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Effects of ethnoscience instruction, school location, and parental educational status on learners' attitude towards science

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ABSTRACT

This study investigated the effect of Ethnoscience instruction and moderating effects of school location and parental educational status on students' attitude to science. It employed pretest-posttest, non-equivalent control group quasiexperimental design. Participants were 352 Junior Secondary School 1 (aged 9–12 years) students from two schools, each in urban and rural areas of Ìbàdàn, southwestern Nigeria. Instruments used are: Teachers Instructional Guide on Ethnoscience instruction, Teachers Instructional Guide on Modified Lecture Method and Attitude Toward Science Scale ($r = 0.86$). Three null hypotheses were tested at 0.05 level of significance. Data were analyzed using Analysis of Covariance. Significant main effect of treatment on attitude to science ($F(1, 347) = 296$, $p < 0.05$) was recorded, with Ethnoscience instruction group performing better than the Modified Lecture Method group. Effect size of treatment was strong ($\eta_p^2 = 0.46$). Also recorded were significant main effects of school location ($F(1, 347) = 10.2$, $p < .05$) and parental educational status ($F(1, 347 = 3.37)$, $p < 0.05$) on students' attitude to science with weak effect sizes ($\eta_p^2 = 0.029$ and $\eta_p^2 = 0.019$ respectively). Learners in rural schools performed better than those in urban schools and those from lowly educated parents had better performance than highly educated parents. Ethnoscience instruction promoted learners' attitude to science. Therefore, its use in educational instruction, especially among traditional science learners, should be explored.

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Ethnoscience instruction; attitude towards science; school location; parental educational status

Introduction

Various efforts have been made in different parts of the world at developing curricula that would meet the aspirations of all stakeholders. Of particular importance to many nations is the curriculum on science and technology. For instance, in America, there is in place the Next Generation Science Standards (NGSS); a concerted effort to establish new education standards. The standards are described by the National Research Council (2012) as being 'rich in content and practice, arranged in a coherent manner across disciplines and grades to provide all students an internationally benchmarked science education.' NGSS are based on the *Framework for K-12 Science Education* which takes into account the two major goals for K-12 science education. These are

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(1) educating *all* students in science and engineering; and
(2) providing the foundational knowledge for those who will become the scientists, engineers, technologists, and technicians of the future.

To educate *all* students, teaching strategies that meet specific needs of learners (taking into consideration their diversity in terms of culture, location and so forth) must be used.

The goals listed above are not quite different from those of other countries, especially developing ones. For instance, the 9-year Basic Education Curriculum, developed by the Nigeria Educational Research and Development Council (NERDC) from the primary and junior secondary curricula, enumerates the objectives of the new Basic Education Curriculum in science and technology as they apply to the learners. They are to:

(a) develop interest in science and technology;
(b) apply their basic knowledge and skills in science and technology to meet societal needs;
(c) take advantage of the numerous career opportunities offered by the study of science and technology; and
(d) become prepared for further studies in science and technology. (FRN, 2014)

In Australia, national curriculum developments in science in recent past focused on the philosophy of *Science for all* and making it accessible to all members of a society. Of particular importance is the inclusion of minority groups, especially in the northern territory where about 30% of students are Indigenous Australians. This meant going beyond the rhetoric of inclusivity to practical ways of its implementation (NT Board of Studies, 1997a).

If the identified objectives are to be realised, there would be the need for the use of different teaching methods and strategies to ensure students' understanding of concepts (Danmole, 2011). Various instructional methods and strategies have been developed for use in teaching and learning of different concepts in science. They include concept map, field trip, problem-solving, and case study. Meanwhile, learners in the traditional setting where day-to-day activities are still substantially influenced by cultural beliefs and practices of the people still exhibit poor achievement in science. For instance, West African Examination Council (WAEC) examiners' reports confirm poor performance of students in the science subjects in various countries in West Africa (WAEC, 2013, 2014). Even within these countries, pronounced differences are noticeable between students in urban and rural areas. Dean (1998) states that there is a pronounced difference in school attainment between urban and rural dwellers in his extensive study of education in Ghana. Rural dwellers are presumed to be greatly influenced by cultural beliefs and norms.

Cobern (1996) adduces a reason for this. He maintains that science as currently taught reflects Western history and foundational beliefs or worldviews. Turnbull (1997) as quoted by Absalom (2008) maintains that learners in the traditional non-Western setting believe that science taught in schools often seems 'not their own.' To them, science concepts seem strange. Elkana (1981) also explains that every culture has its own science which he translates to mean 'something like its own way of thinking and/or its own worldview' and gives the following definition: 'By science, I mean a rational (i.e. purposeful, good, directed) explanation of science of the physical world surrounding man' (p. 1437).

These increasingly receptive positions about indigenous science indicate a growing recognition that there are other ways of knowing the world aside the European scientific way of knowing, formerly considered as universal. Snively and Corsighia (2001) explain that indigenous science is sometimes referred to as ethnoscience which to Hardesty (1977) is 'the study of systems of knowledge developed by a given culture to classify the objects, activities, and events of its given universe.' It interprets how the local world works as viewed from the periscope of a particular culture. Expressions of science thinking manifest abundantly in indigenous agriculture, astronomy, medical practices, mathematics, engineering, architecture, military science, and ecology (Snively & Corsighia, 2001). They also note that ethnoscience includes the knowledge of indigenous expansionists (e.g. the Aztec, Mayan, and Mongolian Empires), as well as the home-based knowledge of long-term resident peoples (i.e. the Inuit, the Aboriginal people of Africa, the Americas, Asia, Australia, Europe, Micronesia, and New Zealand). To Ogunbunmi and Olaitan (1988), it is the study that approximates or reflects the natives' own thinking about how their physical world is to be classified. Abonyi (2002) defines it as the 'knowledge that is indigenous to a particular culture and is concerned with natural objects and events so that it may have potentially the same branches as Western science.' This means that branches of ethnoscience would include ethnochemistry, ethnophysics, and ethnoagriculture. In summary, ethnoscience is the knowledge derived from the norms and beliefs of a particular indigenous community which influences members' interpretation and understanding of nature.

For science learners with this background, a major challenge is how can science teachers enable all students to study science and simultaneously synchronise it with their ideas, beliefs, and values? A line of investigation into learning in science emphasises that pupils of diverse cultural backgrounds frequently interpret science concepts differently than the standard scientific view and that teachers need to begin instruction by determining the prior knowledge that children of Aboriginal cultures, such as the Afro-American, the Afro-Caribbean, Maori in New Zealand, Native American, and the Inuit, may have about the concepts of time, life cycle, growth, death, food chain, energy, taxonomy, evolution, tidal cycle, weather, causation, and resource management (George & Glasgow, 1989; Jegede & Okebukola, 1991; Ogawa, 1995; Smith, 1995; Snively, 1990). Indeed, the probe should emphasise prior cultural knowledge in respect of the concept to be taught. This is not often the case.

Abonyi (1999) notes that current instructional approaches in science education which do not take into consideration prior cultural beliefs seem to have contributed to poor students' interest in science. A number of efforts have been made at solving this problem. For example, Fafunwa, Macauley, and Sokoya (1989) recommend the mother tongue approach based on the success of a programme in which students were taught science using *Yorùbá*, the local language. Abonyi (1999), however, criticises the recommendation as transmitting Western science concepts in local language. Achimugu (1995) recommends the use of improved local instructional materials, but this is noted to be improvising Western instructional materials. The two recommendations have not removed the 'Western' in them (Abonyi, 1999). Various conferences have also made failed attempts at integrating indigenous elements into science curriculum. These include conferences in Addis Ababa in 1961, Tanunarive in 1962, and Lagos in 1964 (Eshiet, 1991). A different approach to solving this identified problem is therefore desirable.

George (2001) recommends criteria for such approach. These include

- drawing upon cultural experience and everyday life;
- accessing different ways of thinking about scientific concepts; and
- bridging the gap between the traditional and the conventional.

Ethnoscience instruction

George's criteria are expected to be met by ethnoscience instruction which can be explained to mean the instructional approach that systematically accesses and assesses the prior cultural beliefs and ideas of learners that are related to the science concept being taught to ensure a better understanding of the concept. The implementation of the ethnoscientific teaching approach is therefore based on the recommendations for teaching science by the *Science for All Movement* (UNESCO, 1991) which are that

(a) the content, language, symbols, designs, and purpose of the curriculum should be linked to day-to-day experiences and goals of the children;
(b) theory should be linked to practice, human purpose, the quality of life, and in-school experience to out-of-school experience; and
(c) teaching and learning should begin from the beliefs, interests, and learning skills that students bring to the classroom and should help each of them extend and revise their ability and understanding (Hiwatig, 2008).

Similarly in the Philippines, local experiences led to the institution of the Culture-Responsive Curriculum for Indigenous People (CCIP) which led to the development and implementation of the Third Elementary Education Project (TEEP). This project emphasised that curriculum should be indigenised; learning should relate to the comprehension of the local environment and culture (Department of Education, 2002).

Ethnoscience instruction is similar to the modified lecture method in terms of contents, basic instructional objectives, and mode of evaluation. The only differences are in the instructional activities and materials in which teachers in the ethnoscience instruction group make use of additional information from common local beliefs and sayings stating their cultural meanings and relating them to science concepts being taught and learnt while also assessing and obtaining additional information from the learners and allowing them form their own opinion on the concept. Learners would also be allowed to utilise additional instructional materials reflecting local beliefs and expressions.

Indigenous students' attitudes towards science

What would then be the effects of Ethnoscience instruction (EI) on students' attitude to science? This is necessary because some scholars identify beliefs and values about an object or situation as capable of affecting students' attitude towards science. For instance, Albert (1974) assessed the effects of EI on academic achievement and interest in science. The result of his study reveals that students taught using EI had higher academic achievement and greater interest in science than those taught using the lecture method. The study took place among American-Indians. He therefore recommends the use of ethnoscience instruction in teaching science concepts to students. What then would be its effects on learners' attitude towards science?

Indeed, attitude towards science learning has been a focus in the literature and studies have been carried out in this respect. Alsop (2005) identifies the following perspectives from which the issue of students' attitude to science can be examined:

(a) students' attitudes towards schooling and different school subjects compared to science;
(b) students' attitudes towards science as a discipline and as a school subject;
(c) the relationship between attitudes towards science and different instructional strategies;
(d) the relationship between attitudes towards science in general and areas of school science;
(e) the relationship between attitudes towards science and student achievement;
(f) the influence of teachers' behaviour towards students' attitudes; and
(g) the relationship between attitudes to science and variables external to the classroom such as age, gender, ethnicity, and grade level.

Therefore, a study of the relationship between attitudes towards science and ethnoscience instruction will not be out of place.

In analysing the determinants of educational outcomes, few studies have considered the relevance of geographical location of schools. The preponderance of indigenous students in rural schools, compared to their level of presence in urban schools and the reverse position of their colleagues who are familiar with Western ways of thinking, make the choice of school location as a moderator variable attractive. Gamoran and Long (2007) and Behrman (2010) conclude that the characteristics of the school have an important impact on academic performance. Distinct differences have been identified between schools in urban and rural areas. These include population density such that rural areas have low population density while urban areas have high population density. Large class sizes are more common in urban schools than rural schools. Studies also show that variables under family background have a great impact on educational performance. One of the variables is parents' educational attainment. It is found that students whose parents have a high educational level obtain better outcomes than students whose parents have a lower level of education (Woßmann, 2010). There are more students whose parents have a lower level of education in the rural areas than urban areas. Issues like these inform the choice of school location and parental educational status (PES) as moderating variables in this study.

School location and students' science learning

Studies on the effect of school location on science learning outcomes indicate conflicting results. Axtell and Bowers (1972) find that students from the rural areas performed significantly better than their urban counterparts in verbal aptitude, English Language, and total score using the American National Common Entrance Examination as a base. Akintunde (2004), who worked on environmental education concepts, concludes that students in urban centres in Nigeria have better performance than those in rural centres but Kannapel and Deyoung (1999) express contrary opinion in their study that was carried out in America. Since many people believe that culture is richer in the rural areas than urban areas, what effects would school environment in terms of location have on students' attitude to science in respect of this study?

Parental education level and students' attitudes towards science

Parental influence which includes PES has also been identified as a determinant of attitude towards learning (Oluwatelure, 2009). PES is a measure of the level of education of parents. Sirin (2005) maintains that PES is considered one of the most stable aspects of socioeconomic status (SES) because it is typically established at an early age and tends to remain the same over time. It has been identified as an important factor affecting students' achievement and attitude to science (Dryfoos, 1990). If PES influences achievement and attitude towards a subject (Olagunju, 1996), the effect of PES on learners' attitude towards science is worth researching. Ogunkola (2002) maintains that attractiveness or repulsiveness to science is influenced by the learner's attitude. The implication is that positive attitude towards science is likely to lead to persistent and better achievement (Odogwu, 2002). Indeed, Osborne (2001) attests to a positive correlation between students' attitude towards science and performance. The effects of EI, school location, and PES on attitude towards science will therefore provide an empirical evidence for the link (if any) that exists between these variables and attitude to science.

Purpose of the study

The study investigated the effect of ethnoscience instruction on students' attitude to science. It also investigated the moderating effects of school location and PES on attitude towards science.

Hypotheses

To guide this study, the following hypotheses were tested at .05 level of significance:

H1: There is no significant main effect of treatment on students' attitude towards science.

H2: There is no significant main effect of school location on students' attitude towards science.

H3: There is no significant main effect of parental educational status on students' attitude towards science.

Method

The study adopted a pre-test–post-test, non-equivalent control group quasi-experimental design. This design was used since experimental and control groups have not been equated by randomisation. Intact classes were used. The target population of the study consisted of all Junior Secondary School class one (JSS 1) students in *Ìbàdàn* municipality, *Òyó* State, Nigeria. It is made up of 11 local government areas (LGAs) (5 in urban and 6 in rural areas). Stratified random sampling was used to select four public co-educational Junior Secondary Schools that were used. Two schools were randomly selected from one randomly selected LGA in the urban centre of *Ìbàdàn* while two schools were also randomly selected from one randomly selected LGA in the rural centre of *Ìbàdàn*. Locational stratification was on the basis of urban centre being part of the municipality with a population of more than 200,000, and many social amenities such as electricity, tarred road, tap water, tertiary institutions, and hospitals, as well as rural centre with a population of less than 20,000 people without tarred road, tap water, tertiary institutions, and hospitals. Two randomly selected intact classes were used in each school. This was to prevent the disruption of normal class activities noting that none of the classes had less than 90% students with *Yorùbá* cultural background. The non-*Yorùbá* students lived and daily interacted with members of the local community and were more likely to be influenced by the culture of the immediate community. *Yorùbá* community is the major tribe in South-West, Nigeria. A total of 352 JSS 1 students (with ages between 9 and 12 years) comprising 198 in urban schools and 154 in rural schools participated in the study.

The instrument for data collection was called Attitude Toward Science Scale (ATSS) ($r = .86$). The scale was used to examine the students' attitude towards science. It is an adaption of the already standardised and universally accepted Modified Fennema-Sherman Science Attitude Scale (Doepken, Lawsky, & Padwa, 2003). This scale is a modification of the original version constructed by Fennema and Sherman (1976). The original version was to measure students' attitude towards mathematics. It was modified to measure students' attitude to science (Doepken et al., 2003). The original version's language was made simpler and changed to fit into science. For example 'I am sure that I can learn math' was changed to 'I am sure that I can learn science' while 'I'll need mathematics for my future work' was changed to 'I'll need science for my future work.' The minor adaptation made in this study is to add another section (Section A) to the instrument to obtain the subjects' personal data including the PES. Section B is made up of a 47-item 5-point Likert type scale of strongly agree (SA), agree (A), not sure (NS), disagree (D), and strongly disagree (SD). Each positive item in the instrument received points as follows: SA = 5, A = 4, NS = 3, D = 2, and SD = 1. The scores were reversed for negative items. There are 24 positive and 23 negative statements. It was given face validation by four experts in science education and test construction. The items were scrutinised in terms of relevance, suitability, general test format, and language. Their comments formed the minor adaptation made to the scale. The adapted version was, however, revalidated by administering it to an independent but similar sample of 30 JSS students.

Teachers Instructional Guide on Ethnoscience instruction and Teachers Instructional Guide on Modified Lecture Method were also used by the teachers involved in the study. Teachers Instructional Guide Ethnoscience instruction package was developed and used for the treatment group while the Teachers Instructional Guide on Modified Lecture Method package was drawn from the basic science curriculum module of the Federal Ministry of Education, Nigeria, and was used for the control group. The modified lecture method involves some practical demonstrations by the teacher and students unlike the traditional lecture method that the teachers were used to and often utilised.

EI involves the following broad steps:

(i) The teacher briefly introduces the concept to be taught and learnt;
(ii) The teacher enumerates and explains previously identified cultural beliefs, common sayings, and practices of the people of the locality that are related to the concept;
(iii) Learners respond and are encouraged to list more related common sayings and other prior knowledge;
(iv) The teacher presents the new science concept and jointly with the students interact with relevant ethnoscientific instructional materials;
(v) Students compare new concept and related common *Yorùbá* sayings and classify the sayings into:
  (a) Compatible;
  (b) Modifiable; and
  (c) Contradictory.
(vi) The teacher demonstrates and allows learners to interact with relevant other instructional materials;
(vii) The teacher asks questions, allows the students to ask questions, and summarises the lesson; and
(viii) The teacher gives assignment.

In terms of contents, basic instructional objectives, and mode of evaluation, ethnoscience instruction and the modified lecture method are similar. Differences exist only in instructional activities and materials in which teachers in the ethnoscience instruction group make use of additional information from common *Yorùbá* beliefs *and* sayings stating their cultural meanings and relating them to science concepts being taught and learnt while also assessing and obtaining additional information from the learners and allowing them form their own opinion on the concept.

For instance, *Yorùbá* expressions about *Adìẹ ń sàba* (longtime observations of broody hens) agree with modern scientific concepts of natural incubation, *Åráa Ṣàngó* (belief in *Òrìṣà – gods and goddesses with Ṣàngó being the god of lightening*) partly agree with electrical discharge in Nitrogen Cycle while *Ìbínú Olúwẹri* (belief in *Òrìṣà – gods and goddesses with Olúwẹri being the goddess of rivers and oceans as being responsible for ocean surge*) contradicts the concept of trade winds. Learners are also allowed to utilise additional instructional materials that reflect local beliefs and expressions such as *Ẹ̌fun*, a white chalk made from ground snail shell and white clay. It is used to appease *Òrìṣà Obàtálá* because of its white colour. It is also used for magical writings and painting the body during rituals. This is used in the science class as an instructional material for teaching and learning of concepts involving calcium carbonate ($CaCO_3$) and so on. Another set of instructional materials that can be used are the leaves of *Ewé'ran* (*Sarcophrynium brachystachys*) (a variety of Yorùbá soft cane) and *Ewé-gbòdògì* (*Megaphrynium macrostachyum*) (another variety of Yorùbá soft cane) used in wrapping food items like cooked rice, fresh pounded yam, and solid maize pap. They can be used in the teaching and learning of environmental conservation concepts. They are degradable materials and are more environmentally friendly than polythene bags.

Fidelity of treatment was ensured right from the development stage of the intervention, based on Vygotsky's sociocultural (Vygotsky, 1978) and Border Crossing (Aikenhead &

Jegede, 1999) theories. These include preparing training manual for each of the experimental and control groups. The materials were reviewed with two experts in these areas. Evaluators with assessment guides were assigned the duty of class observation and assessment of the participating teachers to ensure compliance with the manual. The researcher met every two weeks with the teachers engaged in the study to discuss the intervention processes and activities to prevent intervention drift. Evaluators were kept shielded from intervention and control methods.

Each of the two groups and their teachers were unaware of the other and their strategy. This was ensured through the use of different schools in different local governments for each of the groups to ensure fidelity of treatment. Before the commencement of the experiment, ATSS was administered as a pre-test to subjects in the treatment and control groups. This was followed by nine weeks of experiment during which the regular basic science teachers of the schools taught the selected concepts by adhering strictly to the lesson procedure developed for each of the packages. The contents cover all the four broad themes of basic science curriculum. These are You and Environment, Living and Non-Living Organisms, You and Science, and You and Energy. The experiment was carried out during the normal school periods allocated on the timetable. At the end of the experiment, ATSS was re-administered to the two groups as post-test; results from the two administrations (pre-test and post-test) were used for data analysis.

Analysis of covariance (ANCOVA) was used to test the hypotheses and differences between the groups using the pre-test scores as covariates. Estimated marginal means was used to identify where such differences occurred and determine the performance of each group.

Results

H1: There is no significant main effect of treatment on students' attitude towards science.

Table 1 reveals that there is a significant main effect of treatment on students' attitude towards science ($F(1, 347) = 296$, $p < .05$). This means that students exposed to treatment differ significantly in their post-test mean scores. Hence, H1 is not supported.

The effect size of treatment is, however, strong with partial eta squared (η_p^2) being .46, which means that 46% of the variance in scores is accounted for by treatment. To find out the group with higher adjusted mean score, the estimated marginal mean table (Table 2) of post-test attitude score is presented.

Table 1. Summary of ANCOVA of subjects' post-test attitude scores by treatment, school location, and PES.

Source of variation	Sum of squares	df	Mean square	F	Significant	Partial eta squared = η_p^2
Corrected model	5009.80[a]	4	1252.45	81.72	.000	.485
Intercept	141,003.13	1	141,003.13	9200.29	.000	.964
Treatment	4541.65	1	4541.65	296.34	.000*	.461
Location	156.59	1	156.57	10.22	.002*	.029
PES	103.18	2	51.59	3.37	.036*	.019
Error	5318.10	347	15.33			
Total	172,782.00	352				
Corrected total	103,27.90	351				

[a]$R^2 = .521$ (adjusted $R^2 = .504$).
*Significant at $p < .05$ η_p^2 used to show effect size.

Table 2. Estimated marginal mean of post-attitude score for methods.

			95% Confidence interval	
	Mean	Std. error	Lower bound	Upper bound
EI	179.50	1.951	175.659	183.332
ML	170.02	2.007	166.073	173.968

Note: Dependent variable: post-attitude.

Table 2 shows that learners in the ethnoscience instruction group have higher mean score ($\bar{X} = 180$) than the Modified Lecture group ($\bar{X} = 170$) in students' attitude towards science. The implication of this is that EI is a more effective method in improving students' attitude to science than modified lecture (ML).

H2: There is no significant main effect of school location on students' attitude towards science.

Table 1 reveals that there is a significant main effect of school location on students' attitude towards science ($F(1, 347) = 10.2$, $p < .05$). This means that there is a significant difference between the attitude of students in urban and rural areas to science as shown in their post-test mean scores. Hence, H2 is not supported.

The effect size of treatment is however weak with partial eta squared (η_p^2) being .029, which means that 2.9% of the variance in scores is accounted for by school location. To find out the group with higher adjusted mean score, the estimated marginal mean table (Table 3) of post-test attitude score is presented.

Table 3 shows that learners in rural schools obtained higher mean score ($\bar{X} = 179$) than those in urban schools ($\bar{X} = 171$) in students' attitude towards science. The implication of this is that, using EI, learners in rural schools exhibit improved attitude to science than those in urban schools.

H3: There is no significant main effect of PES on students' attitude towards science.

Table 1 reveals that there is a significant main effect of PES on students' attitude towards science, ($F(1, 347) = 3.37$, $p < .05$). This means that there is a significant difference among learners in their attitude to science as shown in their post-test mean score based on their PES. Hence, H3 is not supported.

The effect size of treatment is weak with partial eta squared (η_p^2) being .019, which means that 1.9% of the variance in scores is accounted for by PES. To find out the group with higher adjusted mean score, the estimated marginal mean table (Table 4) of post-test attitude score is presented.

Table 4 shows that learners of parents with low educational status obtained higher mean score ($\bar{X} = 176$) than those having parents with medium educational status ($\bar{X} =$ 175) and parents with high educational status ($\bar{X} = 174$) in students' attitude towards

Table 3. Estimated marginal mean of post-attitude score for location.

			95% Confidence interval	
	Mean	Std. error	Lower bound	Upper bound
Urban	171.01	1.894	167.279	174.730
Rural	178.51	2.131	174.320	182.703

Note: Dependent variable: post-attitude.

Table 4. Estimated marginal mean of post-attitude score for parent educational status.

	Mean	Std. error	95% Confidence interval	
			Lower bound	Upper bound
Low	175.56	2.81	170.03	181.10
Medium	175.14	1.97	171.27	179.01
High	173.57	2.64	168.39	178.76

Note: Dependent variable: post-attitude.

science. The implication of this is that, using EI, learners from parents with low educational status exhibit highest level of improved attitude to science followed by those from parents with medium educational status and lastly, by those from parents with high educational status exhibiting the lowest attitude towards science.

Discussion of findings

Effects of ethnoscience instruction on students' attitude towards science

Findings from the study as shown in Table 1 reveal that there is a significant main effect of treatment on students' attitude towards science. The estimated marginal mean table of post-test attitude score (Table 2) shows that learners in the EI group had higher adjusted mean than the ML group in students' scores in attitude towards science. Table 1 shows that the difference in the adjusted mean scores is significant. The implication of this is that EI is a more effective method in improving in students' attitude towards science. The significant effect of this could mean that the awareness of the link between the learners' cultural beliefs and science concepts brought about greater emotional attachment to science. EI seems to have removed or reduced the learners' perceived remoteness or strangeness of science concepts through familiarity in the instructional approach used in their presentation.

This study reinforces the conclusion of Berg (2005) that ethnoscientific students were motivated in terms of internal factors (expectancy, affective, and value components) of motivation as summarised by the Pintrich model in his study. The strong effect size is a pointer to the efficacy of EI. This finding equally supports Leonard (2010) who concludes that making the learning and the teaching of the topics more relevant to students' lives helps them see the value of science and in turn motivates them to develop a better attitude towards science and science education. This study corroborates the assertion of Etkina and Mestre (2004) that instructors of introductory science classes should try to motivate their students by asking them to consider the preconceptions about science-related topics that they bring to the class. Similarly, Abonyi (2002) concludes that ethnoscience package is superior to the conventional package in fostering interest in science. In Hiwatig (2008) the ethnoscientific class had a significantly ($p = .031$) higher positive mean rating in their attitude towards science (83.35 or 83%) than the conventional class (79.55 or 80%). This study lends credence to this result.

The conclusion by Turpin and Cage (2004) that there is no significant difference in attitude towards science between students involved in integrated, activity-based science curriculum and those involved in traditional science programme is contradicted by the result of this study. It also negates the conclusion of Shymansky, Yore, and Anderson (2000) in a study of responses in the Third International Mathematics and Science Study of students taught with constructivist and student interactive science teaching strategies which indicate that attitude may be more of a reflection of classroom and school environment than of the science curriculum. They found no significant differences between attitude and awareness in science.

Findings from the study as shown in Table 1 also reveals a significant main effect of school location on students' attitude towards science which implies a significant difference between the attitude of students in urban and rural areas towards science as shown in their post-test mean scores with learners in rural schools obtaining higher mean score than those in urban schools. Using EI, learners in rural schools are more likely to exhibit improved attitude towards science than those in urban schools. The effect size of treatment is weak. The estimated marginal mean table (Table 4) of post-test attitude score shows that learners in rural schools obtained higher mean score than those in urban schools in students' attitude towards science. This is an indication that by using EI, learners in rural schools tend to exhibit improved attitude to science than those in urban schools. Osokoya and Akuche (2012) (citing McGill & Karn, 1997) concur that school location can affect students' attitude towards science either positively or negatively. They went further to state that urban environment can be conceptualised as that which has high population density, containing a high variety of beautiful commonplace views, whereas rural environment is characterised by low population density containing a low variety and isolated weird views. Alokan, Eunice, and Emmanuel (2013) assert that students' problems are strongly associated with poor performance and that sex and location do not affect the negative relationship between student problems and academic performance. Considine and Zappala (2002), who used students in Australia as sample, found that geographical location did not significantly predict outcomes in school performance. The result from this study must have been influenced by the rural environment in which local cultural beliefs are less diffused by foreign cultural beliefs. Learners in the rural schools are more greatly influenced by local cultural beliefs than those in the urban centres. Therefore, a culture-based instructional method is more likely to influence their attitude towards science positively.

Similarly, the results of this study as shown in Table 1 reveal a significant main effect of PES on students' attitude towards science as learners having parents with low educational status exhibited highest level of improved attitude towards science, followed by learners that are progenies of parents of average educational status and lastly, by those of parents that achieved high educational status. The effect size of treatment is also weak. The reason for this result could be because most lowly educated parents and their wards are often closer to culture than the well-educated ones that largely form the group of elite. EI is more likely to have impacted wards of lowly educated parents than the other groups. These lowly educated parents have greater interaction with their children than the ever busy educated parents, many of whom spend more of their time outside the home daily than with their children. And, when they come back in the night after work, they are too tired to give much attention to the children. However, equally very busy less educated parents often have their children around them assisting in their work after leaving schools in the afternoon. This result contradicts Nannyonjo (2007) who concludes that children of parents with high level of education performed better in academic activities than others. He explains that the results are possibly a reflection of parents' ability to support the pupils' school work, and interactions of literate parents with their children in school-related or literacy nurturing activities, including their ability to support their children with homework or help with difficult homework questions.

Conclusion

This study was carried out as part of efforts by educators and researchers at improving the attitude of learners towards science using EI. Findings in the study reveal the efficacy of EI in improving attitude towards science in *Yorùbá* land. It helped to identify differences among students due to school location and PES. This work should trigger the eagerness for replication in other cultures.

It is hoped that this work would engender the much desired improvement in attitude of learners to science education in *Yorùbá* land with the potential for such in other places where there is great attachment to cultural beliefs and sayings. The results show the potential of achieving some of the objectives of basic science education in Nigeria. For instance, improved attitude to science can help learners further develop interest in science and technology. This is likely to bring out better academic achievement in science. This is based on the consensus that attitude could be regarded as a significant predictor of learners' academic achievement. The illustration is that the more positive one's attitude towards an academic subject is, the higher the possibility of him/her performing well academically. This supports the work of some researchers in the U.S.A., who studied the relationship between students' attitudes and academic achievement in college mathematics by inviting 218 freshmen to complete a set of questionnaire and conclude that students' attitudes were highly correlated with their achievement in college calculus (House, 1995, p. 112). Again, Reynolds and Walberg (1992, p. 307), in another longitudinal study also conducted in the U.S.A., found out that attitude had a powerful influence on students' academic achievement in mathematics.

Recommendations

Based on the findings of this study, the following recommendations are made

(1) Educators, administrators, and other stakeholders in the education sector especially those in the area where people are still strongly attached to their cultural beliefs should be trained on the importance and use of EI based on its potentials as confirmed by this study.

    This is in tandem with the suggestion of Snively and Corsighia (2001) that teachers need to probe and incorporate the prior beliefs of indigenous children and talk about the possibility of different perspectives and traditions of science in a classroom that encourages mutual respect, as well as appreciation for differing opinions. Also, this supports the two-way learning enunciated by Harris (1990) and others in Australia to fulfil the needs of indigenous people in their cross-cultural lives.

(2) Effort should equally be made to replicate this study among long-resident oral traditional peoples in other parts of the world such as the Inuit in northern Canada, Navajos in the states of Arizona, New Mexico, and Utah (where the majority of them live) and Hispanics in America and Hausa/Fulani of Nigeria, Ghana, Chad,

Niger, Cameroon, Republic of Benin (all in Africa), Igbo in Nigeria, and other Aboriginal people of Asia, Australia, Europe, Micronesia, the Americas, and New Zealand.

(3) If further replication of this study affirms its efficacy in improving attitude of learners to science in other cultures, efforts should be made at incorporating ethnoscientific materials into the school curriculum in areas where day-to-day activities are still greatly influenced by traditional beliefs and sayings to effect the much desired improvement in learners' attitude towards science. This is in line with the recommendation that led to the CCIP in the Philippines which equally led to the development and implementation of the TEEP. This project is premised on the notion that curriculum should be indigenised; learning should relate to the comprehension of the local environment and culture (Department of Education, 2002). This recommendation further supports by the basis upon which the northern territory curriculum was developed in Australia. The conceptualisation of the place of indigenous knowledge in the curriculum can be illustrated by comparing the statement from Australian Education Council (1994) that 'scientific knowledge … has been enriched by the pooling of understanding from different cultures – Western, Eastern and indigenous cultures including those of Aboriginal peoples and Torres Strait Islanders – and has become a truly international activity' (p. 3). The NT Board of Study (1997b) also considers 'that the worldviews of Western and various indigenous peoples may be different and that their alternative perspectives inform others about using and classifying materials, and understanding phenomena and relationships in the natural and technological world' (p. 3).

(4) Lastly, further studies should be carried out on the effects of EI on other learning outcomes in science.

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