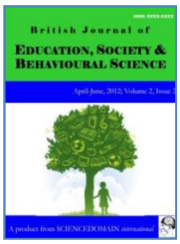

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# Influence of Cultural Practice–Related Misconceptions on Achievement of Senior Secondary Biology Students in Zone C of Benue State, Nigeria

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***Author's contribution***

*This whole work was carried out by the author OMO, who read and approved the final manuscript.*

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## ABSTRACT

This study investigated the influence of cultural practice-related misconceptions on achievement among Biology students of senior secondary schools in Zone C of Benue State in central Nigeria using the survey design. A multi-stage method was used to select the sample of 2,879 SS3 students from 29 mostly coeducational schools. The two researcher-designed instruments for data collection were the Biology Cultural Practice-Related Misconceptions Questionnaire (BCPMQ) and Cultural Practice-related Misconceptions Biology Achievement Test (CPMBAT). Using the Spearman-Brown

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prophecy formula, the reliability index of the instruments were 0.83 for BCPMQ and 0.96 for CPMBAT. Results of the study showed that students bring a substantial amount (88.89%) of their cultural practices into their Biology classes and that there is a significant relationship between the mean achievement scores of senior secondary Biology students and the cultural practice-related misconceptions they hold ($r = 0.331, p = .01 < .05$). There is a significant difference between the mean achievement scores of male and female students in favour of the female students. The study recommends, among other things: adequate training of serving and pre-service teachers to correct identified cultural practice-related misconceptions to facilitate understanding of Biology concepts.

*Keywords: Achievement; misconception; persistent influence; cultural practices; beliefs; cognitive conflict; meaningful learning; worldviews.*

## 1. INTRODUCTION

The persistent underachievement in Science and particularly in Biology has elicited a lot of concern and generated researches to establish the causes of the repeated failures. A major cause of underachievement has been traced to the persistent influence of misconceptions which students bring to Biology classes [1,2]. Misconception has been defined as a consistent departure from an agreement that has been reached and accepted universally by experts in a particular field on a particular conception [3,4,2,5].

Indeed a number of investigations have shown that students' explanations of scientific phenomena are dominated by what they perceive from their cultural beliefs [6,7,8]. As noted by [9], scientific knowledge and explanations have not been an integral part of African life, rather power of witchcraft and evil spirits are means of providing explanations to natural phenomena. This is a departure from scientists' usual thinking and belief that every event in nature is logically and physically a sequence of cause and effect and not as traditionally believed due to some mystical forces [10]. Consequently, there is conflict between students' everyday life world and the world of school science. Hence, the first job of a teacher in the classroom is to eliminate all superstitious beliefs and explain Biology as the study of natural phenomena by minimizing the idiosyncrasies and misinformation arising from superstitious beliefs to bring meaningful understanding and learning.

This is crucial since according to [11], the average Nigerian views the world from five conceptual perspectives: mythology, supernatural, mystic, popular and western scientific. The resultant but entrenched worldviews are responsible for the varying degrees of conflicts, interferences and difficulties Africans experience in learning Science [12]. Hence, the advice by [1], that Science should be presented to students only after a careful consideration of the traditional perspectives is apt. That is why Gallard, as cited in [7], has suggested that Science students should be assisted by teachers to use their knowledge or worldviews in ways that draw on their cultural experiences for meaningful learning to take place. Similarly, [13] has observed that an adequate blend between people's knowledge and the operations of Science removes cognitive conflicts and consequently facilitates learning and achievements.

In the study area consisting of a mix of Idoma, Igede and Ibo ethnic groups, the societies are characterized by authoritarianism and rigid conformity where children are expected to be seen and not heard and to blindly learn from the experience of elders [12]. Besides, girls and women are assigned mandatory but subordinate roles. The girl child learns domestic chores

because of the stereotypic view of her as a mother, child bearer and house keeper. In these traditional societies, adherence to indigenous cultural practices remains firmly entrenched while belief in scientific ideas is, at best, superficial. In these mostly rural communities, the power of witchcraft and evil spirits provide convenient explanations to natural phenomena thereby causing cognitive conflicts between students' out of school life experiences and the world of science. With students' explanations of scientific phenomena dominated by what they perceive from their cultural beliefs, their interpretations of new Biology knowledge are subsumed; their development of personal constructs of meaning is undermined, thereby resulting in rote learning and eventual underachievement. This is because most students still believe that Science is a body of facts and principles that they have to memorize and regurgitate appropriately [14].

Since Biology is one of the Science subjects that have a lot to do with human life and human beings' ways of doing things, there is therefore the likelihood of cultural practices wielding influence on teaching, learning and manipulating of concepts. The implication of this is that there could be a wide cultural gap between the students' cultural explanations and scientific interpretations of reality as the contradictory notions are capable of obstructing the learning of Biology concepts and their application, resulting in misconceptions and underachievement. The purpose of this study is therefore to identify cultural practice-related misconceptions of Biology students and their persistent influence on students' achievement in the subject.

### 1.1 Research Questions

This research was guided by three research questions:

1. What cultural practices do Senior Secondary students in Zone C bring into their Biology classes?
2. How do male students differ from female students in the cultural practice – related misconceptions they hold?
3. How is the achievement of male and female Senior Secondary Biology students affected by the cultural practice – related misconceptions they hold?

### 1.2 Research Hypotheses

Two null hypotheses were tested:

Ho1. There is no significant relationship between the mean achievement scores of senior secondary Biology students and the cultural practice–related misconceptions they hold.

Ho2. There is no significant difference between the mean achievement scores of male and female senior secondary Biology students in a Cultural Practice-related Misconceptions Biology Achievement Test.

## 2. METHODS

### 2.1 Research Design

The survey design is used to establish whether the variables under investigation are related or not apart from describing existing conditions of some educational problems. Furthermore, in this design, a relatively large number of people considered to be the representative of the

entire group is used. It was therefore considered appropriate for use for this study to provide answers to the research questions.

## 2.2 Sample

The sample consisted of 2,872 senior secondary Biology students drawn from intact classes of 29 schools in the 10 cultural groups identified in the Zone. The multi-stage sampling technique was employed in selecting the sample. Where there was only one school or a lone gender school among a cultural group, it was purposively used. Thus, four of such schools were included in the sample to serve the purpose of representativeness of the cultural groups in question. Similarly, to balance the representativeness of the sample considering gender, a random sampling of all the lone-gender schools was employed to include 2 single sex schools. Thereafter, random sampling was used to obtain the remaining 23 coeducational schools.

## 2.3 Data Collection Tools

Two research instruments were developed for this study by the researcher. They are:

a. The Biology Cultural Practice-related Misconceptions Questionnaire (BCPMQ)
b. The Cultural Practice-related Misconceptions Biology Achievement Test (CPMBAT).

The Biology Cultural Practice-related Misconceptions Questionnaire, BCPMQ, consisted of three sections:

Section A contained background information about the respondents.
Section B required the respondents to identify their cultural practices.
Section C dealt with the identification of students' misconceptions.

Section B was made up of ten items. By responding to this section, students made a list of cultural practices in their localities and gave cultural meanings and explanations to the identified practices. Section C consisted of 20 items, developed to identify the cultural practice-related misconceptions that the students held. The items were developed within the content areas which were identified in the literature as either difficult for students to learn, culture-related or in which students hold misconceptions. The respondents were required to select an answer from 4 options (a – d) with a tick [√] mark. Only one of the options was acceptable scientifically and was accepted as correct while the other options were cultural explanations that were given to the Biology concept in question. The respondents were to give a brief explanation of their choices. For a correct choice of the key, the explanation was checked to ensure that the choice did not arise from guesswork or ignorance. If the explanation was correct, a score of 1 was awarded; if not, a score of 0 was awarded. A student who chose any wrong option was deemed to hold a culture-related misconception in that concept. Here is an example.

When it is raining and the sun is shining at the same time, it means:

a. a leopard is giving birth near a stream or river.
b. the harvest for that year will be good.
c. an important person will die.
d. the cloud that forms rain is not thick enough to cover the sun.

Explain your choice:

Thus the misconceptions the students held in some Biology concepts were identified after this section of the Instrument was analyzed.

The Cultural Practice-related Misconceptions Biology Achievement Test (CPMBAT) was a 30-item multiple choice test. A table of specification was applied for the thirty test items using Bloom's taxonomy of learning objectives. The topics covered include nervous coordination, reproduction, genetics, diseases and germs, nutrition, ecology and terrestrial habitats, variation, relevance of Biology to Agriculture. Each item was followed by options a-d. Students were required to tick (√) beside the correct option and explain their choice. For example:

When a black couple gives birth to an albino child, a possible reason is that the

a. couple had sex in the afternoon.
b. woman committed adultery.
c. skin of the child is not pigmented due to lack of melanin.
d. wife saw a masquerade when she was pregnant.

Explain your choice:

## 2.4 Validation

The face validation of these instruments was established by 4 Senior Lecturers in Science Education and 1 expert in Measurement and Evaluation. The use of table of specification and subjection to inspection by the validators ensured content validity, non-repetition of questions and relevance to the research questions and hypotheses. After modification, using their comments, corrections and suggestions, 20 out of the initial 36 items for BCPMQ and 30 out of initial 46 items for CPMBAT emerged. The reliability estimate for internal consistency established by using the split – half method and the Spearman-Brown prophecy formula were 0.83 for BCPMQ and 0.96 for CPMBAT.

## 2.5 Implementation

Prior to the implementation, there was a training of Biology teachers in the 29 selected schools who were used as Research Assistants for the study. The focus of the training was to provide them with both comprehensive and detailed explanations of the instruments before they were handed over to them to administer on students in their respective schools. CPMBAT was to be administered 24 hours after the administration of BCPMQ.

## 2.6 Data Analysis

The scripts were collected, marked and scored using the marking scheme prepared by the researchers.

Percentages, mean and standard deviation were used to answer the research questions. A cultural practice was considered Biology-related and therefore confirmed where at least 50% of the respondents identified it as the cultural practice of their people. Similarly, the existence of a misconception was established or confirmed where at least 50% of the respondents ticked and explained a concept different from the agreed correct one held by the scientific community.

The Pearson product moment correlation coefficient and the test of independent samples were used to test hypotheses 1 at P < .05 because the hypothesis sought to test the significance of the relationship between the two samples. The t-test of independent samples was used to test hypothesis 2 because it sought to test the significance of difference between two means.

## 3. RESULTS

Results in this study are presented according to research questions and hypotheses.
Data for answering research question 1 are contained in Table 1.

Table 1 reveals that 42 cultural practices identified are related to Biology. 37 (88.09%) of these cultural practices were identified by at least 50% of the respondents and thus were confirmed as the cultural practices of the people. This implies that only 5 (11.91 %) were identified by less than 50% of the respondents and were therefore not confirmed as cultural practices of the people. The culture-related Biology concepts identified are micro-organisms, ecology, genetics, nervous coordination, relevance of Biology to Agriculture, and variation. The cultural explanations of these concepts are completely at variance with those that are scientifically acceptable. This reveals that students bring their cultural practices into their Biology classes.

Data for answering research question 2 are contained in the histogram in Fig. 1.

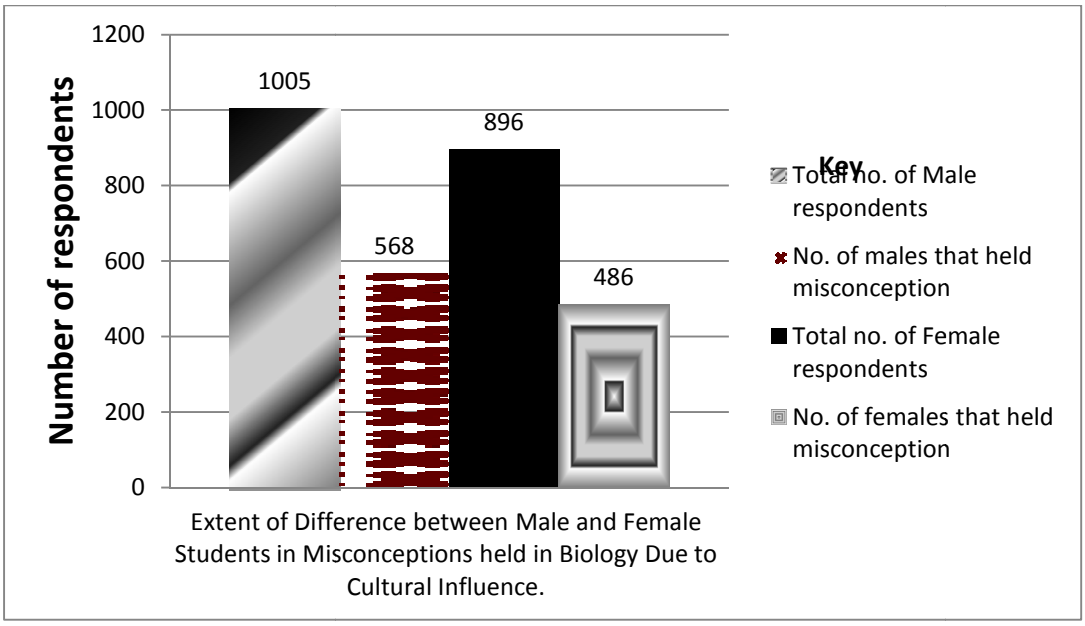


**Fig. 1. Extent of difference between male and female students in misconceptions held in biology due to cultural influence**

**Table 1. Number and percentage of respondents that identified various cultural practices**

| S/N | Natural phenomena | % | Cultural explanation portend | Related scientific concept | Explanation | Decision: cultural practice |
|---|---|---|---|---|---|---|
| 1. | Sweeping the house in the night | 82.6 | Depleting one's wealth | Micro-organisms/ Diseases | Clean environment | Confirmed |
| 2 | Itchy right palm | 76.2 | Receiving money | Irritability | Irritability due to allergy /dryness | Confirmed |
| 3 | Itchy left palm | 76.2 | Giving away money | Irritability | Irritability due to allergy/dryness | Confirmed |
| 4. | Sneezing suddenly | 81.5 | Being discussed somewhere | Irritability | Reaction to dust/allergy | Confirmed |
| 5. | Itchy soles | 66.9 | Possible Journey | Irritability | Irritability due to allergy/dryness | Confirmed |
| 6. | Hitting of the right leg against stone | 53.3 | Good luck | Movement | Flaw in nervous coordination | Confirmed |
| 7. | Hitting of the left leg against stone | 57.8 | Bad luck | Movement | Flaw in nervous coordination | Confirmed |
| 8. | Fornication/Adultery | 68.7 | Death | Diseases | STD | Confirmed |
| 9. | Observance of Ej'alekwu | 59.1 | Good health/ bumper harvest | Nutrition | Soil fertility | Confirmed |
| 10. | Male sighted as first thing in the morning | 51.6 | Good luck | Ecology/Terrestrial Habitat | Chance happening | Confirmed |
| 11. | Female sighted as first thing in the morning | 51.6 | Bad luck | Ecology/ Terrestrial habitat Habitat | Chance happening | Confirmed |
| 12. | Giant rat, chameleon sighted in the day time | 80 | Bad omen | Ecology/Terrestrial habitat | Feeding/ protective happening | Confirmed |
| 13. | Hooting of owl at night | 82.4 | Death warning | Ecology | Nocturnal | Confirmed |
| 14. | Continuous howling of unthreatened dog at night | 82 | Death warning | Ecology | Mating behavior | Confirmed |
| 15. | Eating of left over guinea corn food | 11 | Sickness | Disease/Micro organism | Food poisoning | Not confirmed |

***Table 1 continued……***

| | | | | | | |
|---|---|---|---|---|---|---|
| 16. | Swarmed house by bees | 58.6 | Misfortune, sickness/death | Ecology/terrestrial habitat | Social behavior | Confirmed |
| 17. | Venturing into sacred places | 82.5 | Mysterious | Ecology | Exploration | Confirmed |
| 18. | Heating a boy with a broom | 50.6 | Impotence/ enslavement | Ecology | Man's activities | Confirmed |
| 19. | Upper eyelid twitching | 81.6 | Good luck | Nervous coordination | Involuntary action | Confirmed |
| 20. | Lower eyelids twitching | 81.5 | Bad luck | Nervous coordination | Involuntary action | Confirmed |
| 21. | Presence of a black cat | 81 | Witch | Genetics | Dominant gene | Confirmed |
| 22. | Couple mating in the afternoon | 51.9 | Birth of albino | Genetics | Mutation of genes | Confirmed |
| 23. | Imitating the language of the gods | 77.3 | Death | Nervous coordination | Remembrance | Confirmed |
| 24. | Eating the leg of a dog when pregnant | 40.3 | Birth of a restless child | Nutrition | Feeding | Not confirmed |
| 25. | Walking over food by a woman | 49.7 | Death of boys | Ecology | Movement | Confirmed |
| 26. | Mentioning reproductive organ | 52.3 | Curse/ punishment | Nervous coordination | Remembrance | Confirmed |
| 27. | Eating snail by pregnant women | 71.2 | Salivating baby | Nutrition | Protein repairs the body/ salivary gland | Confirmed |
| 28. | Eating python, adder by pregnant women | 71.2 | Strong bones/ babies crawl on their tummies | Nutrition | Protein repairs the body | Confirmed |
| 29. | Eating grass cutter by pregnant women | 80.1 | Babies sleep lightly | Nutrition | Protein repairs the body | Confirmed |
| 30. | Eating red monkey (Otukpo) | 51.2 | Death | Nutrition | Protein repairs the body | Confirmed |
| 31. | Eating black money | 76.2 | Very active and crafty babies | Nutrition | Protein repairs the baby | Confirmed |
| 32. | Sun shining while raining | 61.6 | Leopard giving birth near a stream | Reproduction | Water cycle/end of gestation period | Confirmed |

***Table 1 continued……***

| | | | | | | |
|---|---|---|---|---|---|---|
| 33 | Dropping of an item with the left hand | 533.6 | Forgetting where the item was kept | Nervous coordination | Brain is the seat of remembrance | Confirmed |
| 34 | Observance of new yam festival | 71.3 | Good health and good harvest | Nutrition | Soil fertility | Confirmed |
| 35 | Giving birth to babies | 52 | Reincarnation of ancestors | Reproduction/ genetics | End of gestation period/sex selection | Confirmed |
| 36 | Going to chiefs' burial ground | 53.4 | Death barrenness | Ecology | Exploration | Confirmed |
| 37 | Eating roasted yam by pregnant women | 49.6 | White patches on skin | Variability | Mutations | Confirmed |
| 38 | Menstruating women cooking for their husbands | 37.3 | Sickness/death of husband | Reproduction | Menstrual cycle | Not confirmed |
| 39 | Passing along certain paths on some days | 29.2 | Sickness/curse | Characteristics of living things | Movement | Not confirmed |
| 40 | Eating of egg by women and children | 43.8 | Stealing | Nutrition | Protein repairs cells/ growth | Not confirmed |
| 41 | Having sex with a close relation | 80.9 | Death unleashed by alekwu | Reproduction | Inbreeding/ Weak offspring | Confirmed |
| 42 | Wearing of dress inside-out | 66.1 | Good-luck | Nervous Coordination | Conditioned reflex action | Confirmed |

This histogram reveals that of the 1005 male students, 586 or 58.43% held misconceptions in the identified concepts. This proportion is higher than that of the 896 female students out of whom 450 or 50.23% held misconceptions. This shows that female students hold fewer misconceptions in Biology concepts than their male counterparts.

Data for answering research question 3 are contained in Table 2.

**Table 2. Extent of influence of cultural practice-related misconceptions on achievement of male and female biology students**

| Gender | N | Mean misconception | Mean achievement | SD | Mean diff. |
|---|---|---|---|---|---|
| Male | 1003 | 23.67 | 37.45 | 21.64 | 13.75 |
| Female | 896 | 25.63 | 45.93 | 26.20 | 19.67 |
| Total | 1901 | 24.59 | 41.45 | 24.21 | |

Table 2 reveals that the male subjects have a mean achievement score of 37.45 and a standard deviation of 21.64. Their female counterparts have a mean achievement score of 45.93 with a standard deviation of 26.10. This shows that the female students who scored high on identified cultural practice-related misconceptions (i.e. held fewer misconceptions) scored high in an achievement test while the males who scored lower in misconceptions (i.e. held more misconceptions) scored lower in the achievement test.

Data for testing hypothesis 1 are contained in Table 3.

**Table 3. Relationship between BCPMQ & CPMBAT of senior secondary biology students**

| Instrument | N | Mean | t | r | Sig(2-tailed) |
|---|---|---|---|---|---|
| BCPMQ | 1902 | 24.588 | 0.109 | .331*** | |
| CPMBAT | 1902 | 41.447 | | | |

*Correlation is significant at 0.01< 0.05 level ( 2-tailed )*

The data presented in Table 3 show that the Pearson product correlation between BCPMQ & CPMBAT is significant at $p < 0.05$. The null hypothesis was therefore rejected, implying that there is a significant relationship between the mean achievement of senior secondary Biology students and the cultural practice-related misconceptions they hold ($r = .331$, $p = 0.01 < 0.05$). This means that students who scored high on cultural practice-related misconceptions (that is, held fewer misconceptions) scored high in the achievement test. On the contrary, students who scored low in the cultural practice-related misconceptions (i.e., held more misconceptions) scored low in the achievement test.

Data for testing hypothesis 2 are contained in Table 4.

**Table 4. T-test of mean achievement of male and female students in CPMBAT**

| Gender | N | Mean | ∂ | t | df | Sig.(2- tailed) |
|---|---|---|---|---|---|---|
| Male | 1006 | 37.48 | 21.54 | -7.73 | 1900 | .000 |
| Female | 896 | 45.93 | 26.10 | | | |

*s = significant at p < 0.05*

The data in Table 4 reveal that the calculated t-test of mean achievement of male and female Biology students in CPMBAT was significant at $p < 0.05$. The null hypothesis was rejected. This means that there is a significant difference between the mean score of male and female senior secondary Biology students in a Cultural Practice-related Misconceptions Biology Achievement Test ($t = -7.73$; $p = 0.01 < 0.05$). Thus, female students performed better than their male counterparts. This means that students who perform better (i.e. hold less misconceptions), perform better in achievement tests and vice versa.

## 4. DISCUSSION

The results of this study show that students bring many of their cultural practices into their Biology classes. This tallies with the observation of [8], that personal intuition/experience related to cultural factors prevalent in the society as the cultural setting of our homes give room for conflicting traditional beliefs and superstitions which may appear logical but are at variance with scientific concepts. This interferes with meaningful learning and cause misconceptions which subsequently lead to underachievement in the subject.

The histogram in Fig. 1 confirms that the extent of the misconceptions students hold due to cultural influence is substantial. This finding is in line with those of [15,16] that students consider new information in the context of their prior knowledge and worldviews and that it takes a confrontation between these new and existing ideas and their resolution for meaningful learning to be achieved which according to [2,1], result in misconceptions. [1] further reported that new concepts cannot be learned if alternative models that explain a phenomenon already exist in the learner's mind except a forum is provided for students to confront their misconceptions, reconstruct and internalize their knowledge based on scientific models.

Table 2 further shows that misconceptions do not only exist but that there is a significant relationship between the mean scores of Biology students and the cultural practice-related misconceptions they hold. This is so because according to [7], learners who have had themselves firmly established in their traditional belief systems are likely to find the study of Science rather bewildering because of the likely clash between their anthropomorphic view of their world and the mechanistic views presented in Science. [17,9,18] also found that the cultural environment in which Science is taught significantly affects its learning. The results of this study are therefore pointers to the fact that cultural practices which are at variance with Biology concepts and which persist even with years of teaching and learning, can cause misconceptions which can lead to underachievement of Biology students.

Results in Tables 3 and 4 reveal that misconceptions due to cultural influence had significantly more influence on the achievement of male respondents than on their female counterparts. This may be because the male folks are more attached to their cultural beliefs as they are the ones to enforce the penalties against the women folks. Thus, the more female enlightenment, the less the traditional stranglehold on them. Hence the finding of this study disagrees with [13,19], who reported that girls are more superstitious than boys because many of the cultural practices and restrictions are directed more at females than at their male counterparts. Interestingly, [18] and [20] statistics of results on gender basis (2003-2010) reveal that there is no significant difference in male and female students' mean achievement in Biology. This may be explained by the finding of [18] that a favourable learning environment bridges the gap that exists between the achievement of male and female Science students.

## 5. CONCLUSION

From the findings of this study, we can conclude that Biology students bring their cultural practices into their classes which can lead to misconceptions and underachievement. There is a significant relationship between the mean achievement of senior secondary Biology students and the cultural practice-related misconceptions they hold. Female students who held fewer misconceptions performed better than their male counterparts. This means that if cultural practice-related misconceptions are maturely understood, it will result in better achievement of senior secondary Biology students.

## 6. RECOMMENDATIONS AND IMPLICATIONS

Based on the findings of this study, workshops, seminars and refresher courses should be organized for serving Biology teachers on how to correct identified misconceptions. This will enhance scientific values like critical mindedness and understanding of Biology concepts. Authors of Biology textbooks should make extra efforts to use identified cultural practices and related misconceptions to illustrate Biology concepts in order to explain them adequately and promote meaningful learning. Similar studies should be carried out in other Nigerian and African communities for the purpose of comparison and to broaden the empirical base of this study.

The implication is that gradually more people will find scientific explanations more plausible and acceptable than their cultural beliefs and practices. This will modify the influence of superstitions and adherence to taboos, worldviews and beliefs. Eventually, there will be reformation of the traditional religion, culture and society and enhanced achievements in Biology.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

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