

# The Views of Students on the Integration of Indigenous Industrial Activities in the Teaching and Learning of Integrated Science

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## Abstract

The main aim for this study is to investigate the views of students exposed to teaching science by integration of indigenous industrial activities in the teaching and learning of selected concepts of matter in the Greater Accra Region of Ghana. The study concentrated on the second year Junior High School students of Kaneshie Kingsway '2' JHS of Kaneshie Kingsway Cluster of Schools in the Okaikoi South Metro of the Greater Accra Region of Ghana. The study employed posttest-only non-equivalent control group design of the quasi-experimental research design. The researcher employed the purposive sampling technique for this study, making up of 43 males and 47 females. The instruments used for collecting data for this research were test, questionnaire and semi-structured interview schedules. The findings from this research indicated that students have positive view about the usage of teaching science by integration of indigenous industrial activities in the teaching and learning of selected concepts of matter.

**Keywords:** Indigenous Industrial Activities, Traditional Approach, Indigenous Knowledge, Enculturation.

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## Introduction

Every traditional society of the world possesses a form of science or technology which is employed in indigenous practices geared towards the satisfaction of basic needs. These informal practices may be useful even in the face of modern science and technological advancements (Ogunniyi, 1988; Samuel, 1996). Instead of rendering them obsolete in these societies, they can be refined and integrated in the knowledge and techniques of modern science. Because they constitute direct experiences with the immediate environment and with the natural world, they may be very useful to teachers and learners in enriching classroom science experiences and thereby facilitating teaching and learning.

Formal and informal sciences interact with one another. In Nigeria, both are practised in different contexts and their linkage is advocated (Mejeha, 1992; Animola, 1992; Seweje, 2000). For this to become a reality in Nigerian, the National Policy on Education (NPE) of 1977 categorically introduced indigenous knowledge and technologies into the curriculum from such diverse fields as traditional arts and crafts, traditional cosmetics, traditional food systems and medicine, knowledge of the environment, and African civilization (Federal Republic of Nigeria, 2004). Although this perspective may seem retrogressive considering the present pace of global scientific and technological advancement, the motive is crucial in orientating learners to perceive science as action taking place daily in the environment.

Children acquire indigenous concepts of the natural world from the communities in which they live. They also develop their own concepts and explanations about natural phenomena from the environment. Children's conceptions and views of the natural world are products of socio-cultural influences as well as individual construction (Wertsch, 1991). Science education, which is seen to directly deal with the natural world, could play a major role in shaping children's conceptions and world views. However, in the science classroom, children's indigenous conceptions and world views may sometimes be incompatible with scientific knowledge and the scientific world view. Contemporary view holds that an African is operating in two worlds when it comes to the learning and practising of Western Science and Technology. Based on this view, it is apparently obvious that the curriculum materials drawn out to teach science and other science related subjects to African

children must have the recognition for these “two worlds”.

A great concern has been raised about the fact that the teaching and learning of science in African schools has been divorced from the variety of science and technology concepts in indigenous, informal and formal industrial activities within learners’ environment, of which they may have prior knowledge. Learning is a process of building on existing knowledge base. The activation of learners’ prior knowledge and experiences refers to cueing the memory of concepts or ideas and situations and bringing these to the forefront to be utilised by learners (SACOST, 2008). For any effective teaching and learning to occur, the knowledge and personal experiences of learners need to be first activated.

There are a lot of indigenous industrial activities that the learner may be aware of in his or her community. Some of these are “*pito* and *burukutu*” brewing, soap making, batik making, tie and dye making, blacksmithing, shea butter or oil extraction from nuts and seeds, herbal extraction, *kenkey* making, beads making and leather making, to mention a few. Students see these activities or practices carried out, but never know how the processes in there are related to the science studied at school. Realising the importance of indigenous technologies in science teaching, Anamuah-Mensah (1987) advocates the integration of indigenous technologies in the teaching of science. As a consequence, a Centre for School and Community Science and Technology (SACOST) was established by African Forum for Children’s Literacy in Science and Technology (AFCLIST) and nested at University of Education, Winneba Since 2000. The focus of the Centre is to promote the use of indigenous technologies in the teaching and learning of science in Ghanaian schools. Many scholars like Anamuah-Mensah (1987), George (1988), Aikenhead (1997a) and Anthony-Krueger (2010) have argued in favour of the efficacy of the use of the indigenous technologies in science teaching and learning process to improve science learning outcomes. Anthony-Krueger (2010) showed that at higher levels of Bloom’s Taxonomy in the Cognitive domain (comprehension, application, analysis and synthesis) students in selected Junior High Schools in the Upper West Region of Ghana performed better in science.

Linking formal science and outside the school experiences within the community is based on the constructivist perspective of the social construction of knowledge (Wheathey, 1991). Constructivism in science is about the theory of construction of mental processes that make children give meaning to what is learned and apply it to their daily lives (Wheathey, 1991). This suggests that, the present traditional ‘trial and error’ instructional method used in teaching integrated science in Ghanaian JHS does not lead to conceptual understanding. This has made students in indigenous societies around the world have, for the most part, demonstrated a distinct lack of enthusiasm for the experience of schooling in its conventional form (Battiste, 2002). This is an aversion that is most often attributable to an alien institutional culture, rather than any lack of innate intelligence, ingenuity, or problem-solving skills on the part of the students (Battiste, 2002). The curricula, teaching methodologies and assessment strategies associated with mainstream schooling are based on a worldview that does not adequately recognize or appreciate indigenous notions of an interdependent universe and the importance of its place in their societies (Kawagley, Norris-Tull & Norris-Tull, 1998).

Ghanaians demonstrate informal science in diverse ways in the natural world. These indigenous activities or practices are hidden or unrecognized but they can be sought out for probable articulation with formal science in order to enrich classroom learning experiences. The immediate challenge is to identify aspects of these practices that can be blended or integrated with formal science knowledge in order to sensitise society and science educators, and encourage local and global awareness. Therefore, this study is to investigate the effect of integrating indigenous industrial activities in the teaching and learning of matter.

### Statement of the Problem

One of the ever surfacing observations made by many science teachers is JHS students’ inability to perform creditably in application science questions. This does not only reflect in their class exercises and terminal examinations, but also in their performance at the Basic Education Certificate Examination (BECE). For instance the Chief Examiner’s Report of BECE (2001) indicates this fact by testifying that candidates of general science were lacking the ability to apply scientific concepts and principles in solving problems.

Moreover, observations have shown that African school graduates have not been applying the knowledge they acquire from the science classroom in daily practical activities. The above observation is often seen as an attitudinal lapse, but this could be related to the indigenous conception of the African which some authors describe as being very peculiar to their own ways of life (Anamuah-Mensah, 1987). Perhaps these conceptual peculiarities are the only unique thing of the African which may account for the observed attitudinal lapse.

It is a fact that prior conceptions of learners influence teaching and learning. Studies have shown that taking accounts of pupil’s prior knowledge during teaching is one of the strategies which enhance learners’ ability to adapt learning to practical settings (Rivet & Krajcik, 2002). In the African context these prior conceptions are often related to the indigenous ideas/ conceptions. However, most African science curricula systematically ignore the spectacular achievements of the African people in science (Hodson, 1993). Therefore, science taught in African schools is completely disjoined from indigenous concepts and hence teachers scarcely make any effort

to alter pupils' prior conceptions to make room for functional adaptation. When children's prior conceptions are known and respected, plausible alternatives could be offered to them to make a negotiation. Hence the knowledge of children's prior conceptions from their indigenous settings can play an important role in learning outcomes.

It is equally important to note that there are many indigenous conceptions that conflict with the Western Science that is taught in African schools. According to Fafunwa (1972), and Osborne and Wittrock (1985) the conflict between these two bodies of knowledge is most likely to:

- i. Make learning of science more difficult.
- ii. Prevent learners from practising science concepts learnt.
- iii. Affect teachers' way of teaching science concepts.

If the above are true, then this might account for learners' tendency to label science as being masculine and difficult. This psychological perception alone has a serious repercussion in learners' attitude towards science learning and application. In fact, since the African teachers themselves were taught without the appropriate alteration of their indigenous conceptions or ideas, they themselves will have some level of imbalance in their convictions with regard to scientific conceptions. This will invariably affect the way they lay emphasis on the application of the science concepts they teach. The most pressing observation in Ghana in particular is the existing gap between knowledge and practice/application. The activation and use of prior knowledge is therefore the first step towards any effective teaching-learning process. Hence, this study is therefore designed to investigate the views of students exposed to teaching science by integration of indigenous industrial activities in the teaching and learning of selected concepts of matter.

### Purpose of the Study

This study was designed to find out the views of students exposed to teaching science by integration of indigenous industrial activities in the teaching and learning of selected concepts of matter.

### Research Questions

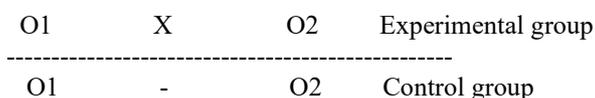
1. What are the views of students exposed to teaching science by integration of indigenous industrial activities in the teaching and learning of selected concepts of matter?

**Ho 3:** There is no significant difference between the views of students exposed to teaching science by integration of indigenous industrial activities in the teaching and learning of selected concepts of matter in integrated science and their achievement in integrated science.

### METHODOLOGY

This study employed posttest-only non-equivalent control group design of the quasi-experimental research design. This research design was used because the study investigated the effect of two teaching approaches: integrating indigenous industrial activities in science teaching and the traditional approach to science teaching on experimental and control groups, which have not been equated by randomization.

In employing this design, two intact classes (Form 2<sup>A</sup> and 2<sup>B</sup>) were used with one, as an experimental group and the other, control group. Both groups were assessed with same baseline test items in order to determine their academic standard. Form 2<sup>A</sup> class obtained the lower mean mark of 6.45 and was made the experimental group while 2<sup>B</sup> class which had the higher mean mark of 6.81, was designated the control group. The two classes were given different treatments after which they were assessed with post-test items to ascertain the effect of the treatments. The design is further explained in the model below.



The abbreviations and symbols used in the model have the following meanings:

O1 means assessment 1 (baseline test)

O2 means assessment 2 (post-test)

The symbol 'X' implies treatment of integrating indigenous industrial activities in the teaching/learning of matter (experimental group).

The symbol '-' implies using the traditional science instructions in the teaching/learning of matter (control group).

The dotted line indicates that there is no random assignment of subjects to the groups.

### Population

The study (accessible) population was all second year Junior High School students of Kaneshie Kingsway '2' JHS of Kaneshie Kingsway Cluster of Schools in the Okaikoi South Metro of the Greater Accra Region of

Ghana.

### Sample and Sampling Procedure

The researcher employed purposive sampling procedure in selecting the school for the study. The purposive sampling technique, also called judgment sampling, is the deliberate choice of subjects due to the qualities they possess. It is a non-random technique that the researcher decides what needs to be known and sets out to find subjects who can and are willing to provide the information by virtue of knowledge or experience (Bernard, 2002; Lewis & Sheppard, 2006). However, purposive sampling can be applied to research in a number of ways, such as in preliminary studies where the researcher is still testing the feasibility of a proposed study (Poggie, 1972), sampling informants with a specific type of knowledge or skill (Prance, 2004; Vargas & van Andel, 2005; Li, Long, Liu, Lee, Guo, Li & Liu, 2006), comparisons of cultural practices (Neupane, Shaarma&Thapa, 2002) etc.

Only Kaneshie Kingsway '2' Junior High School was sampled for the study. The sample for the study was two intact classes of second year (2<sup>A</sup> and 2<sup>B</sup>) Junior High School students in the selected school. This was made of 43 males and 47 females. The use of second year Junior High School students was dictated by two factors. Firstly, second year students were expected to have prior knowledge on the topic 'matter' from first year. Secondly, concepts on the topic 'matter' featured prominently in the second year integrated science teaching syllabus (2007) and students were studying it at the time of the research.

### Instrumentation

The instruments used for the collection of data in this study were test, questionnaire and semi-structured interview schedules.

### Test

Two test instruments were used for the collection of data for the study. These were the baseline test and post-test. Each test instrument question was of twenty items, comprising:

- ten (10) multiple-choice items;
- five (5) true/false items and
- five (5) short-answer/completion items.

### Baseline test

A baseline test (Appendix A) was basically used to classify the two intact classes into control and experimental groups. It was administered to all participants in their respective classrooms by the researcher and the questions were based on what they were taught on the topic matter in the previous year (form one). The class that obtained the lower mean mark in the baseline test was chosen as the experimental group and that with the higher mean mark as the control group. This was to prevent the situation where any observed positive effect might be as a result of the pre-existing academic difference between the classes.

### Post-test

Lessons were prepared linking indigenous industrial activities to scientific concepts by the researcher. The experimental group was then taught some selected concepts using these lessons for a period of six weeks. The selected concepts included states of matter, properties of the states of matter, change of states of matter, mixtures, separation of mixtures, metals and non-metals. The indigenous industrial activities that were integrated into the teaching of these concepts were *kenkey* making, *gari* production, blacksmithing, leather making and beads making.

The control group was however, taught the same topics using only the traditional approach to teaching and learning of integrated science for the same period by the researcher. Subjects in both experimental and control groups were then tested with a Post-test Instrument (Appendix B) - Students' Achievement in Integrated Science Test (SAIST). The outcomes of the test (SAIST) were used to answer Research Questions 1 and 2.

### Questionnaire

The students' questionnaire was made up of ten (10) items (Appendix C) and, were close-ended and on a five-point Likert type scale. The students' questionnaire was used to find out how the integration of indigenous industrial activities in the teaching and learning of selected concepts on *matter* had influenced the attitude of JHS students towards the learning of integrated science.

### Interview Schedule

Semi-structured interview (Appendix D) was employed as one of the main tools in this research to collect more information from the pupils. This is because, where a quantitative study has been carried out, qualitative data can

be used to validate particular measures or to clarify and illustrate the meaning of the findings, and to see whether their experiences concur with the ratings on the measure (King, 1994).

The researcher interviewed twenty (20) students from the experimental group. These students were chosen at random using simple random technique and gender balance was taken into account. In all ten males and ten females were sampled for the interview. The students' interview was made up of ten (10) items. The interview formed the secondary source of data to supplement the questionnaire, which was supposed to be the primary source of data. It was used to determine whether the respondents' (students) expressed views were consistent with their questionnaire responses, and finally it assisted in interpreting and explaining the findings.

### Validity and Reliability of the Instrument

Students test, questionnaire and interview were developed in consultation with peers and supervisors providing expert advice to enhance content validity of the instrument. In order to ensure that the research instruments produce scores that are stable and consistent and their test items and questionnaire items are devoid of any ambiguities (Creswell, 2008), the test items were pilot-tested at the Kaneshie Kingsway '1' JHS at Kaneshie in the Greater Accra Region which is outside the accessible population. The above school was used because it has some attributes similar to the accessible population of the study. The test items was personally administered to twenty (20) students in the pilot school and the result was analysed afterwards to determine the validity of the instrument and helped revise items that needed correction. But questionnaire and semi structured interview items were examined by experts in science education who had undertaken research involving classroom studies and indigenous industrial activities and some colleagues for peer review. Their responses varied in length and detail, but in general, were of a positive and supportive nature. The revised questionnaire and semi-structured interview items were then used to collect data on attitudinal changes students' exposed to teaching science by integration of indigenous industrial activities exhibit.

On the days that data were collected, the Subjects were made to understand that the questionnaire, baseline test, post-test and interview were in no way a test and that what was required of them was to answer in a sincere manner. The researcher took the respondents through the twenty items on the baseline test and post-test, and ten item questionnaire explaining and citing examples to bring home meaning to statements which seemed difficult to be understood by the respondents.

Cronbach alpha co-efficient was used to determine the reliability of the instrument after the pilot-testing. The cronbach alpha co-efficient of the baseline test was 0.838, that of the post-test was also 0.771, which indicates that the tests were reliable, (Appendix E). A test with a Cronbach alpha coefficient of 0.7 indicates that the test is 70% reliable in practice and any reliability co-efficient equal or greater than 0.7 is acceptable. According to Borg, Gall and Gall (1993) coefficient of reliability values above 0.75 are considered reliable.

### Results /Discussion

#### Analysis with respect to research question one

**RQ 1** What are the views of students exposed to teaching science by integration of indigenous industrial activities in the teaching and learning of selected concepts of matter?

#### Analysis with respect to research question one

**RQ 1:** What are the views of students on the integration of indigenous industrial activities in the teaching and learning of integrated science?

**Table 1: Coding Manual of Students' Responses on Interview Items**

S/N	Themes/Categories of Responses	Number of Responses (N=20)	
		Affirmative Responses	Negative Responses
1	Students' preference for integration of indigenous industrial activities in science lesson	20 (100%)	0 (0%)
2	Relevance of concepts to daily life activities	20 (100%)	0 (0%)
3	Preference of new method to science to learning	20 (100%)	0 (0%)
4	The efficacy of new method on achievement	20 (100%)	0 (0%)
5	New method is time consuming	8 (40%)	12 (60%)
6	Augmenting class participation through integration of indigenous industrial activities	20 (100%)	0 (0%)
7	Contribution of indigenous educational visits / TLM	20 (100%)	0 (0%)
8	Ability of new method to enhance retention of what is learnt.	20 (100%)	0 (0%)
9	Use of Science concepts to explain indigenous ideas.	18 (90%)	2 (10%)
10	Use of indigenous prior ideas in learning science	15 (75%)	5 (25%)

A look at Table 1 reveals that all the students (100%) in the experimental group were of the view that the

science lessons taught with integration of the indigenous were preferred to the previous science lessons. Again, 100% of the students attested that the science concepts learned were relevant to their daily activities at home (Table 1). From the data in Table 1, each one of the students prefer science teachers to use a method that links science learned at school to the indigenous (local) activities within the society. As indicated in Table 1, each and every one of the students was of the view that the new method used would help them to improve upon their achievement in the second class exercise. However, 60% of the students' responses indicated that the new method was time-consuming, but 40% of them thought the science periods were enough for the new method. As captured in Table 1, the entire students believed that the new approach encourages students' class participation and easy retention of learned concepts. On the other hand, all the respondents (100%) considered the educational visits, the use of videos and charts on indigenous activities as major contributing factors to their easy understanding of the science concepts. As found in the same Table 1, a total of 90% of the students had prior knowledge (local knowledge) that could be used to enhance the explanation of scientific concepts such as thunder and lightning, and giving of birth to twin, while 10% did not have. In addition, 75% of the interviewees stated some scientific concepts and their corresponding indigenous prior ideas which facilitated their understanding of the concepts whereas 25% were not able to do.

### Analysis and testing of hypotheses (1)

**Ho 1:** There is no significant difference between the views of students exposed to teaching science by integration of indigenous industrial activities in the teaching and learning of selected concepts of matter in integrated science and their achievement in integrated science.

**Table 2: Relationship between Views and Achievement**

		Views in integrated science
Achievement of students in post-test	Pearson Correlation(r)	-0.144
	P-value	0.363
	N	42

The result of Table 2 reveals a Pearson's correlation (r) between experimental group students' views in integrated science and their achievement in integrated science of -0.144. According to Black (1999),  $-0.3 < |r| < 0.3$  signifies a weak (little) or no correlation. However, this correlation was not statistically significant ( $p=0.363$ ). There is therefore no correlation between experimental group students' views in integrated science and their achievement in integrated science.

### Students' views on the integration of indigenous industrial activities in the teaching and learning of integrated science

Reflections from students' responses on interviews indicated that the students' opinions about the integration of indigenous industrial activities in science teaching and learning were positive (Table 1). In the views of the constructivists, learners should no longer be passive recipients of knowledge supplied by teachers (Fosnot, 1996). From this perspective, learning as a process of acquiring new knowledge, is active and complex. It should be an active interaction between teachers and learners, with learners making sense of what is taught by trying to fit these with their own experiences. An emphasis on constructivism to promote children's conceptual knowledge in science lessons is by building on their prior understanding, active engagement with the subject content, and applications of real world situations (Stofflett&Stoddart, 1994). Hence, the indigenous industrial activities in the community should be actively integrated in the teaching/learning process if the teacher should make any headway in the teaching, and the students will learn meaningfully. If students should have reservations and be apprehensive of the kinds of teaching-learning aids that are used in the classroom, meaningful learning cannot take place. At best, students will only be engaging in rote learning to pass their examinations.

### Relationship between students' views and achievement

The results as well revealed that the relationship between students' views in integrated science and their achievement in integrated science was not statistically significant (Table 2). This means that, the achievement of the experimental group students in the post-test did not correlate with their response to the views scale questions. This therefore suggests that, there was no relationship between experimental group students' views in integrated science and their achievement in integrated science. Fuller and Clarke (1994) are of the view that there are other factors such as class size, teachers' experience and qualifications, availability of instructional materials, class attendance, method of teaching and students' learning styles, etc. that influence students' achievement. By implications therefore, views of students towards a subject alone cannot predict their achievement.

## Conclusion

The study revealed that students who were exposed to the integration of indigenous industrial activities in the teaching and learning science developed a higher positive attitude towards integrated science (Table 1). The outcome of the study also indicated no statistically significant relationship between achievement and views of students exposed to the integration of indigenous industrial activities in the teaching and learning of concepts on the topic matter (Table 2).

There was this revelation during the interview session that, in most circumstances, science concepts are taught using lecture, discussion, and illustration methods. This consequently lowers learners' conceptual understanding of science as they study by means of memorisation or rote learning. Several of the interviewees were of the view that they would prefer the use of a teaching approach or strategy that links science learned at school to the indigenous (local) activities within the society. They also indicated that the indigenous activities connected their prior knowledge from home to the school, hence making the learning of science concepts interesting, fun and easy to understand. This further created good learning environment, full of activities, better class participation by students and develop in learners highly positive attitude towards the teaching and learning of science through the use of integration of indigenous industrial activities. Finally, they are of the view that revising of their previous knowledge from their environment or linking the new concept to be learnt to what they know already from their local community help them to remember and also retain the new concept for a very long time.

## Recommendations

Based on the findings of this study, the following recommendations were made:

Teachers should take cognizance of the fact that students' prior knowledge which they activate to begin a new lesson does not only comprise of the science concepts that have been taught previously but also includes the diverse indigenous knowledge the students learn from the society.

Teachers should try as much as possible to link science concepts they teach at school to the day to day activities students engage in at home and also the indigenous industrial activities within the society so as to make science relevant to the students. When this is done, it is hoped that it will whip-up students' interest in science, thus bring about improvement in students' achievement and attitude in science and would also encourage them to study it to the higher levels.

Science teachers should invite indigenous craftsmen, artisans etc. from the indigenous community as resource persons into the school to educate students on the processes and principles applied in some of these indigenous industrial activities in their community. This would whip up students' interest and help them to develop positive attitude towards science.

Students should be encouraged to explore their immediate indigenous environment in order to relate the science concepts they learn in the classroom to the activities they engage in the environment. This could be enhanced by giving students science projects that are related to their indigenous environment.

Teachers should be encouraged to improvise from the indigenous environment in the absence of the real TLM. This can be done by providing teachers hand books which should provide guidelines to that effect.

Furthermore, teachers in the process of their teaching and learning in the classroom should be encouraged to apply the science concepts to the community and also try as much as possible to fill the portion in their lesson note books for application.

Finally, science and technical students should be given letters and assignments that would enable them to visit local craftsmen to interact with them.

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