technologies. Moreover, they are better able to cope with the demands of everyday life in an increasingly technology-dominated society, better positioned to evaluate and respond appropriately to scientific and pseudoscientific arguments used by advertisers, commercial organizations and politicians, and better equipped to make important decisions that affect their health, security and economic well-being. Twenty-first century citizens need integrated understanding of the big ideas of science and habits of mind such as systematic thinking and communications. According to Kyunghee et al. (2011) citizens of the 21st century need to realize that science is a human endeavor that changes, as new evidence is uncovered. However, these aspects of scientific literacy provide only a partial picture. Scientific literacy should also emphasize character and values that can lead learners to make appropriate choices and decisions to ensure a sustainable planet and provide all people with basic human rights.

When school confronts students, almost daily, with a language that promotes economic globalization, increasing production and unlimited expansion, it is implicated in the manufacture and maintenance of what Bowers (1996, 1999) calls the myths of modernity. Some would claim that the resulting mind-set puts at risk the freedoms of individuals, the spiritual well being of particular societies, and the very future of the planet.

Our present educational institutions, which are in line with, and feeding into industrialism, nationalism, competitive trans-nationalism, individualism, and patriarchy must be fundamentally put into question. All of these elements together coalesce into a worldview that exacerbates the crisis we are now facing. What is abundantly clear is that little of the world's poverty, injustice, terrorism and war will be eliminated, and few of the world's environmental crises (ozone depletion; global warming; land, air and water pollution; deforestation; desertification; and so on) will be solved, without a major shift in the practices of western industrialized society and the values that sustain them. Interestingly, one of the keys to ameliorating the current situation may lie in increased levels of scientific literacy among the world's citizens. In spite of the benefits of scientific literacy to individuals and the nations, irregularities are observed by way of the gap between classroom learning and the level of usefulness of learners to themselves and the society. The problem could be due to non availability of suitable laboratory facilities, poor science teacher quality and quantity, large class size, heavy teaching load, and the general lack of understanding of science enquiry process skills (Onwu, 1992) and (Olanrewaju, 2001) This study is therefore geared towards finding out the level of scientific literacy of Nigerian university undergraduates. In other words, are undergraduates equipped to face the challenges of the modern society? Does Nigerians know what they need to know about science? To properly achieve this aim

the concept scientific literacy was made to cover the following dimensions- science knowledge, science process, science skill, thinking/reasoning skill, application of science to technology. The interplay of science interest and scientific literacy was regarded as crucial to this study.

2. METHODOLOGY

Descriptive research design of the survey type was employed in gathering the data for this study.

2.1 Population

All the undergraduates in the one hundred level in the universities found in the south west zone of Nigeria constituted the population for the study.

2.2 The Instrument

The instrument used for the study is "Literacy Level Rating Scale". This self constructed and validated instrument was made up of six sections. The first five sections were self-constructed while the fifth section was adapted from Bakare's Science Interest Inventory.

The details of this could be seen in the table below.

Table 1. Details of the variables upon which the instrument was constructed

Section	Item	Variables Measured
A	1 - 6	Bio data
B	7-8	Laboratory Facilities
C	9-16	Quality classroom activity.
D (SLT)	a-r	Knowledge - Recall
E 1	(i- ix).	Acquisition of scientific skills
E 2	I (i -xxvii), II (i-vi)	Application of Concepts/ Principle to solve day-to-day Problem
E 3	(a – d)	Inquiry Skills, Designing and Communicating to others.
E4	(e-h)	Reasoning Skill
F	1-24	Interest in Science

2.3 Sample and Sampling Technique

Two hundred and ninety seven students formed the sample for the study. The sample was selected using multi-stage sampling technique. The first stage involved the stratification of institutions in the southwest zone of Nigeria into State and Federal Universities, and the selection of seven universities, which took part in the study as qualified samples. The second stage involved the stratification of the students into male and female, public and private former schools. In the third stage, Science students were purposively selected from

chemistry, physics, Biology, microbiology and mathematics departments, and finally, random sampling technique was used to obtain the sample that took part in the study.

2.4 Validation of Instrument

The research instrument was validated using face validity. Construct validity was also applied to the instrument using both discriminate and concurrent validity.

2.5 Reliability of the Instrument

The reliability of the instrument was determined by the use of split – half reliability test. Each section of the instrument was scored separately. The scores of even numbered responses were correlated with that of the odd numbered responses.

2.6 Administration of the Instrument

The researcher together with the technologists administered the questionnaires to the respondents in each of the institution involved. The respondents filled them and returned them immediately so as to avoid interacting with themselves while completing the questionnaire. The information supplied by the respondents constituted the data.

2.7 Data Analysis

Descriptive statistics of mean and median was used to analyze the questions. Those respondents, whose scores fell between the median and the highest score, were regarded as high in the various dimensions of scientific literacy, while those whose score fell below the Median was regarded as low.

The hypotheses were analyzed using Pearson "r" correlation coefficient and t-test analysis.

3. RESULTS AND DISCUSSION

3.1 Results

Research Question 1

What is the overall scientific literacy level of respondents? In table 2, the answer to research question one has been answered. It was revealed that the respondents are generally of low literacy in scientific skills and knowledge. 21% of the respondents were high while 78% were low.

Table 2. Overall scientific literacy level of respondents

Respondents with high literacy		Respondents with high literacy		Total
N	%	N	%	
63	21.4	231	78.6	294 (100%)

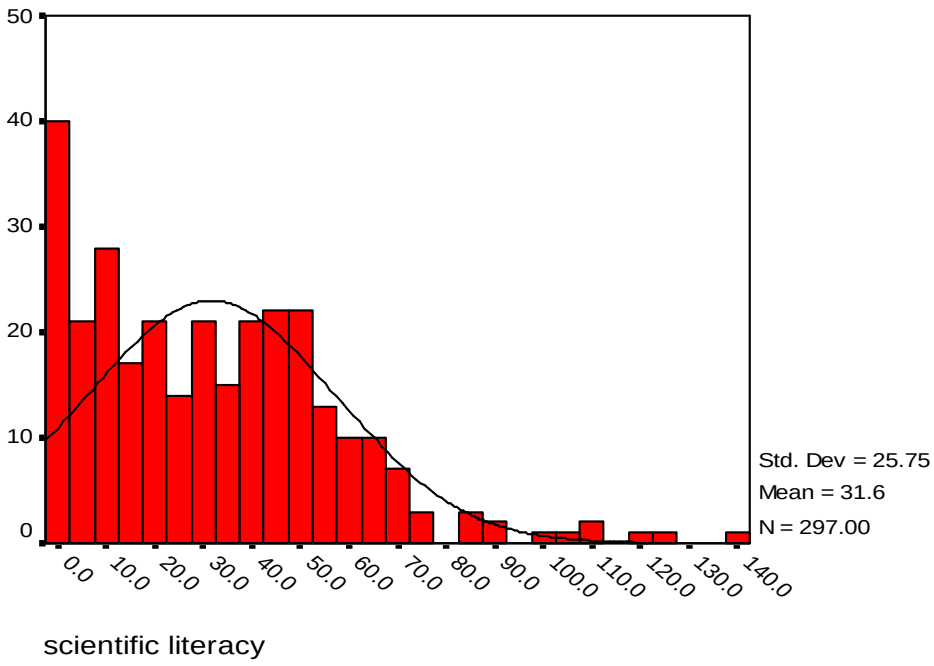


Figure 1 Scientific literacy level of the respondents
axis = frequency of respondents
X axis = scientific literacy level

Figure 1 is a histogram, which is drawn to show the distribution of the respondents' scores on the scale. The height of the bars indicates the frequency of the respondents on each scientific literacy level.

Majority of the respondents as indicated by the histogram had low scientific literacy level scores. The frequency as indicated on the y-axis confirms the fact that many of the respondents had low scientific literacy level scores, thereby corroborating the answer to (research question 1). The scores between 72 and 144 belong to the respondents with high scientific literacy level (i.e. right side of the histogram). It was observed that the respondents were very few in number, judging by the height of the bars.

Research Hypothesis 1

There will be no significant difference in the scientific literacy level of university undergraduates based on sex.

Table 3. Sex difference on scientific literacy test scores of respondent

Variable	N	Mean	Std. Deviation	Df	t-cal	t-table
Male	169	34.0390	25.1145	291	1.273	1.645
Female	124	30.2218	25.6535			

1.273<1.645 table value at 0.05 level of significance hence, the nul hypothesis was not rejected

Research Hypothesis 2

There will be no significant relationship between the respondents' interest in science and their scientific literacy level scores.

Table 4. The relationship between the respondents' science interest inventory scores and their scientific literacy test scores

Variables	Means	N	SD	Df	Correlation	Table value
SLT	32.2478	295	25.3796	294	0.368	0.195
SII	35.0712	295	31.8976	294		

0.368>0.195 table value at 0.05. Level of significance, therefore the nul- hypothesis was rejected.

Research Hypothesis 3

There will be no significant difference in the respondents' scientific literacy level scores based on type of former schools attended.

Table 5. The effects of former school attended on the respondents' scientific literacy level

Variable	N	Mean	Std	Df	t-cal	Tab value
Public School	193	30.0030	24.90	286	2.71	1.645
Private School	93	38.5806	25.57			

In table 5, a significant difference was observed in the scientific literacy level of respondents who attended public schools and those who attended private schools. It was revealed that the respondents from public schools had a mean score of Xpub=30.00, while their counterparts from private schools had a mean score of Xpri=38.58. The table also showed that t-calculated was 2. 71 at df of 286 with alpha level of 0.05. The t-critical was 1.645, which was less than the calculated value 2.71. Hence, the hypothesis that states that there will be no significant differences in the respondents' scientific literacy level based on school type was rejected.

Research Question 2

What is the scientific literacy frequency of the low and high interest groups?

Table 6. Scientific literacy frequencies of the low and high interest groups

Interest	Frequency	Percentage	Cumulative Percent
High interest group	92	66.7	67.2
Low interest group	45	32.6	100
Total	137	100	

As shown in table 6, it could be observed that respondents in the high interest group were 92 in number with a percentage of 67.16, while the respondents in the low interest group were 45 in number with a percentage of 32.84. The total numbers of respondents utilized in this section of statistical analysis were 137. This was due to the fact that respondents who did not respond to the section on interest were left out.

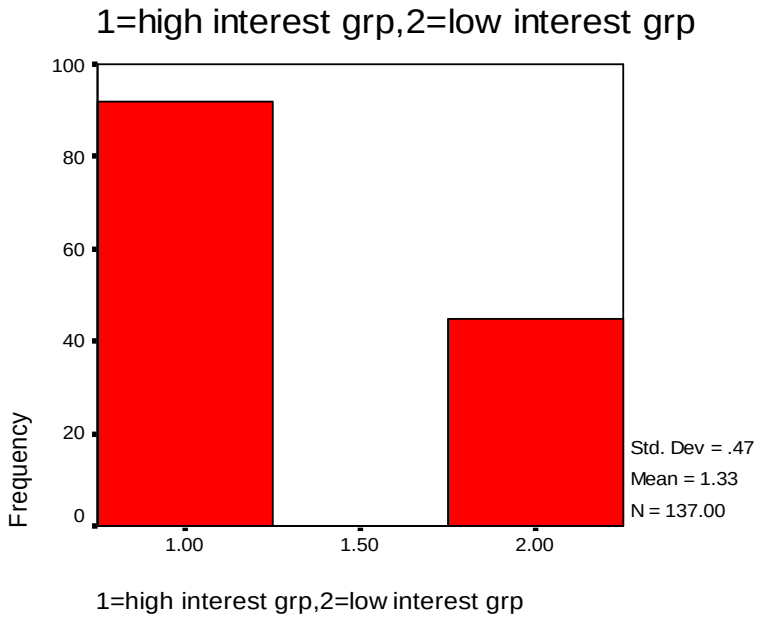
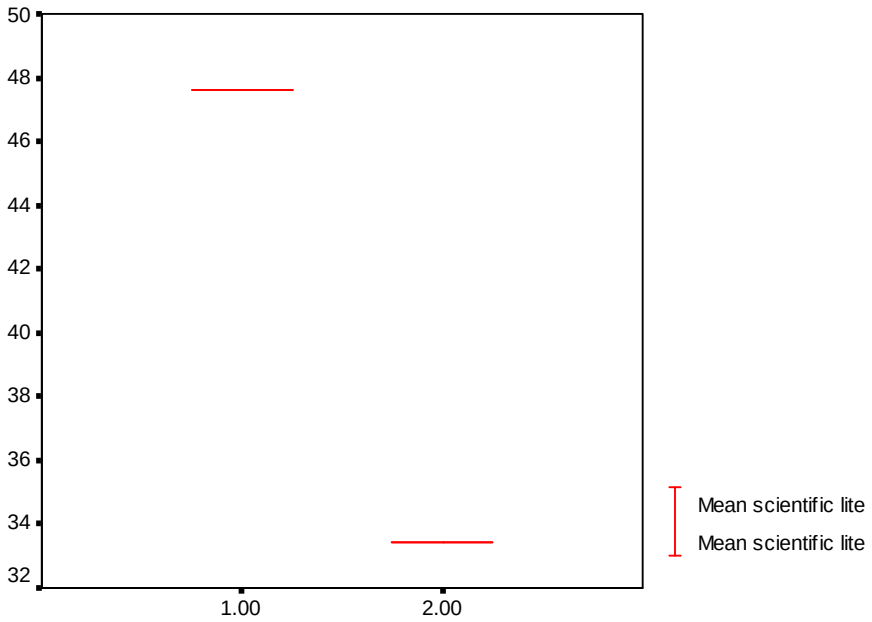


Figure 2 (a). Scientific literacy level of high and low interest groups

In figure 2a the histogram contains two bars separated by an empty space. The first bar corresponds to the scientific literacy level of respondents in the high interest group, while the second, which is shorter represents, the scientific literacy level of the respondents in the low interest group.

Figure 2 (b) is a line graph, which reveals the mean difference between the high interest group and the low interest group. Two horizontal lines could be observed. The first horizontal line represents the mean scientific literacy level of the high interest group whose mean corresponds with 48 on the y-axis. The lower horizontal line represents the scientific literacy level of the low interest group whose mean is a little above 32. Again this provides answer to (research question 2).



1=high interest grp,2=low interest grp

Figure 2 (b). Mean scientific literacy of high and low interest groups
Y axis= mean scientific literacy
X axis= interest level

3.2 DISCUSSION

The findings as revealed in the results section (tables 2-6 and figures 1, 2a and 2b) which provide answers to the research questions and research hypotheses tested are discussed below.

From the histogram displayed in figure 1, it was observed that the overall scientific literacy level of the respondents sampled from the universities in the southwest zone of Nigeria was generally low. This finding was also confirmed by the result obtained in table 2. This conforms to studies carried out on population or sections of population in some other countries of the world, e.g. United States of America, United Kingdom etc.

The researcher must quickly make it clear at this juncture, that, this pattern of result is not new neither is it the first in the world. This type of report was given by National Science Foundation (2000) concerning the adults in the United States American. Cheung and Taylor (1991) reported a similar situation in the United Kingdom. This occurred between 1960 and 1969, leading to the first serious attempt to evaluate the science curriculum on a large scale and subsequent emergence of a new Nuffield Science Course. The case of Japan was reported by Takemura (1986).

The type of finding in this research is expected to lead to a conscious building of an appropriate curriculum that would include relevant contents, and encourage scientific thinking.

In this research work effort has been made to evaluate an important phase of curriculum, which is the 'curriculum goals 'or 'outcome'. Hence all that were observed are expected to have implication for curriculum implementation and instruction. Curriculum evaluation is supposed to be a part of curriculum development, and for Nigeria, it should not be different. The result of this curriculum goal evaluation should lead spontaneously to a chain of reactions in environments where research reports are taken seriously. This research finding is a feedback that would inform teachers and curriculum planners and in fact all stakeholders as to the necessary steps to be taken to improve science curriculum practice in Nigeria.

The outcome of this research points to the fact that we need not see acquisition of cognitive scientific knowledge during classroom learning as an important source, through which scientific literacy may be acquired.

Some students already believe that schooling is a waste of time: it confines them against their will in physically unattractive surroundings, imposing on them a code of conduct, which they regarded as unfamiliar and unwelcome. Sometimes students are presented with a science curriculum that they regard as remote from real life. Even if they make the effort to learn science, they are presented almost daily with unappealing messages about the nature of science and scientific practice. In the researcher's experience on the field as a science teacher it was observed that science is being presented as complex and difficult, and only accessible to 'experts' who always subjected themselves to long and arduous training. Frequently, scientific knowledge is characterized as established and proven knowledge that is not to be challenged or doubted by mere students. Moreover, it is often presented in an unfamiliar and depersonalized language. For many students, all this constitutes such a formidable barrier that they are unable to make satisfactory progress.

I am of the opinion that there should be a conception of scientific literacy that can re-direct science and technology along more socially just, environmentally responsible and ethically sound lines. Scientific literacy means knowing what scientific resources to draw on, where to find them and how to use them (Fourez, 1997). The real function of scientific literacy is to help people learn to think for themselves and to reach their own conclusions about a range of issues that have a scientific and/or technological dimension. Scientific literacy should be sought not because it improves the economy, produces more technological 'goodies' or provides job opportunities for individuals, but because it liberates the mind. It also enables us to decide which experts to trust and which conclusions to rely on especially when knowledge does not seem to be then same. The scientific literacy measured in this study was linked with the secondary school science curriculum. The result obtained indicated a low level of scientific literacy among the product of the science curriculum. For scientific literacy to be seen as the blueprint of the science curriculum, then such a curriculum must not only emphasize cognitive aspects, but also the processes of inquiry, which incorporates a way of knowing how to solve day to day problems, including values and limitation of science.

The fact that a statistically significant difference was observed in the scientific literacy of respondents based on the type of secondary schools they attended, was wonderful. Teachers in private school, under close supervision by the proprietors and proprietresses would compensate for any inadequacy in the area of facility and equipments by improvisation and the application of several other measures that will boost the performance, and literacy level of their students. The school managements know that good performance is one of the best means of advertising their schools. On the other hand, visitation to well-

established private secondary schools and international colleges justifies parents' struggle to put their children in private institutions despite the high school fees paid.

In table 3, the hypothesis of no sex difference was not rejected. This pattern of result is not abnormal. It is expected that young adults, male and female members of the society should respond to the challenges posed by technological developments, social upheaval, and environmental collapse, which determine their well being and survival (Wright, 2004; Diamond, 2005).

There is an equal demand on all young people to anticipate local national and global problems as well as the exploration of future science scenario. They are expected to participate equally in public science and technology policy creation as well as learning opportunities involving role plays, debate, and participatory forums where in students develop skills in complex decision making process involving scientific tools and data.

In table 6, it was observed that the respondents in high interest group also had high scientific literacy scores. A very strong relationship was also observed between scientific literacy and science interest in table 3. In figures 2a and 2b the same pattern could be observed between interest in science and scientific literacy. There was a higher frequency of the respondents in the high interest group having high scientific literacy level scores as well as a higher mean of scientific literacy.

Interest is an important aspect of personality variable as well as an important predictor of scientific literacy. Interest goes a long way to determine people's disposition to mastering contents, skills as well as acquisition of literacy in any area of human endeavor Anastasy, (1968). There is little wonder why interest dictates the zeal and the ease with which learners learn science. Interest may be killed by a number of factors, which has been mentioned

4. CONCLUSION

Based on the findings in this study, it is concluded that the scientific literacy of Nigerian secondary school science products (i.e. the students from the 6-3-3 science curricula) was low. This was arrived at in view of the fact that the literacy level of the sample for this study, which represented the group being examined, was low.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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