Exploring the impacts of Students' Interaction with Indigenous Craftsmen on their Attitude and Interest in pursuing Physics related Careers

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Subject/Problem

Emerging literature reveal that students generally regard physics as conceptually difficult, abstract, uninteresting and "only suitable for highly exceptionally talented and gifted students (Williams, Stanisstreet, Spall, Boyles & Dickson, 2003; Angell, 2004; Barmby & Defty, 2006; Checkley, 2010). In Nigeria, evidence shows that low enrolment and massive failure in public examinations in physics is indicative that many students have difficulty learning the subject (Erinosho, 2013). Even though many factors have been identified as responsible for this low enrolment and massive failure in public examinations, the current study focuses on how to improve students' attitude and interest towards the subject through activity-driven techniques using real life experiences. Attitude and interest are both affective constructs and have been known to far reaching influence on students participation in science related activities and projects with the resultant positive impact on learning, achievement and future career choices in sciences (Freedman, 1997; Webster & Fisher, 2000). Yara, (2009) defines attitude towards science as interest or feeling towards studying science or the scientific approach assumed by an individual for solving problems, assessing ideas and making decision. He reports that many students develop negative attitudes to science learning, probably because teachers are unable to satisfy their aspiration or goals. In fact studies have reported that the strongest factor affecting students' decision to choose to study physics and the attendant achievement in physics is their overall attitude towards physics (Abiakwo, 2002; Abak, Eryilmaz, & Fakioglu, 2002; Akpinar, 2006; Capri, Ozkendir, Ozkurt & Karakus, 2012; Capri, 2013; Drake, 2009). This is in addition to the steady decline in students' interest towards Physics as they progress in their study of physics (Murphy & Whitelegg, 2006; Reid, 2003). The most pronounced decline in students' interest towards Physics, especially for females, is associated with the increase in negative feelings towards the Physics subject in school (Murphy & Whitelegg, 2006). In fact emerging literature reveal that there is mounting decline in young people's interest in pursuing scientific careers (Department for Education, 1994; Osborne, Simon & Collins, 2003; Lepkowska, 1996) and this has been attributed to the increasing negative attitudes towards science (Dearing, 1996; Robert, 2002). This situation has the potential for impacting a nation's economic prosperity negatively since a nation's scientific and technological development depends on how well educated and trained its work force is, especially in physics specifically and sciences in general. The foregoing problem serves as a motivation for this study that sought to explore the impacts of students' interaction with indigenous craftsmen on their attitude and interest in pursuing physics related careers.

Though there is no conclusive evidence that support the notion that inquiry based instructional strategies significantly generate positive attitude and increased interest in the learning of physics, there is consensus that learning science in an informal environment that supports free choice science learning, and everyday experiences, contributes to studentspositive attitude, engagement, understanding and interest in science (Bell, Lewenstein, Shouse & Feder, 2009).

This study therefore sought to discover how providing physics students with the opportunity to interact with indigenous craftsmen in their mechanic workshops impacted their interest and attitude towards physics. Additionally, the study sought to explore the interaction of this experience with their science career choices.

1. What impact does the senior secondary school physics students' interactions with local indigenous craftsmen have on their attitude towards physics?
2. What impact does senior secondary school physics students' interactions with local indigenous craftsmen have on their interest in pursuing physics related career?
3. How did the students perceive the opportunity to interact with local indigenous craftsmen?

Two research hypotheses guided the conduct of this study:

1. There is no significant effect of senior secondary school physics students' interactions with local indigenous craftsmen on their attitude towards physics.
2. There is no significant effect of senior secondary school physics students' interactions with local indigenous craftsmen on their interest in pursuing a physics related career

Theoretical Framework

Recent studies corroborate the idea that sciences are better taught using a combination of outdoors and in-classroom experiences. This is based on the findings that science education is most effective when situated within students' natural environment using the most natural method that help students explore the learning situation (Aikenhead & Ogawa, 2007; Anderson, Kisiel & Storksdieck, 2006). This according to researchers (e.g. Brown, 2004; Salmi, 2003; Tobin, 2006) is critical as it gauges the way the students participate in the learning, their interest, attitude and achievement. Students' attitude towards science is essentially a measure of expressed preferences and feelings about science. This attitude may not necessarily be related to behaviours exhibited by the students, even though it is the students' behaviours that are measured. Hence most researchers rely on the theory of reasoned action (Fishbein & Ajzen, 1975), which is concerned with predicting the behaviour as it relates to intentions. This theory helps us to understand that attitude towards doing school science can help us predict the behaviour towards science, and that there is a relationship between attitude, intention and behaviour. In addition, studies (Crawley & Coe, 1990; Oliver & Simpson, 1988) have found that social support from peers and attitudes towards enrolling for school subjects are strong determinants of students' choice to pursue such subjects. This study is premised on the belief that when science education is conducted in a participatory, placed-based and a combination of in-classroom and out-of-classroom environment the students' positive attitude and interest towards science might be increased. This is based on the theory of reasoned action, which ties positive attitude and behavior to how strongly students perceive the benefits of the experience. This study is based on the presumption that students' willingness to change their attitude towards physics and to develop positive disposition towards science related career depends on their perception of how beneficial and rewarding the visit to the mechanic workshop is to them.

Design or Procedure

A mixed-methods approach to data collection and analysis was used for this study. Qualitative method was used to complement the weaknesses that may occur from using only a quantitative approach. The quantitative part of the study employed both quasi-experimental non-randomised pre-test, post-test, non-equivalent control group and descriptive survey designs. Randomization was not possible because school authorities showed reluctance to use a large proportion of the school in the study. Hence, intact classes only were used. The study sample consisted of one hundred and sixty students (70 from two experimental schools and 90 from the control schools) selected from four intact co-educational senior secondary school physics classes. Physics Students Attitude Questionnaire (PSAQ), Physics Students Interest Questionnaire (PSAQ) and Student Perception Interview Schedule (SPIS) were used to collect data for this study. The reliability coefficients of the Physics Students Attitude Questionnaire (PSAQ) and Physics Students Interest Questionnaire (PSAQ) were found to be 0.86 and 0.81 respectively. The face validity of the instruments was determined by three experienced university physics educators and two seasoned Senior Secondary teachers. The qualitative data was collected using a structured student perception interview schedule. Prior to the beginning of the treatment, permission of the school authorities for the use of their schools' facilities and selected students was sought and granted.

Two groups namely, experimental and control groups were first pretested using the Physics Students Attitude Questionnaire (PSAQ), Physics Students Interest Questionnaire (PSAQ) just before the commencement of the treatment. The researchers with the help research assistants undertook the administration of the pretest, in two weeks. Thereafter, the treatment began with the experimental groups exposed to real life learning activities by interacting with mechanic craftsmen as they showed and discussed six different types of machines at the local craftsman's workshop. The local craftsman who had been briefed on details of the students visit to the workshop undertook the delivery of instruction at the workshop. They explained the functions of each machine and how they are used. Thereafter, the students were given tasks to perform and asked to work on them using the appropriate machines. The control group was taught the same topics as the experimental group but was taught the concepts by lecture method. To provide the required instruction to experimental group the research assistants used an predesigned instructional guide. The treatment was accomplished in four weeks. At the end of the treatment, the Physics Students Attitude Questionnaire (PSAQ) and Physics Students Interest Questionnaire (PSAQ) were given to the students.

In order to measure the impacts the senior secondary school physics students' interactions with local indigenous craftsmen had on their attitudes and interests in pursuing physics related careers, questionnaires on attitude and interest were given to them at the end of the interactions. Students' perceptions of their experiences at the mechanic workshop as well the new method of instruction were also obtained. Students were given freedom to express their views in their own words and this provided reliable, comparable qualitative data (Cohen & Crabtree, 2006) to triangulate with the quantitative data. Observation and videos were used to capture the rich interactions that went on between students and the local indigenous craftsmen at the workshop sites.

Findings and Analyses

Quantitative data was analysed using both parametric and Pearson's correlation statistics using the Statistical Package for Social Sciences (SPSS). While means and standard deviations were used to answer the research questions, the data for the null hypotheses, were subjected to descriptive and Pearson's correlations statistical techniques. Analysis of the qualitative data was done through narrative techniques by transcribing verbatim the students' responses to the structured students' perception interview questions. The structured interviews of both teachers and students were used to compliment field notes from observations.

Result

Results of the descriptive statistics using mean and standard deviation showed that there is a positive impact on the students' attitude towards physics, and their interest in the choice of physics related careers of the visit and interaction of the physics students with the local indigenous craftsmen. The result of the experimental group: mean, (31.77); standard deviation, (4.30) and of the control group: mean, (29.52); standard deviation (3.29) showed that students' who visited and interacted with the local indigenous craftsmen exhibited enhanced positive attitude towards physics and their future aspiration and choice of physics related careers compared to those who did not participate in the interaction with the local indigenous craftsmen. Also, study results showed that the visit and interaction of physics students with the local indigenous craftsmen had positive impact on students' interest in choosing physics related careers. Results of the experimental group: mean, (32.14); standard deviation, (3.60) and of the control group: mean, (29.09); standard deviation (3.21) served as evidence to support that students' who visited and interacted with the local indigenous craftsmen exhibited enhanced positive attitude towards their future aspirations and choice of physics related careers compared to those who did not visit and interact with local indigenous craftsmen. To further determine if there was any relationship between the students' career choices, their attitudes and interests as a result of their interactions with the indigenous local craftsmen, a correlation analysis was conducted. As shown in Table 3, there were significant positive correlations between the students' career choices and students' attitudes ($r = 0.399$, at $p = 0.001$) towards physics. Additionally, there was significant positive correlations between the students career choices and the students' interests ($r = 0.414$, at $p = 0.000$), but there was no significant correlations between students' career choices and students' interests and attitudes towards physics and physics related career choices in the control group ($r = 0.226$, $p > 0.05$ & $r = 0.133$, $p = 0.226$, $p > 0.05$ respectively).

From the qualitative result, the students perceived their interaction with the indigenous craftsman as an opportunity strongly influenced their future physics related career choices. In addition, considerable level of impact the interaction had on their attitude and interest towards choosing a future physics related career choices was quite tremendous.

Fig. 1: Students' physics future career choices

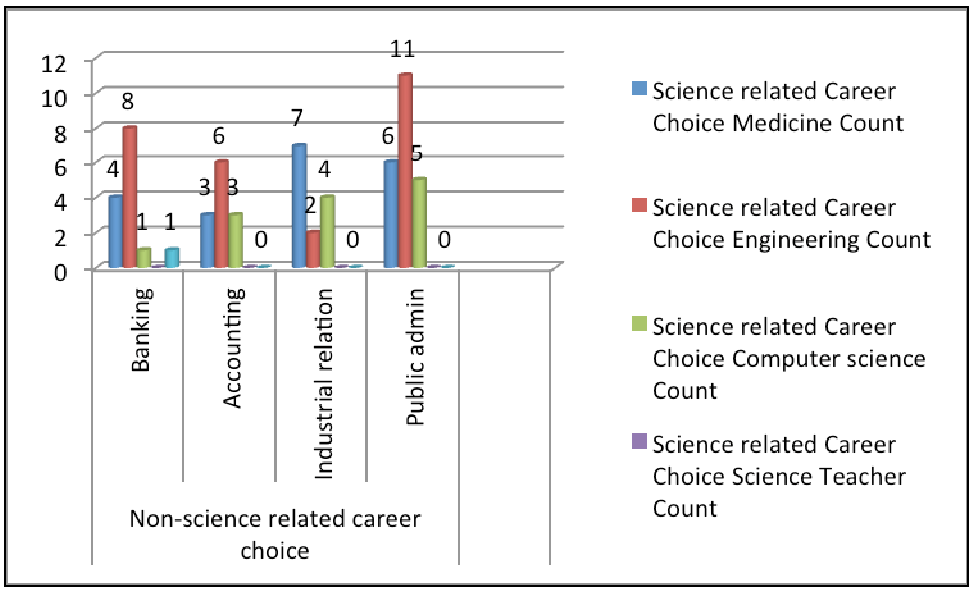

Figure 1 shows the students career choice as a result of their interaction with indigenous craftsmen. Out of the 70 students that participated in the study only one chose a non-science related career choice. In addition, 27 students chose engineering, 20 students chose medicine, and 13 students chose computer science while no students like being a science teacher.

Discussion/ Conclusion

Findings from this study revealed that there are significant positive correlations between experimental students science related career choices and their attitude towards physics. Students' favourable dispositions towards physics related careers as evidenced in the significant positive relationship found between students' interest in physics and their choice of related careers after interacting with indigenous craftsman is a testament to the efficacy of this kind of science instruction. Furthermore, the fact that experimental group students' understanding of the concept of machines improved significantly as a result of their visit to the indigenous craftsman's workshops compared to those who did not visit and interact with indigenous craftsmen not corroborates this result but supports prior studies that reported that science education is most effective when situated within students' natural environment using the most natural method that help students explore the learning situation (Aikenhead & Ogawa, 2007; Anderson, Kisiel & Storksdieck, 2006). This is even more telling, given that most students in the experimental group showed interest in becoming engineers and medical doctors. The following are some of the excerpts from the perception of their interaction with the indigenous craftsman's:

S_1: The interaction I had was very interesting

S_2: I learnt better at the indigenous craftsman's workshop than I did in the classroom

S_3: I really enjoyed the interaction with real objects

S_4: I will like to continue to learn physics this way

S_5: I saw and used machines in real life as against seeing them in text- books only

S_6: My love or interest to choose physics as a future career has increased

S_7: The interaction was very creative and inspiring

These remarks indicate students were pleased with the whole experience and support the notion that the visit probably enhanced their attitude and improved their interest towards choosing science related careers.

Contribution to Teaching and Learning of Science and to NARST

This study provides additional credence to previous studies that support outdoor learning. Science teachers should adopt this method of instruction that allows students to experience and make connections between their real world and what is being taught in the classroom. Perhaps, exposing students to this kind of science instruction holds promise in improving students' attitude toward as well as rekindling their interest in the study of science. Additionally, this study has provided reasoned action dimension on science research that seeks to discover was to improve students' attitude towards science while rekindling their interest. NARST participants will benefit from pursuing this line of science education research. The finding is supported by that Akinbobola (2015) who reported that good instructional strategy could enhance students' attitude towards the subject.

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