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Comparative Study of Preconceived Scientific Ideas Held by Different Groups of Junior Secondary School Students in Niger State, Nigeria

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Abstract
This study investigates the preconceptions of junior secondary school students in Niger State on scientific ideas. The sample was made up of three hundred and sixty (360) junior secondary school students (JSSS I) who were randomly selected from twelve secondary schools. Four schools in each three educational zones with thirty (30) students from each school (15 males and 15 females) were used. The research instrument used was a 24 items of preconceptions on scientific ideas scale (POSIS) adapted by the researcher to obtain students' preconceptions on scientific ideas. Five experts in science education validated the instrument. A reliability coefficient of 0.78 and 0.80 were obtained for the instrument using test-retest method and Cronback alpha analysis respectively. Four hypotheses were formulated and tested. Data collected by means of the instruments were analyzed using the mean, standard deviation, t-test and ANOVA statistics. The study revealed that the gender of the respondents did not influence their preconceived knowledge on scientific ideas. (t-cal=1.42, df =358, p< 0.05). The preconceptions across the three educational zones in the state did not differ significantly. (F-cal=2.76, DF= 357 and 2, p< 0.05). There was no significant difference between the responses of students from rural and urban schools on preconceived ideas about selected scientific ideas. (t-cal=1.36, df =477, p< 0.05). However, it is revealed that the private school students responded more positively to the statements than did their counterparts in public schools. (t-cal=3.28, df= 477, p< 0.05). Based on the findings, recommendations were made, among others, that science curriculum for Nigeria be reviewed to include basic ethnographic and ethno science concepts which will facilitate the deep understanding of scientific concepts and acquisition of appropriate scientific skills.
Keywords: Preconceptions, Scientific ideas, School Location and Type

Introduction

The conflict between science and cultural beliefs in Nigeria is an acknowledged fact among Nigerian population in particular and Africans in general (Wasagu, 1999). It has been observed that one of the major signal of this conflict is the apparent decline in scientific knowledge among school children and the citizenry at large (Olorundare, 1995).There is a rapidly changing scientific and technological environment in today's World and if immediate steps are not taken, may end up with citizenry that cannot achieve its full potentials unless appropriate scientific and technological education are provided (Solomon, 1998). The influence of science in our daily lives, welfare, security and economy cannot be over emphasized as one continues to experience increasingly science and technology related personal and societal problems. Studies in Nigeria and Ghana (Jegede and Okebukola, 1991, Akpan, 1991, Anamuah Mensah and Akpan, 1992) have shown that student cultural beliefs interfere with the way they learn science. In fact it is now recognized that an African child is practically operating along three ways of life, scientific, cultural, traditional and religious, (Wasagu, 1999). The theory of conceptual change put forward by Posner (1982), showed that conceptual change theory has been defined by several science education researchers in a variety of ways. Chi and Roscoe (2002), Disessa (2002) and Posner (1982) defined it as a learning process in which the existing conception (ideas or beliefs about how the world works) held by a student is shifted and restructured, often a way from an alternative conceptions or misconceptions and toward the dominant conceptions held by expert in a field.

In many African countries, particularly in Nigeria, many people believe in taboos, witchcraft, destiny, reincarnation, dreams, spirits, rituals and divinities, which reflects the highest level of accumulated experience in a given society. Bajah (1986) asserted that in all societies, there are traditional beliefs, values and ways of doing things. In the same view, Awoseye (1987) opined that in one African society or the other, there exist some strong beliefs on fate, witches, taboos, rituals and demons. These beliefs according to Kolo (2005) and Babagana (2010) are not verifiable. They referred to superstition as irrational and baseless beliefs.

The fact still remains that all African traditional communities, even natural resource utilization,

management and conservation are guided by a wealth of knowledge accumulated over centuries, which are reinforced by taboos and rituals, Binns, 1995, wamen ,1995, Mchumu, 1999, Sibanda, Asabere-Ameyaw and Anamuah-Mensah, 2003). In Burkina Faso and Northern Ghana some forests and mountains are believed to express the spiritual powers of the earth and are places of worship and are therefore observed as sacred (Baijo, 1997; Gyau-Boakys and Tumbutto, 2002). Similarly, in Zimbabwe, traditional societies are encouraged to take greater care of their natural resources through taboos and other traditions for conserving them (Mavi and Shava, 1999). Ishaik (1996) found that culture and superstitions had significant negative effect on learning of science. He found that religion, society, organization, material, culture and philosophy of society play prominent role in learning

In a position paper reported in Science Teachers' Association of Nigeria (STAN), Ivowi, (1992) and Morimoto (2004) further confirmed that vague practice of or adherence to cultural beliefs are actually among some of the major causes of poor performance in science, technology and mathematics education in Nigeria. There is a growing concern and a lot of criticisms against improper or lack of deep understanding of science concepts, mass failure and low level of achievement in science despite the emphasis given to science teaching in recent years.

Statement of the Problem

A lot of emphases are placed on science education in Nigeria as a step towards technological development and self reliance. However, it is observed that despite all efforts many students still perform far below expectations (Nsofor, 1998). Underpinning science education in the recent years at all levels and within all disciplines is an explicit shift in the goals of science teaching to students developing deeper understanding of major concepts within a scientific discipline. An explicit confrontation between pre- knowledge and new knowledge is the critical element in teaching toward understanding of science. This has prompted the researcher to investigate junior secondary school student's cultural beliefs, misconceptions or alternative conceptions, as they impact on their academic achievement in science. For it is now realized by some science educators, Akpan, (1994); Katcha, (2005) and Yaki, (2010), that the teaching and learning of science is getting more complex, sophisticated and challenging worldwide, so much so that the traditional role of the teacher as a dispenser and a chief custodian of knowledge in the regular classroom is obsolete.

Purpose of the study

The purpose is to conduct *Comparative study of preconceived scientific ideas held by different groups of Junior Secondary School Students in Niger State, Nigeria. To this end, the following questions are raised on some selected scientific ideas:* Shooting stars, thunderstorm, sun and moon eclipses, poliomyelitis, albinos, baby not crying at birth, Eggs should not be given to children, eye twinkles/blinks, palm itches, rainbow appearance, drought, delivery of twins, tornadoes, miscarriages, albinism etc.

- What are the differences in preconceived knowledge held by male and female Students about selected scientific ideas?
- How does preconceived knowledge about scientific ideas held by students in three educational zones differ among them?
- To what extent does preconceived knowledge about scientific ideas held by urban and rural students differ?
- What are the differences in preconceived knowledge about scientific ideas held by students in public and private secondary schools?

Hypotheses

The following null hypotheses were formulated to guide the study:

HO_1. There is no significant difference in the preconceived knowledge held by male and female students about selected scientific ideas.

HO_2. There is no significant difference in the preconceived knowledge held by JSSS1 Students in the three educational zones in the state about the selected scientific ideas.

HO_3. There is no significant difference in the preconceived knowledge held by rural and urban students about the scientific ideas.

HO_4. There is no significant difference in the preconceived knowledge held by private and public secondary school students about the selected scientific ideas.

Population and Sample

The target population for this study comprised all the junior secondary school (JSS I) students in Niger State. The total population of all the JSSS 1 under the research study in Niger state is currently six thousand nine hundred and twenty eight (6,928).

The sample was based on the three educational zones in the state. From each educational zone, one public school and one private school, one urban school and one rural school were selected for the study. Random sampling was employed to arrive at three hundred and sixty (360) JSS students. In each of the sampled schools this was used to pick thirty students (m=15 f=15) that constitute the sample.

Instrumentation.

One instrument called preconceptions on scientific ideas scale (POSIS) was used for the study. This consists of 24 items on possible explanation about scientific ideas that are of Likert type with 4 options namely: Strongly agree (SA); Agree (A); Disagree (D) and Strongly Disagree (SD) on weighted points of 4, 3, 2, 1 respectively. The items were trial tested, validated and found reliable considering the fact that its Cronbach alpha co-efficient value is 0.84. This value was considered reasonably adequate for research studies of this nature.

Administration of the Instrument

The data for this research were obtained by administering the questionnaire instrument on the subjects used for the study. Prior to administering the questionnaire items, the researcher having confirmed through teachers' records of work, ensured that all the sampled schools had covered some simple science concepts in integrated science. The students were given one hour to explain in detailed succinctly and concisely to the 24 items questionnaire. The marking scheme was used to mark the scripts. The data collected from the three hundred and sixty (360) respondents was used for the analysis using t-test and ANOVA statistics. The following points were allotted to the response format of Strongly agree (SA) 4 points, Agree (A) 3 points, Disagree (D) 2 points and strongly disagree (SD) 1 point.

Results

The results are presented in line with the hypotheses tested.

HO_1. There is no significant difference in the preconceived knowledge held by male and female students about selected scientific *ideas***.**

Table 1: t-test Result In Respect of Male and Female Students' Preconceived Knowledge on Scientific *ideas.*

	Number (N)	Mean - (X)	Standard deviation (SD)	Df	T-value	Std. Error	Sig. (Two-tailed)	Decision
Male	180	2.59	0.73					
Female	180	2.66	0.79	358	1.42	1.2714	0.5554	Accepted

Result on table 1 showed that there was no significant difference between the responses of male and female students' preconceived knowledge on scientific *ideas*. As a result, the first hypothesis was accepted. In other words, the gender of the respondents did not influence the students' preconceived knowledge on scientific *ideas*.

Ho_2: *There is no significant difference in the preconceived knowledge held by students in the three educational zones in the state about the selected scientific ideas.*

Table 2: ANOVA Result on Preconceived Knowledge of Students on Scientific *Ideas in the three educational zones in the state.*

Source Of Variation	Sum Of Square	Df	Mean Square	F-Value	Std. Error	Sig. (Two-tailed)	Decision
SSw	25196	357	634.68				
SS_b	3504	2	1752	2.76	1.3432	0.06142	Retained

Results of the analysis show on table 2 indicated that there was no significant difference in the preconceived knowledge held by students in different educational zones. It then implies that the preconception of students across the three educational zones in the state did not differ significantly.

HO_3. There is no significant difference in the preconceived knowledge held by private and public secondary school students about the selected scientific ideas.

Table 3: t-Test Result In Respect of Public and Private Secondary School Students' Preconceived Knowledge on Scientific *ideas.*

School Type	Number (N)	Mean - (X)	Standard deviation (SD)	Df	T-Value	Std. Error	Sig. (Two-tailed)	Decision
Public	279	2.17	0.85					
Private	200	2.36	0.94	477	3.28	1.3112	0.0000	Rejected

Table 3 presents the t-test result of public and private secondary school students' preconceived knowledge on scientific ideas. The mean score of public students was 2.17 and 2.36 for the calculated t-value of 3.28 was significant at 0.05 level. This indicates that there is statistically a significant difference between the preconceived knowledge of public secondary school students and private secondary school students on scientific ideas (t=3.28, df=477, P <0.05). Hence, the null hypothesis three was rejected, indicating that there is a significant difference between public secondary school students and private secondary school students on *preconceived knowledge on* scientific ideas.

Ho_4: *There is no significant difference in the preconceived knowledge held by rural and urban students about the scientific ideas.*

Table 4: t-Test Result In Respect of Rural and Urban School Students' Preconceived Knowledge on Scientific *ideas*

Location	Number (N)	Mean - (X)	Standard deviation (SD)	Df	T-Value	Std. Error	Sig. (Two-tailed	Decision
Rural	200	2.88	1.70					
Urban	279	2.73	1.72	477	1.36	1.5143	0.5310	Accepted

Table 4 presents the t-test results of urban and rural secondary school student' preconceived knowledge on scientific ideas. The mean score of rural students was 2.88 and 2.73 for urban. The calculated t-value of 1.36 was not significant at 0.05 level. This indicates that there is statistically no significant difference between the preconceived knowledge of rural secondary school students and urban secondary school students on scientific ideas (t=1.36, df=477, P <0.05). Hence, the null hypothesis four was upheld, indicating that there was no significant difference between urban secondary school students and rural secondary school students on preconceived knowledge on selected scientific *ideas*.

Discussion

With regards to the first hypothesis, gender was found to be independent of preconceptions about selected scientific *ideas*. The study corroborates the findings of Ogunniyi (1985) which reported negative relationship between gender and cultural beliefs. This could be due to the fact that both males and females were brought up in the same environment and have the same exposure to the most popular beliefs of the society. The results of this study support the findings of Akpan and Lessa (1997). That's to say, achievement in science is not influenced by one's gender. The reasons behind these equal responses by both genders could possibly be attributed to the necessary attention given to both boys and girl's science at primary and secondary schools by the board that was charged with that responsibility. In addition, both boys and girls found in these schools had to go through several, serious as well as careful scrutiny before being admitted. Therefore these careful selection could well have accounted for the equal responses and consequent reduction in the level of negative or wrong preconceptions.

The result of statistical analysis shows the non significant difference between the preconceptions and the selected scientific *ideas* in relation to students of zone A, zone B and zone C. It is apparent that 300 out of the 360 respondents involved in this study which represents 83% could be said to be holding to cultural beliefs. These kinds of students are faced with the problem of harmonizing the often conflicting explanations of cultural beliefs on one hand and the scientific explanations on the other hand.

The results of hypothesis on location shows that there were students with cultural beliefs in both rural and urban schools as regards certain scientific concepts like reproduction, rainbow, drought, thunder, shootings stars, albinism, eye blinking, dreams, fertility of soil, animal behaviors, genetic, germ theory, solar system, eclipses etc.. The reasons accounting for these could be due to period of establishment of schools, kinds of schools, learning environment, equipment and human/ materials resources available and the level of enlightenment attained.

The probable explanation for this discrepancies found among these students is that majority of them are

still mere learners, hence, science was seen as a mere collection of facts that needs to be memorized. Most of the students have continued to build up mistaken views, beliefs and dislike toward science, seeing it as a white man's magic. Consequently, most of them learn science for the sake of passing examination and obtaining certificate (Wasagu, 1999). However, it is now generally accepted that studying science should not be pursued for the sake of examination purposes only. Instead, knowledge of school science should help traditional children challenge basic problems in their everyday life. According to Biamba (1993:8), "instead of superimposing values that are hardly ever assimilated by traditional children science education might best serve as a medium for bridging the gap between traditional and scientific outlooks of nature and knowledge". After all, socialization of young ones involves not only the transmission of knowledge and values, but also the beliefs of the society. Beside, a belief may be in the air for many decades or even centuries before receiving scientific confirmation on the basis of conclusive status when the time is appropriate.

Recommendation

At last it has been established with a fair amount of certainty that the Nigerian child between the ages of zero and ten is brought up in African environment and tradition. It is also established that these traditional knowledge, in often cases are embedded in supernaturally re-enforced principle and laws. As much, it may therefore, amount to a mere imagination for any science teacher to assume that such traditional concepts can easily be washed away by the introduction of western concepts, available evidence reveals that it rather introduces conceptual conflicts which interacts very adversely with student's science concepts acquisition, interest in science and even their science process skills. In view of these, the researcher wishes to recommend that:

(a). The science curriculum for Nigeria can be reviewed to include basic ethno graphic and ethno science concepts which will facilitate the acquisition of pure scientific concepts.

(b). The current instructional approach need serious adjustment to include a thorough exposition of what the learners already knows about a given topic in a fashion that will bridge the gap between the learner's preconceived knowledge and the new science concepts being introduced.

(c). The science teacher being given adequate orientation on traditional concept categories can be guided on how to unmask this hidden indigenous concepts in the learners so that science lesson starts from what is already known to what is not yet known, or accepted.

(d). every effort should be made to bring materials for science instruction close to the learners through indigenization and not just improvisation.

(e). It is recommended that there should be a close cooperation between student's preconceptions emanating from their cultural beliefs and science even where conflicts seem to exist. This is because many a times a belief may be in the air for many decades or even centuries before receiving scientific confirmation on the bases of conclusive research. In fact popular beliefs achieve scientific status only when the time is appropriate. Science teachers should know some of these beliefs and modify their approach rather than dismiss them as unreasonable or unfounded.

(f). It is also recommended that the curriculum activities of science teachers association of Nigeria as well as research by individual science educators to be directed towards how to incorporate cultural beliefs into their curriculum. This is because cultural beliefs are not peculiar to Nigeria alone, but it exists everywhere, however, science has been aggressive enough in the west to dislodge most of the cultural beliefs (Wasagu, 1999). This can be done through workshops and visits to areas of interest where scientific explanations can be demonstrated to contradict POSIS, STAN workshops should consider involving local herbalist and other traditionalists in their workshops and conferences so that both rational and irrational beliefs can be discussed openly with teachers.

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