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TEACHERS SCIENTIFIC LITERACY: CONTRIBUTIONS TO STUDENTS ACADEMIC ACHIEVEMENT AND SCIENTIFIC LITERACY IN SECONDARY SCHOOLS IN RIVERS STATE.

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Abstract

The aim of the study was to investigate the role teachers' scientific literacy plays in the development ofstudents' scientific literacy and achievement in basic science with a view to understanding their relationship. The study adopted a correlation design with a population made upof all the teachers and students from allthe public junior secondary schools in Rivers State. A sample size of 200 students was used and the selection was done through a simple random sampling. The study was guided by three research questions and a corresponding three null hypotheses were formulated and tested at 0.05 levels of significance. Data were gathered through a self design instrument made up of three sections.The mean and standard deviation were used to answer the research questions while the independent t-test and Analysis of Variance (ANOVA) were used to test he hypotheses at 0.05 levels of significance. Findings revealed that scientific literacy has a significant relationship with students' scientific literacy and achievement. The finding further revealed that teachers' levels of scientific literacy determine the students' literacy. In view of the above findings, some recommendations were made.

Keywords: Teacher,scientific literacy, academic achievement, basic science, secondary school.

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Introduction

In the present science and technology world, science is significant and indispensable because of the numerous contributions it has for society. Science is vital in almost all human endevours; health and medicine, education; agriculture; security; banking; sports and recreation; transportation, warfare and so on. (Joseph,2016).

These increase activities of science and technology, havealso doubledthe rate of discoveries, inventions and innovation globally. Besides, they have practically increased the standardof living by providing basic amenities which have help tackled the health challenging issues and other facets of human endeavours.

More so, school children at the basic and secondary levels of education need basic and rudimentary scientific knowledge to be able to straddle in different science and technology fields of endeavour at the tertiary level of education. Similarly, to be in grip with the increase knowledge driven societies, citizens in the globe require more knowledge of science and about science to be able to straddle the day- to -day activities that are linked with scientific and technological concepts or enterprise.

To attain this, the school has a great responsibility to play, in order to conscientiously increase the scientific literacy, that is, knowledge of the citizens about science and its application to life situations. For this to happen effectively, the teacher who transmits the knowledge to the students has to first of all arm him/her with adequate knowledge of science and technology in order to be able to transmit same to the studentsand to make them scientifically literate.

According to Derek (2007) the notion, scientific literacy has become relevant, and has come to the nucleus in science education curriculum and in almost all aspects of human activities. It has also drawn the attention of international organizations such as American Association for the Advancement of Science (AAAS), the council of Ministers of Education Canada, and the United Nations Education Scientific and Cultural Organization (UNESCO) and in Nigeria, Association like Science Teachers Association of Nigeria (STAN) for the need of the inclusion of scientific literacy in school curriculum especially at the primary level and its sustainability at the other levels of education as the only way of popularizing the concept.

For the schools to achieve these objectives, the teachers' level of scientific literacy is vital. Thiswill help to determine the scientific level of the students as well as that of the nation. Since the advancement of

scientific level of the nations literacy predicts to a large extent the economic growth, social stability and socio- political levels of the nation (Bidokht & Assareh, 2011).It will also helps to curb the crime levels and environmental ethics.

Perspectives of Scientific literacy

Robert in AAAS (2014) portrayed, "scientific literacy" as a concept which has the following predicates:an understanding of the basic concepts of science; the nature of science, the beliefs that control scientists in their pursuit of knowledge: the interrelationships between science, technology and society, the interrelationship between science and the humanities, andthe differences between science and technology.

While Hazen (1992) conceptualized scientific literacy as a combination of ideas, history and standards that help one grasps the scientific issues of our time and its relationship to natural events. He further said that "scientific literacy" is integrated into the most general scientific beliefs and broad based knowledge of science. Therefore, to be scientifically literate, it means that a person possesses basic facts,language and terminologies sufficient to follow the content of the daily issues of global concern such as relativity in physics, environmental issues, global warming and certain emerging issues in science.

The programme for International Students Assessment (PISA), defined scientific literacy, as scientific facts and the use of that awareness to identify questions, acquire new knowledge, explain scientific phenomena, and a draw evidence based conclusions about related issues, their understanding of the features of science as a form of human knowledge and inquiry of how science and technology shape our materials, intellectual, cultural milieu and its willingness to engage with science related issues and with the ideas of science as a reflective citizen.

While one of the leading organization popularizing scientific literacy, the *National Science Education Standards*,(NSES)(2009) explained that scientific literacy to means that a an average person can ask, find, or determine answers to questions derived from inquisitiveness about everyday experiences. It means that a citizen has the capacity to express, clarify, and predict natural phenomena. Scientific literacy entails being able to read about scientific facts with understanding of the articles about science in the

popular press and to engage in socio-political and science- technology and society related discuss about the legitimacy of the conclusions they have adduced. 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 scientific 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. Despite the enormous role played by scientific discoveries, inventions, technological innovation on our environment, some of our schools and learners do not understand the basic day-to-day terms used to address common issues that inundate scientific literature. Also, do not have adequate information to deal with these issues; examples of such emerging global issues are global warming, ozone layer depletion, green house emissions etc.Therefore to close this gap, the schools are tointentionally and deliberately transmit this scientific knowledge to the students via the teachers.

How would the teacher transmits these scientific knowledge that are required to transform the students, nation, and citizens to its fullest scientific and technological height if the teacher does not possess the adequate scientific literacy that is needed to sustain him/herself. Since the level of scientific literacy of the teachers determines to a reasonable extent the scientific level of a nation as well as that of the citizen.There is close nexus or relationship between the scientific literacy and educationalrebirth and this nexus may be attributed to the fact that the standard of development of modern societies is based on how much citizens perceives, conceives, feels, sensed and used science knowledge, besides technology (Milne, 2007). Wagner and Kozma (2005) declared that, economic boom, development of the society, and the ability of competition in the era of globalization are based on scientific excellence and these positive changes depend on the level of teacher scientific literacy to which they are transmitted to the students.

The National Scientific Education Standard (2009) posited that scientific literacy is the knowledge and understanding of scientific knowledge and process required for personal decision making, participation in civic and cultural affairs, and economic productivity. It is believed that scientific literacy describes the ability of an individual (both teacher and student) to understand scientific laws, theories, phenomena and things. Similarly, Hazen and Trefil (2011) stated that scientific literacy is an accretion of knowledge and skills required to comprehend science as presented by electronic and print media.

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Effects of Teacher's Scientific Literacy on the Students

Scientific literacy of the teacher played crucial roles in the development of students' scientific literacy, which in-turn enhances the learner's academic achievement in sciences both at the Junior Secondary School and at the other levels of education. This was also the view of Porter (2013)who explained that apart from enhancement of the overall academic achievement of learners, teachers scientific literacy also,improves students' scientific literacy development, enable junior students to embrace science related subjects even at the senior secondary school levels, gives students the ability to be creative and skillful in hands- on and mind -on activities, enable learners to reason abstractly and develop more scientific cultures, Provide learners with positive scientific attitudes. Buttressing further on the roles of teachers scientific literacy on students, Ralott, 2013, said that, itgives students academic self-efficacy, self-control, motivation or self-confidence, emotional intelligence, determination and interest in doing science, it gives learners the opportunity not to engage in unethical vices such as examination malpractice, harassments and so on, but helps students acquire concrete skills and content such as the basic working definitions and vocabulary as universal unifying concepts in schools, gives them scientific literacy skills which may include but not limited to, critical observation, objective analysis, measurement, estimation and Scientific Error.

The concern of this research was the situation where the teachers handling students in the basic science in secondary schools do not have adequate scientific knowledge, what would be the effect on students' development and achievement?It was against this backdrop that Chaney (2013) highlighted the effects teachers who lack adequate scientific literacy mayhave on the development of the students' scientific literacy and academic achievement. He said that, primarily, it has the tendency to reduce both the acquisition of students' scientific literacy and the development of positive attitude towards science; it creates the possibilities for students to shun or shift away from the core science related subjects at the other levelsof education, a situation where students mayeventually disengage all science related disciplines, it slows down learner's ability to be creative and skillful in carrying out science activities and practical activities; reduce students' abstract reasoning ability and less development of scientific culture; do not allow learners to achieve academic self-efficacy, self-control, motivation, emotional intelligence and determination

Adding to its crucial role played by teachers' scientific literacy, Paul (2009) reported that teachers' positive scientific literacy has a lot of impacts both on the students' scientific literacy development and

academic achievement in science. To him, teachers who possess positive scientific literacy goes a long way to influence theirpersonalitybuilt in them creative and teaching skills for the training of students in science, helps teachers havedeep pedagogical preparation to handle science subjects in line with curriculum and contents. The author further explained that Scientific literacy empowers science to handle abstracts concepts empirically which helps the learners to gain self confidence which in increases their attitude towards learning the subject.

The main interest of this study was the fact that many teachers without adequate scientific knowledge are at the centre of the process of transmitting scientific knowledge to students.The danger is the imaginable negative impact this might have on the students' academic achievement in sciences and particularly in basic science, the gate way science. The negative impact of teachers without adequate scientific literacy creates in students academic progress has already been expressed by Miller(2007), Havis and Sass(2011) who explained that whenever a teacher lacks adequate knowledge of scientific knowledge the consequence is grave and can cause the teacher to; poor handling of sciences concepts, choose what to teach instead of following the scheme and curriculum systematically and sequentially, meanwhile, teachers without the requisite knowledge of science will definitely suffer from mastery of the subject matter since they will not go in details in the subject.

Scientific literacy is the knowledge and understanding of scientific idea and processes required for personal decision making, making one to take part in civic and intellectualinteraction, and economic productivity. It also includes specific types of abilities whichIndividuals will display in different ways, when engaging in scientific discuss such as appropriately using technical termnologies, or applying scientific perception and processes. And individuals often will have differences in literacy in different domains, such as more understanding of life-science concepts and words, and less understanding of physical-science concepts and words.

Scientific literacy has different degrees and type; it enlarges and grows deeper over a lifetime, not just during the years the learner is in school. But the attitudes and values established toward science in the early years will shape a person's development of scientific literacy as an adult. Therefore for learners to be well groomed, they need to have adequate knowledge about the different aspects of scientific literacy which include:

1. Cultural Scientific Literacy - means understanding the science by a person with average intelligence and education of a culture;

2. Civic Scientific Literacy- represents the level of scientific knowledge meant for understanding and necessary for a person to make informed decisions with regard to legislation and public policy;

3. Scientific Literacy Practice - refers to scientific knowledge that a person needs to solve practical problems;

4. Aesthetic Literacy and Consumer Science - indicates to what extent the understanding of scientific laws and phenomenon enhances our appreciation of life itself through intellectual beauty of scientific ideas.

5 Digital and Communication Literacy**:** This is the awareness, altitude and ability of individual to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyze and synthesize, digital resources, construct new knowledge, create media expressions and communicate with others in the context of specific life situations in order to enable constructive social action, and to reflect upon this process (Martins & Cirudziecki, 2006)

The understanding of scientific literacy is intended to make thenation developed scientifically and technologically. However, the different has been the case as observed in the country, where virtually every aspect of our scientific and technological advancement is being imported. The major reasons adduced as the sole cause of this backwardness is that the scientific literacy of both the teachers and students are not fully developed in the schools, where students are suppose to be taught and develop in the areas of science. Consequently, the teacher whose major job is to transmit the knowledge is doubted if his levels scientific literacy is good enough to develop that of his students. Therefore the study was intentionally raised to clinically investigate the teachers' levels of scientific literacy and the effects on students' scientific literacy and development

Research Questions.

1 Does teachers level of scientific literacy contributes to students' scientific literacy?

2 Does the teachers' scientific literacy relate to students academic achievement in Basic science?

3 Does the sex of the teacher contribute to students' scientific literacy?

Hypotheses

1 There is no significant relationship between teachers and students scientific literacy in basic science

2. There is no significant relationship between teachers' scientific literacy and students' achievement in science

3 There is no significant relationship between teachers sex and student scientific literacy

Methodology

The study investigated the roles teachers' scientific literacy; (that is the level of teachers' knowledge of science) plays on the students' scientific literacy and achievement. The study was a correlation study. The population of the study comprised all the teachers and students in junior secondary schools(UBE)in all the public schools in Rivers state. A sample of two hundred students and teachers were selected and used. The participants were selected through the simple random sampling, where 20 schools were first selected from all the schools in Rivers State from these schools ten students each were selected as the active participants. Data were gathered through a researchers validated instruments: Teachers scientific literacy inventory scale; The students scientific literacy questionnaire, while the students results were also used to provide the students achievement scoresThe instruments were well validated before administering to the respondents, again the reliability of the instrument was determine and the coefficient r was established. The instruments were distributed and after an hour interval, it was retrieved alongside their results from the various principals. Analysisof the results were carried out in two folds; the use of descriptive statistic to determine the mean and standard deviation while the null hypotheses were tested using the independent t-test and Analysis of Variance (ANOVA)

Results and discussion

Research question 1. Does teacher scientific literacy contribute to students' scientific literacy in schools?

Ho_1: There is no significance relationship between teachers and students scientific literacy

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Table 4.4: Summary of regression analysis on the relationship between teacher scientific literacy

A: model Summary

Model	R	R square	Adjusted R Square	Std. Error of the estimate
1	495[a]	.159	.146	.54956

b. Predictors: (Constant), Teacher Literacy

B: Coefficients[a]

Model	**Unstandardized Coefficients**		**standardized Coefficients**	**t**	**sig.**	
	B	**Std. Error**	**Beta**			
1. (Constant)	2.096		4.771		.020	.000
Teacher Literacy	.702	1.386	.495	.507	.006	

Dependent Variable: Student Literacy

C: ANOVA[a]

Model	**Sum of squares**	**df**	**Mean square**	**f**	**sig.**
Regression	.078	1	.078	6.257	.006[b]
1. Residual	8.456	28	.302		
Total	8.534	29			

a. Dependent Variable: Student Literacy

b. Predictors: (constant), Teacher Literacy

Table1 Shows that the regression analysis on the relationship between teacher scientific literacy and students' scientific literacy is strong and positive (Beta=.495). The table also showed a 15.9% contribution of teacher literacy on development of student literacy. The regression analysisshowed that an increase in teacher scientific literacy lead to an increase in student scientific literacy. The tables shows that there is significant relationship between teachers and students literacy (F1, 28=6.257, p<.05). The null hypothesis one was rejected at 0.05 alpha levels.

Research Question 2

Is there any relationship between teacher scientific literacy and students' academic achievement?

Ho_2: There is no significant relationship between teacher scientific literacy and the mean achievement score of students in basic science.

Table 2 Summary of regression analysis on the relationship between teacher scientific literacy and the mean achievement score of students in basic science

A: Model Summary

Model	R	R square	Adjusted R Square	Std. Error of the Estimate
1.	.147	.202	.193	.69249

a. Predictors: (Constant), Teacher Literacy

B: Coefficients[a]

model	Unstandardized Coefficients		Standardized coefficients	t	Sig.
	B.	Std. Error	Beta		
(Constant)	4.121	6.012		.686	.000
1. Teacher Literacy	.432	1.746	.147	.248	.023

a. Dependent Variable: Achievement

C: ANOVA[a]

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Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	.029	1	0.29	5.061	.023[b]
1. Residual	13.427	28	.480		
Total	13.456	29			

a. Dependent Variable: Achievement

b. Predictors: (Constant), Teacher Literacy

Table 2 shows that the summary of regression analysis on the relationship between teacher scientific literacy and students' achievement in basic science might be described as strong and positive (Beta=.147). The R-square value of .202 shows a 20.2% contribution of teacher literacy on student achievement in basic science. The result showed that an increase in teacher scientific literacy leads to an increase in student achievement in basic science. The F-statistic shows that there is significant relationship between teacher scientific literacy and students' basic science achievement (F1, 28=5.061, p <.05). The null hypothesis two was rejected at 0.05 alpha levels.

Ho_3: There is no significant difference between male and female teachers contribution on students' scientific literacy.

Table 3: Mean, deviation and independent sample-t-test on the difference in the sex contribution of the teachers on students scientific literature

		Male		**Female**			
S/N	Teacher level of scientific literacy	Mean	SD	Mean	SD	t	p-value
1.	I study science in my bachelors programme	3.85	0.37	3.50	2.13	2.13	0.04
2.	I have knowledge of science very well	3.05	0.39	3.30	0.67	-1.29	0.21
3.	My understanding of science is adequate	3.70	0.57	3.60	0.52	0.47	0.64
4.	I have command of factual information	3.20	0.41	3.30	0.48	-0.59	0.56
5.	I have familiarity with laws, principles and theories	3.90	0.31	3.60	0.62	2.00	0.06
6.	I have concept of cause and effect relationship	3.10	0.31	3.30	0.48	-1.38	0.18

7.	I have habit of basing judgment on fact	3.90	0.31	3.50	0.71	2.18	0.04
8.	I have ability to formulate workable hypotheses	3.10	0.31	3.50	0.53	-2.64	0.01
9.	I am willingness to change opinion on the Basis of new evidence	3.70	0.66	3.60	0.52	0.42	0.68
10.	I have freedom from superstitions	3.20	0.41	3.50	0.53	-1.72	0.10
11.	I have appreciation of natural beauty	3.90	0.31	3.50	0.53	2.64	0.01
12.	I have appreciation of man's place in the universe	2.95	0.60	3.30	0.67	-1.44	0.16
13.	I have deep of interest in science.	3.75	0.55	3.60	0.52	0.72	0.48
14.	I can carry out experiment independently	3.15	0.37	3.40	0.52	-1.54	0.14
15.	I have ability to apply relevant knowledge in everyday life	3.60	0.60	3.60	0.52	-1.03	1.00
16.	I have ability to utilize the processes of scientific inquiry 3.15	0.67	3.40	0.52	-1.03	0.31	
17.	I prove adequate knowledge about scientific debate	3.55	0.51	3.40	0.70	0.67	0.51
18.	Science equipped me to be relevant in everyday life.	3.15	0.49	3.20	0.42	-0.28	0.78
	Grand Mean	**3.44**	**0.07**	**3.45**	**0.08**	**-0.38**	**0.70**

Table 3 shows the mean, standard deviation and independent sample t-test on the difference in the sex contribution of the teachers on students scientific literacy were 3.44, SD=0.07 and 3.45, SD=0.88 for male and female respectively. The result of the independent sample t-test shows that teachers sex significantlycontributes to the difference in the students' levels of scientific literacy (t=.38, p>.05).The null hypothesis three was retained at 0.05 alpha level.

H04: there is no significant difference in the school location and students scientific literacy.

Table 4: Mean, standard deviation and independent sample t-test on the different in the school location and students scientific literacy

S/n	Student level of scientific literature	Urban, N=89 Mean	SD	Rural, N=61 Mean	SD	t	p-vale
1.	Distinguishes expert from the uninformed	2.43	0.89	2.44	1.06	2.57	0.01
2.	Distinguishes theory from dogma and Data from myth and folklore	2.12	0.72	2.13	0.96	1.90	0.06
3.	Knows that science in social contexts Often has dimensions in political, judicial, ethical and sometimes moral interpretation	2.49	0.88	2.26	0.85	2.70	0.01
4.	Senses the ways in which scientific research is done and how the findings are validated	2.52	0.84	2.39	0.90	4.41	0.00
5.	Uses science knowledge where appropriate in making life and social decisions forming judgments, resolving problems and taking action	2.40	0.97	2.34	0.81	2.77	0.01
6.	Distinguishes science from pseudo-science	2.46	0.91	2.44	0.83	2.87	0.00
7.	Recognizes that our global economy is largely influenced by advancement in Science	2.52	0.99	2.59	0.92	4.96	0.00
8.	Display curiosity about the natural and human made world	2.60	0.91	2.74	0.83	1.63	0.11
9.	Values scientific research and technological problem solving	2.63	0.83	2.64	0.86	1.46	0.15
10.	Remains open to new evidence and tentativeness of scientific knowledge	2.51	0.99	2.80	0.96	1.48	0.15

11.	Engages in science/technology for excitement and possible explanations	2.75	0.91	2.85	1.08	3.21	0.00
12.	Knowledge of the risks and benefits of Science	2.63	0.92	2.74	1.05	2.86	0.00
13.	Ability to think scientifically	2.89	0.85	2.69	0.96	3.18	0.00
14.	understanding science and its application	2.69	0.83	2.66	0.85	5.41	0.00
15.	Understanding the nature of science, including its relationship with culture	2.55	0.83	2.66	0.93	1.35	0.18
	Grand mean	**2.55**	**0.52**	**2.56**	**0.45**	**5.51**	**0.00**

Table 4 shows that the mean, standard deviation and independent sample t-test on the different in the school location and students scientific literature were 2.55, SD=0.52 and 2.56, SD=0.45. the result of the independent sample t-test shows that there is significant difference in the school location and students scientificliteracy (t=5.51, p<.05). the null hypothesis four was rejected at 0.05 alpha level..

Discussion

Teacher scientific literacy has been shown clearly by the result of this study that it determines the level of students' scientific literacy in basic science. In other words, the teachers' level ofscientific knowledge determines the acquisition of scientific literacy in the students. It therefore implies that when the teachers' levelof scientific literacy is at the level ofcultural,meaning that the teacher has just the understanding of the science with average intelligence and education of a culture, which also, will be the level of the students' scientific literacy. The findings corroborates the finding of Jacinta, (2011) who observed that, some of the major factors responsible for students scientific literacy included teacher scientific positive impartation of science lessons cum commensurate learning of science subjects.Abraham (2017)also found that twenty percent (20%) of students scientific literacy was contributed by teachers scientific literacy, consequently, the findings revealed a significant relationship between teachers and students scientific literacy

Findings also revealed that the levels of teacher's scientific literacy influences students' achievement in Basic science; thatis, there is a relationship between students' academic achievement in science and the teacher level of scientific knowledge. For students to do well in science subjects, the knowledge of the teacher in the subject is very important.

On gender, the findings revealed that male teachers show more understanding of scientific laws than their female counterparts in secondary schools. This position supports the findings of Afolabi and Audu (2007) that teachers' sex has significant influence on the achievement of students in sciences, consequently developing their scientific literacy,interest and attitude.

One startling findings of the study was that the level of scientific literacy possessed by teachers and students differ significantly across location. The direction of teachers and students in the urban areas were tilted to more scientific thinking, while that of the rural was engagement in rural technologies to alleviate the technologically deficient areas and excitement and so scientific literacy development in citizens or students also depend. The findings agreed with the result of Abraham (2016) that students and teachers in the urban settings are better in the ability to think scientifically while those of the rural are typically engrossed in local technologies that can sustain excitements and so scientific literacy development in citizens or students also depend on the location. Those in urban areas develop scientific knowledge faster consequent upon the facts that they are readily exposed to scientific nature than their rural counterparts' because the scientific knowledge of the teacher in the rural setting are not fully harnessed due to dearth of scientific stimulations.

Conclusion

From the foregoing, the development of students' scientific literacy depends on the knowledge and the level of scientific literacy of the teacher. Though the findings did not support the hunch raised. That is significance relationship between students' scientific literacy and development and teachers knowledge of science. There are factors which proved inimical to the development of the literacy levels of both teachers and students, such factors include the teacher inability to master the subject due to insufficient knowledge they have in the subject; and the gender of the teachers and school location. Therefore, based on the findings, the following conclusion are advanced

1 There is a significant relationship between teachers' scientific literacy and students' scientific literacy.

2 the gender disparity was clearly defined of their perception about students and teachers scientific literacy ands

3 the students' perception about the importance of science was clearly demarcated between the urban and rural schools. Urban schools proved better understanding and development in scientific literacy than students in rural schools.

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