Pre-Service Chemistry Teachers' Attitude and Conceptual understanding of Matter concept in Delta State, Nigeria

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Abstract
The study investigated pre-service chemistry teachers' attitude towards chemistry and their conceptual understanding of the matter concept. The sample of the study consisted of available 122 pre-service chemistry teachers from Delta State. The study adopted an ex-post facto research design. Four (4) research questions and one (1) null hypothesis guided the study. Two instruments were used for data collection: Attitude towards chemistry scale and Matter concept Test. Descriptive statistics of frequency counts and percentages and Pearson Product Moment of Correlation were used to analyse the data collected. The findings of the study among others showed that the subjects had a negative attitude towards chemistry and had no conceptual understanding of matter. The results also showed a positive relationship between attitude and their conceptual understanding of matter. It was therefore recommended that teacher educators should embrace appropriate instructional strategies and methods in their various institutions that will foster and encourage the promotion and development of students' positive attitude towards chemistry in order to enhance conceptual understanding.

Keywords: Attitude towards chemistry, conceptual understanding, matter concept.

Introduction
Attitudes, like academic achievement are important outcomes of chemistry education at all levels of education. The development of students' positive attitudes regarding chemistry as a school subject is one of the major responsibilities of every school teacher after-all how one behaves is more important that what one knows (NERDC, 2008).

Accordingly, Mokoro, Wambiya and Aloka (2014) defined "attitude as an approach, temperament, sensation, situation with regard to a person or thing." Attitude is a hypothetical constructs that indicates an individual's like or dislike towards an item. It may be positive, negative or neutral. According to Oskamp and Schuttz, (2005) attitude is a predisposition to respond in a favourable or unfavourable manner with respect to a given object. Oskamp &Schuttz(2005) described that there are three major theoretical viewpoints of attitudes that have been proposed by social psychologists viz.

i. the tri-component point of view forwards affect, behaviour and cognition as the three component of attitude which is a single entity.
ii. the second view assumes that the term attitude refers to the affective component only and that cognition behaviour are determinants of attitude.
Attitude towards chemistry denote interest or feeling towards studying chemistry. It is the students' disposition towards liking or disliking chemistry. A number of factors have been identified as related to students’ attitude towards science (chemistry). Such factors include teacher's attitude, teacher's method, gender, curriculum content, career interest, cognitive styles, influence of parents among others (Adesoji, 2008; Delmang & Gongden, 2016). Chemistry curriculum commonly incorporate many abstract concepts which are central to further learning in both Chemistry and other Sciences: Chemistry topics are generally related to or based on the structure of matter. Matter concept is a foundation domain in chemistry because the subject of chemistry is a science of matter and students' understanding of matter concept is fundamental to their conceptual understanding of all the chemical concepts in the discipline. Things that surround us are regarded as matter. Matter is anything that has mass and occupies space. The house one lives in, the clothes one wears, the food one eats, the air one breathes in, the water one drinks, stone, wood, plants, and animals including the person writing this article are examples of matter.

Holme, Luxford and Brandriet (2015) arrived at a 5 component definition of conceptual understanding after considering definitions from 1,395 chemistry instructors. According to Holme et al, a student who demonstrates conceptual understanding can:

- transfer being able to identify the concept in new settings; to transfer the idea of the concept to a new setting.
- predict/explains ability to predict or explain observations based on well tested hypotheses systems
- Translate. Understanding how the fundamental interactions of the microscopic particles in a sample of matter give rise to its properties.
- Problem solving or solving problems
- In depth knowledge: deeper level grasp of ideas and theories that is note rote memorization of steps to solve a problem.

Statement of the Problem

Various reasons have been given for students’ dismal performance in chemistry. They include methods of teaching, students’ attitude, teachers’ attitude, and abstract nature of the concepts, misconceptions by teachers and students and students' inability to solve chemical problems. (Delmang & Gongden, 2016). Teachers' attitude and conceptual understanding are major factors that relate to students attitude and conceptual understanding. Teachers’ attitude and conceptual understanding have the potential to either facilitate or inhibit learning and also the development of students' positive attitude regarding chemistry as a school subject is one of the major responsibilities of every school teacher.

Unfortunately, the performance of students in the senior secondary certificate examination (SSCE) has been poor despite the several studies and their recommendations. From 1997 – 2012, the percentages of passes ranged from 23.30 to 50.98. (See appendix A).
Even though a lot of researches has extensively studied students attitude and conceptual understanding, previous researches has focused greatly on senior secondary school students and less attention has been given to chemistry teachers especially pre-service chemistry teachers who are the teachers of tomorrow. If teachers do not show a positive attitude to their subject and do not show mastery of concepts knowledge, they would in turn influence what is taught in schools, and attitude of the students. This may likely perpetuate misconception, poor achievements and negative attitude of the students hence it has become worthwhile to investigate the attitude and conceptual understanding of pre-service teachers.

The Purpose of the Study
The purpose of this study therefore, is to investigate pre-service chemistry teacher’s attitude towards chemistry, their conceptual understanding of the matter concept, and show if there is a correlation between the aforementioned.

Research Questions
Four (4) research questions were raised to guide the study.
1. What is pre-service chemistry teachers’ attitude towards chemistry?
2. What is their attitude by sex
3. Do pre-service chemistry teachers have conceptual understanding of the matter concept
4. What is their conceptual understanding of the matter concept by sex

Null Hypothesis
Ho: There is no significant relationship between pre-service chemistry teachers’ attitude towards chemistry and their conceptual understanding of the concept of matter

Methodology
An ex-post facto design was adopted for the study. The total population for the study was all pre-service chemistry teachers in Government owned university and Colleges of Education as at the time of study. The sample for the study was made up of available respondents. The only Government owned University and two Colleges of Education in Delta State. The sampled subjects consisted of available 122 pre-service chemistry teachers 2014/15 academic year. Out of the 122 subjects, 52 were from the only government owned University and 70 subjects from two government owned Colleges of Education. The institutions although are at different levels of Education, are responsible for the production of quality teachers in Nigeria.

Instrument for Data collection
Two instruments were used for data collection: Attitude towards chemistry Scale (ATCS) and concept of matter test. Attitude towards chemistry scale was developed by Salta and Tzougraki (2004) and adapted by the researcher. This instrument consisted of Thirty (30) statements to which respondents were required to indicate their dispositions. The thirty (30) statements were attached to a four point Likert Scale ranging from strongly Agree to strong Disagree: Fifteen (15) of the statement were considered to be favourable towards chemistry and thus agreement with them indicated a positive attitude, and the other fifteen (15) unfavourable towards chemistry that is agreement with then indicates a negative disposition.
Concept of matter test was a two tier diagnostic multiple-choice test. It was made up of twenty (20) items. Concept of matter test was developed by the modeling institute of the Arizona state University. It was adopted and modified by the researcher. The first part of each of the twenty
items consisted of a multiple choice content question. The second part of each item contained a set of four possible reasons for the answer. The two-tier diagnostic multiple choice instrument produced the right or wrong answer and in addition produced reason(s) for the choice made which helped to reveal the understanding or otherwise of the matter concept by the subjects.

Data Analysis and Results

Research Question 1: What is pre-service chemistry teachers’ attitude towards chemistry?

Table 1: Frequencies of positive and negative responses

<table>
<thead>
<tr>
<th>Subscale</th>
<th>No of item</th>
<th>No of items with &gt; 50% positive responses</th>
<th>No of items with &lt;50% negative responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Difficulty</td>
<td>9</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>ii. Interest</td>
<td>7</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>iii. Usefulness</td>
<td>7</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>iv. Importance</td>
<td>7</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>12</td>
<td>18</td>
</tr>
</tbody>
</table>

Attitude towards chemistry scale (ATCS) had four subscales as shown in Table 2 above. On subscale 1, the subjects had more than 50% positive responses in 3 of the 9 items. Subscale II, they had more than 50% positive responses in 2 of the 9 items. In subscale III and IV they had more than 50% positive responses in 3 of the 7 items and 4 of the 7 items respectively. This implies that the respondents of the study had negative attitude towards chemistry.

Research Question 2: What is their attitude towards chemistry by sex?

Table 2: Frequencies of positive and negative responses by sex

<table>
<thead>
<tr>
<th>Subscale</th>
<th>No of item</th>
<th>No of items with &gt; 50% positive responses</th>
<th>No of items with &lt;50% negative responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Difficulty</td>
<td>9</td>
<td>Female 1, Male 2</td>
<td>Female 4, Male 2</td>
</tr>
<tr>
<td>ii. Interest</td>
<td>7</td>
<td>Female 1, Male 1</td>
<td>Female 3, Male 2</td>
</tr>
<tr>
<td>iii. Usefulness</td>
<td>7</td>
<td>Female 2, Male 1</td>
<td>Female 2, Male 2</td>
</tr>
<tr>
<td>iv. Importance</td>
<td>7</td>
<td>Female 2, Male 2</td>
<td>Female 2, Male 1</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>Female 6, Male 6</td>
<td>Female 11, Male 7</td>
</tr>
</tbody>
</table>

Table 2 shows that by sex, the female respondents had more than 50% positive responses in 6 of the total items the male respondents also had more than 50% positive responses in 2 of the total items. Female respondents had more than 50% negative responses in 11 of the total items while the male respondents had in 7 of the items. This therefore implies that by sex the respondents had a negative attitude towards chemistry. Please note that ATCS was made up of 30 items under 4 subscales. Responses by the respondents were by percentage as shown in Table 2.

Research Question 3: Do pre-service Chemistry teachers have conceptual understanding of the matter concept?

Table 3: Descriptive of pre-service chemistry teachers’ conceptual understanding

<table>
<thead>
<tr>
<th>Content</th>
<th>&lt; 50% conception</th>
<th>&gt; 50% conception correct</th>
</tr>
</thead>
</table>

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Table 3 shows that the subjects had more than 50% conception in only four (4) of the twenty (20) items and less than 50% conception is sixteen (16) of the items. This clearly demonstrates a lack of conceptual understanding by the subjects of the study.

**Research Question 4:** what is the Conceptual understanding of the matter concept by sex

<table>
<thead>
<tr>
<th>Table 4: Conceptual understanding of the matter concept by sex</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Content</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Physical &amp; Chemical changes</td>
</tr>
<tr>
<td>States of matter</td>
</tr>
<tr>
<td>Kinetic theory of matter and its application</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

Table 4 reveals that both male and female pre-service chemistry teachers had misconception in all the 10 items of kinetic theory and its application. Male subjects had misconception in 3 of the 5 items on states of matter while the female subjects had misconception in all the 5 items. Both sexes had misconception in 4 of the 5 items on physical and chemical changes. The analysis therefore implies lack of conceptual understanding by the subjects by sex.

**Null Hypothesis**
Ho: There is no significant relationship between pre-service chemistry teachers’ attitude towards chemistry and their conceptual understanding of matter.

**Table 5:** Pearson correlation statistics showing relationship between pre-service chemistry teachers (n = 122) attitude towards chemistry and conceptual understanding of matter concept.

<table>
<thead>
<tr>
<th>Variable</th>
<th>r</th>
<th>r²</th>
<th>%</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude towards chemistry and conceptual understanding</td>
<td>0.6</td>
<td>0.36</td>
<td>36%</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Statistical Package for Social Sciences (SPSS) software was used for statistical analysis. It is super easy software for analyzing data and running statistical tests. Table 6 shows that there is a positive relationship between pre-service chemistry teachers’ attitude towards chemistry and their conceptual understanding of matter. The strength of the relationship is strong because r is greater than half. The percentage based on the coefficient of determination is 36% this implies that 36% of the subjects’ conceptual understanding is explained by their attitude towards
chemistry. The relationship between the two variables is significant because $0.02 < 0.05$, so $H_0$ is rejected.

Discussion of findings

This study investigated pre-service chemistry teachers’ attitude and their conceptual understanding of matter concept in Delta State of Nigeria. Findings revealed that pre-service chemistry teachers; both male and female had negative attitude towards chemistry. Their attitude towards chemistry were investigated under four subscales viz difficulty of the subject, interest, usefulness and importance to their day to day lives. The respondents had more than 50% positive responses in only 12 of the 30 items in the ATCS. Of the 9 items in chemistry difficult, they had more than 50% responses in only 3 items. This finding is in agreement with that of Woldeamanuel, Atagana & Engida (2013). Their study investigated students’ anxiety towards the learning of chemistry in Ethiopian universities. The results showed that the students had negative attitude towards chemistry and that the students in rural areas registered more fear in learning chemistry than their counterparts in urban areas.

Finding of this study also revealed that the respondents; male and female had no conceptual understanding of the matter concept. Of the 20 items on the matter concept test, respondents showed correct conception in only 4 items. This finding corroborates that of Jegede (2007) who investigated students’ anxiety towards the learning of chemistry in some Nigerian secondary schools. The results showed that 97% of the students held the popular notion that the subject is too wide, demanding and rather cumbersome; about 97% of them feared chemistry because it demanded too much calculation; while 95% of them were of the opinion that it is too difficult to understand chemical equations. About 94% revealed that there were more failures in chemistry examinations than passes.

Recommendations

Based on these findings, it is hereby recommended:

1. That teacher’ educators should embrace appropriate instructional strategies in their various institutions to enhance, facilitate and promote positive attitude towards chemistry and conceptual understanding of chemical concepts.
2. It would also be necessary to organize workshops and seminars for both in-service and pre-service teachers whereby the importance and appropriateness of teachers’ conceptual understanding and attitudes could be highlighted.
3. There is dare need to promote mastery of concepts knowledge and positive attitude towards chemistry in pre-service teachers because if the teachers of tomorrow do not show the aforementioned, they would influence what is taught in schools and it is likely that would perpetuate poor achievement, misconceptions and negative attitude in their own students tomorrow.

APPENDIX A

Table 1: Performance of Chemistry Students in the West African Senior Secondary School Certificate Exam (WASSCE)

<table>
<thead>
<tr>
<th>S/No</th>
<th>Year</th>
<th>% of Candidates with Grades 1-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1997</td>
<td>25.30</td>
</tr>
<tr>
<td>2</td>
<td>2001</td>
<td>36.25</td>
</tr>
<tr>
<td>3</td>
<td>2002</td>
<td>34.42</td>
</tr>
<tr>
<td>4</td>
<td>2003</td>
<td>50.98</td>
</tr>
</tbody>
</table>
References


