to chief examiner’s report 2015-2016. To this effect, professional bodies are highly challenged to discover more authorities in the quality of teaching and learning of mathematics. In spite of all the efforts made by researchers in discovering some of the methods, poor performance of student in mathematics still abound. This is confirmed by the WAEC chief examiner’s report of 2015-2016 who asserted that students still performed poorly in mathematics. This made the researcher to carry out a study on the Impact of Mathematics Teachers Characteristics on Students’ Achievement in Senior School Certificate Examination. The mathematics teacher’s characteristic is examined in terms of teacher’s qualification, teachers working experience as well as teacher’s age and sex.

**Research Questions**
The study was guided by four research questions.

1. How does teacher’s qualification affect Mathematics students’ achievement in SSSCE?
2. How does teacher’s working experience influence Mathematics students’ achievement in SSSCE?
3. How does teacher’s age affect Mathematics students’ achievement in SSSCE?
4. Does teacher’s sex affect Mathematics students’ achievement in SSSCE?

**Hypotheses**
The following null hypotheses guided the study at 0.05 level of significance.
**Ho₁**: There is no significant difference between the teachers’ qualification and the students’ achievement in Mathematics.

**Ho₂**: There is no significant different between the teachers’ working experience and the students’ achievement in Mathematics.

**Ho₃**: There is no significant difference between the teachers age and the students’ achievement in Mathematics.

**Ho₄**: There is no significant difference between the sex of the teachers and students’ achievement in Mathematics.

**Method**

The study employed a descriptive survey. The population of the study consists of all the seventy three (73) Mathematics teachers and all the two thousand and eighty five (2085) SSIII 2015/2016 students from the seventeen (17) public secondary schools in Awka South Local Government Area of Anambra State. Purposive sampling technique was used to select 7 Co-education schools from the Local Government Area. Twenty nine (29) Mathematics teachers (twenty females and 9 males) in the selected schools were used for the study and the students were six hundred and seventy eight (678) in number.

Structured questionnaire which contains twenty three (23) items as well as the S S C E Mathematics result for the year 2015/2016 academic session were the instruments
used for data collection. The Instrument was validated by experts in measurement and evaluation. It was also established reliable with a reliability index of 0.89 using Cronbach Alpha formular. The mean statistic and standard deviations were used to answer the research questions while the hypothesis was tested using the $Z$ – test statistic at 0.05 level of significant.

Results

Table 1: The mean achievement scores and the standard deviation of the students who were taught Mathematics by graduate teachers and those who were taught by non-graduate teachers in SSCE.

<table>
<thead>
<tr>
<th>Qualification of Teachers</th>
<th>$\bar{X}$</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.Sc (ed) &amp; B.Sc</td>
<td>2.1</td>
<td>2.2</td>
</tr>
<tr>
<td>N.C.E</td>
<td>1.5</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Table 1 shows that the mean achievement and the standard deviation is 2.1 and 1.77 respectively for those students who were taught by graduate teachers while that of those students who were taught Mathematics by non-graduate teachers are 1.5 and 0.7 respectively. The above result indicates that the students who were taught by higher qualified teachers performed better than those that were taught by lower qualified teachers in Mathematics.
Table 2: The mean achievement scores and the standard deviation (in S.S.C.E in Mathematics) of the students that were taught by teachers who have 6 years and above teaching experience and those of the students who were taught by teachers who have less than 6 years teaching experience.

<table>
<thead>
<tr>
<th>Years of Experience</th>
<th>$\bar{X}$</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\geq$ 6 years</td>
<td>1.80</td>
<td>1.00</td>
</tr>
<tr>
<td>$&lt;$ 5 years</td>
<td>1.20</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Table 2 shows the mean achievement and standard deviation of 1.80 and 1.00 respectively for the students taught by teachers whose teaching experience is 6 years and above the while those who were taught by teachers with teaching experience of less than 6 years have their mean performance and standard deviation to be 1.20 and 0.60 respectively. This shows that the more experienced a teacher is, the better the performance of the students.

Table 3: The mean achievement scores and the standard deviation (in S.S.C.E in Mathematics) of the students who were taught by teachers whose ages are thirty six (36) and above and those taught by teachers whose ages are below thirty six years (36).

<table>
<thead>
<tr>
<th>Age of Teachers</th>
<th>$\bar{X}$</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\geq$ 36 years</td>
<td>1.60</td>
<td>0.90</td>
</tr>
</tbody>
</table>
According to table 3, the mean achievement in SSCE in Mathematics of the students who were taught by younger and older teachers are 1.80 and 1.60 respectively while their standard deviation are 1.10 and 0.90 respectively. This result indicates that the younger teachers perform better in their classroom teachings than the older ones.

**Table 4: The mean achievement scores and the standard deviation of students who were taught mathematics by male teachers and those who were taught by female teachers.**

<table>
<thead>
<tr>
<th>Sex of Teachers</th>
<th>$\bar{X}$</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1.70</td>
<td>1.00</td>
</tr>
<tr>
<td>Female</td>
<td>1.80</td>
<td>1.10</td>
</tr>
</tbody>
</table>

Table 4 indicated that the mean achievement of the students who were taught mathematics by male teachers and of students taught by female teachers of mathematics are 1.7 and 1.8 respectively, while their standard deviation are 1.2 and 1.3 respectively. This shows that the two groups have very slight difference in their means and so the sex of teachers does not have much influence of on the performance of the students.
Hypotheses

Table 5: Teachers’ qualifications and the students’ achievement in mathematics.

<table>
<thead>
<tr>
<th>Qualification of Teachers</th>
<th>N</th>
<th>X</th>
<th>S.D</th>
<th>X-cal</th>
<th>X-crit</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate</td>
<td>400</td>
<td>2.1</td>
<td>2.2</td>
<td>4.918</td>
<td>1.96</td>
<td>Reject Ho</td>
</tr>
<tr>
<td>Non Graduate</td>
<td>278</td>
<td>1.5</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Since the calculated X value of 4.918 exceeds the critical value of 1.96, the null hypothesis is rejected. This implies that there is significant different between the teachers’ qualifications and the students’ achievement in S.S.C E mathematics.

Table 6: Teacher working experience

<table>
<thead>
<tr>
<th>Years of Experience of Teacher</th>
<th>N</th>
<th>X</th>
<th>S.D</th>
<th>X-cal</th>
<th>X-crit</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 6 years</td>
<td>560</td>
<td>1.80</td>
<td>1.00</td>
<td>1.657</td>
<td>1.96</td>
<td>Accept Ho</td>
</tr>
<tr>
<td>&lt; 6 years</td>
<td>118</td>
<td>1.20</td>
<td>0.60</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The calculated value 1.657 of X is less than the critical value of X which is 1.96. Therefore the null hypothesis is accepted showing that the number of years of expenses do not affect the achievement of students significantly.
Table 7: Teachers age and the students’ achievement in Mathematics.

<table>
<thead>
<tr>
<th>Age of Teachers</th>
<th>N</th>
<th>X</th>
<th>S.D</th>
<th>X-cal</th>
<th>X-crit</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 36 years</td>
<td>160</td>
<td>1.60</td>
<td>0.90</td>
<td>2.71</td>
<td>1.96</td>
<td>Reject Ho</td>
</tr>
<tr>
<td>&lt; 36 years</td>
<td>518</td>
<td>1.80</td>
<td>1.10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical value of X, + 1.96 is less than the calculated X-value. Hence there is significant different in mathematics achievement of students who were taught by older teachers and those taught by younger mathematics teachers.

Table 8: Sex of the teachers and students’ achievement in Mathematics

<table>
<thead>
<tr>
<th>Sex of Teachers</th>
<th>N</th>
<th>X</th>
<th>S.D</th>
<th>X-cal</th>
<th>X-crit</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>250</td>
<td>1.70</td>
<td>1.00</td>
<td>0.95</td>
<td>1.96</td>
<td>Accept Ho</td>
</tr>
<tr>
<td>Female</td>
<td>428</td>
<td>1.80</td>
<td>1.10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The calculated value of X which is 0.95 is less than 1.96 which is the critical X value. So the null hypothesis is accepted. There is therefore no significant different between the achievement on mathematics of students taught by male teacher and those taught by female teachers of mathematics.
Discussion
Students’ achievement in table 1, was better when the teachers are B.Sc (ed) and B.Sc holders than when N.C.E teachers taught the students. There is really a significant difference in the achievement of the student in table 2, teachers who has more experience produced students whose achievement was better than newly employed teachers but the difference is not significant.

The students performed better in table 3 when younger teachers handled them than when the older teachers taught them and the difference in achievement is significant.

It was discovered in table 4 that the achievement of students in SSCE mathematics does not depend on the sex of the teachers.

The result of the study has many educational implications. It implies that teachers with at least first degree, minimum of six years teaching experience, should be employed to teach in SS III classes. It also implies that younger teachers should be employed to teach in our secondary school systems.

Conclusion
The study revealed that our secondary school mathematics teachers should obtain a minimum of 1st degree for better achievement of the students especially in SSCE. The study further revealed that experienced teachers should be made to teach external examination classes in secondary schools.
Finally, when teachers get old and weak, they should be replaced by younger teachers.

**Recommendations**

It is recommended that

1. Non graduate Mathematics Teachers should not be employed to teach in secondary schools in Nigeria.
2. Mathematics teachers with less than 6 years teaching experience should not teach external examination classes.
3. Seminars, conferences and workshops should be organized for both young and older mathematics teachers if they are to perform excellently.
4. The country should lay emphasis on production of teachers both in quantity and in quality.

**References**


Otor, E.E, (2011). Effects of Concept Mapping Strategy on Students’ Attitude and Achievement in Difficult

INSTRUCTIONAL STRATEGIES FOR CORRECTING CHEMISTRY STUDENTS’ ALTERNATIVE CONCEPTIONS TO REDUCE THEIR LEARNING DIFFICULTIES IN CHEMISTRY CLASSROOM IN ONITSHA AND OGUIDI EDUCATION ZONES

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Abstract
This study is premised upon the conception that secondary school chemistry students have alternative conceptions in most chemistry concepts and this alternative conception tends to be very resistant to instruction because learning entails replacing or radically re-organizing students’ knowledge. The study therefore investigated the instructional strategies for correcting those alternative conceptions held by chemistry students in secondary schools as a way of reducing learning difficulties in
chemistry classroom. Four research questions guided the study. The design for the study was a descriptive survey design. A validated questionnaire was used and it has a reliability coefficient of 0.83 using Cronbach Alpha Technique. The researchers with the help of a research attendant distributed and collected the questionnaire and the data obtained was analyzed using mean and standard deviation. The results revealed that most of the chemistry teachers agreed that students have alternative conceptions in most chemistry concepts but they are not aware of the instructional strategies that can be used to correct them. Hence they do not use the instructional strategies listed in teaching. It was recommended among others that chemistry teachers should identify possible types and sources of alternative conceptions and use two or more of the instructional strategies listed in teaching because the instructional strategies which ultimately might prove effective in correcting alternative conceptions might differ according to the type or source of the alternative conception.

**Keywords:** Alternative Conceptions, Chemistry, Learning Difficulties, Instructional Strategies.

**Introduction**
Chemistry is an important aspect of science, however, there is considerable evidence which shows that vast majority of the students do not do well in chemistry as well as show less than expected interest in the study of this subject. According to Atherton (2011), the main hurdle
lies in students’ inability to demonstrate a good understanding of the very basic concepts of the subject. Due to high gaps in students’ understanding of the fundamental concepts, they are unable to engage in in-depth learning of advanced level content. Thus, many students consider the subject challenging and difficult (Childs & Sheehan, 2009; Sirhan, 2007). Chemistry is a difficult subject to teach and learn both at secondary and tertiary levels. Major learning difficulties are due to the particular views of chemistry phenomena that in many ways contradict intuitive and everyday views of the learners. As a result, major misunderstandings occur when students try to comprehend chemical explanations within the framework of their pre-instructional conceptions. They consider the concepts difficult.

Situations revealing chemistry students’ tensions and difficulties includes when the teacher introduced a new concept in a lesson and students could not cope with it, a lesson involving more advance-level information pertaining to the subject matter under consideration, students recalling factual information (word to word) instead of describing the ideas, information or meaning in their own words, students inability to linking ideas or making conceptual connections, students not offering explanations in support of their view point, students not asking questions. Mayhill and Brackley (2004) pointed out that rather than providing an overview of students’ conceptions in various topics, we review learning difficulties from the perspectives of the challenges of
multiple representations and the relation of Chemistry to everyday experiences. We believe that these perspectives contribute substantially to the limited success of teaching and learning of chemistry.

Learning is an active process and what students do with facts and ideas with which they have been presented depends to a very high extent on what they already think and believe. Being able to recognize and work with these students-held ideas and conceptions is thus a key component of an effective educational strategy (Worcester 2004). Many researchers such as Imenda (2005) have reported that it is now well established that learners do not come to the classroom with empty minds because they develop belief about things that happen in their surroundings from the earliest days of their lives from any previous life experiences or observation not necessarily arising out of formal education. In this regard, learners come to school lessons, with a wide range of some already strongly held ideas, which may differ from the theories the educator may wish to develop. These their ideas or knowledge can be erroneous, illogical or misinformed. According to Kika 2004, these erroneous understandings are termed alternative conceptions or misconceptions.

Alternative conceptions are very typical and both children and adult possess them. They develop from the natural effort to make sense of the world around them. Atimes things we already learned are unhelpful in learning new concepts/theories. To Mulford & Robinson (2002),
alternative conceptions play a larger role in learning chemistry than simply producing inadequate explanations to questions. Students either consciously or subconsciously construct their concepts as explanations for the behavior, properties or theories they experience. They believe most of these explanations are correct and if they then encounter new information that contradicts their alternative conceptions, it may be difficult for them to accept the new information because it seems wrong. The anomalies do not fit their expectations. Under these conditions, the new information may be ignored, rejected, disbelieved, and deemed irrelevant to the current issue held for consideration at a later time or accepted while making minor changes in the students’ previously held concepts (Worcester 2004).

These concepts once formed influence the sense learners make of further learning, are resistant to change and make a considerable number of learners hold on to certain intuitive notions despite formal science education they received. If anomalous new information is presented in a learning situation where the student is rewarded (with grades) for remembering it, the information may be memorized in order to earn the reward, but it is likely to be quickly forgotten because it does not make sense. The origins of alternative conceptions bear their roots in the individuals’ previous experience and observation, language, cultural experience and the way teachers and textbooks presents their information. Also some concepts are simply very difficult to grasp. They may be very
abstract, counter intuitive or complex so students’ understanding of them is flawed (Burgeon, Heddle & Duran 2010). There are various diagnostic instruments for identifying alternative conceptions (misconceptions). They include interviews, open-ended tests, multiple choice tests, questionnaire, sorting tasks etc (Duran & Gurel 2007).

Some alternative conceptions that have been incurred among secondary school students are;

- Some students, who were able to balance an equation, could not draw a diagram of what was happening.
- Some students cannot answer conceptual questions about electron repulsion in valence shell but some can answer test questions designed to test this understanding.
- Particulate model is difficult for students to grasp. Whether it is introduced early or later, students need to fully master the concept to be able to distinguish between elements, compounds and mixtures (kind 2004). Alternative conceptions can impede learning and it tends to be very resistant to instruction because learning entails replacing or radically reorganizing students’ knowledge. Hence, conceptual change has to occur for learning to take place. This puts teachers in the very challenging position of needing to bring about significant conceptual change in students’ knowledge to make learning less difficult to them.
Generally, ordinary forms of instruction such as lectures, laboratory, discovery learning or simply reading text are not very successful at overcoming students’ alternative conceptions. Thus alternative conceptions are tenacious and resistant to extinction by conventional teaching methods. Hence, the researchers deemed it necessary to investigate the instructional strategies that can help chemistry students leave their alternative conceptions and form correct concepts in order to reduce learning difficulties in chemistry classroom.

**Purpose of the Study**
Specifically, the study sought to:
1. Identify those concepts of chemistry in which chemistry teachers agree that students have alternative conceptions.
2. Ascertain the chemistry teachers level of awareness on those concepts students’ have alternative conceptions.
3. Ascertain the instructional strategies that are effective in helping students leave their alternative conceptions and learn correct concepts.
4. Determine the extent of chemistry teachers’ level of utilization of these instructional strategies in teaching chemistry.

**Research Questions**
The following research questions guided the study:
1. In which concepts of chemistry do chemistry teachers agree students have alternative conceptions?
2. To what extent are chemistry teachers aware that students have alternative conceptions in those concepts?
3. What are the instructional strategies that are effective in helping students leave their alternative conceptions and learn correct concepts?
4. To what extent do chemistry teachers utilize those instructional strategies in teaching chemistry?

Method
A descriptive survey design was used to collect data for this study. The population of the study consisted of all the chemistry teachers in the 31 and 64 government owned secondary school in Onitsha and Ogidi Education Zones respectively of Anambra State. 28 chemistry teachers from Onitsha Education Zone and 30 chemistry teachers from Ogidi Education Zone formed the sample (58) for the study. The sample size was 58 and was selected by purposive sampling. The instrument for data collection was a 56- items questionnaire produced by the researchers and titled Strategies for Correcting the Alternative Conceptions Held by Chemistry Students (SCAC).

The SCAC had two sections A and B. Section A sought information on the personal data of the respondent while section B made up of 56-items consisted of 4 parts. Part 1 and 3 was constructed on a four point scale and weighted as follows, strongly Agree (SA)= 4; Agree (A) = 3; Disagree (D) = 2; and Strongly Disagree (SD) = 1. Part 2 and 4 was constructed also on a four point scale and
weighted as follows, High Extent (HE) = 4; Moderate Extent (ME) = 3; Low Extent (LE) = 2; Very Low Extent (VLE) = 1.

The SCAC was validated by two lecturers from chemistry and one lecturer from measurement and evaluation. Their corrections were effected in the final draft of the instrument. The instrument was trial-tested on 10 chemistry teachers from seven (7) secondary schools in Awka Education Zone. The result obtained was used to determine the reliability of the instrument using Cronbach Alpha Technique. The reliability index was found to be 0.83 and it was considered adequate for the study.

With the help of research assistant, copies of the questionnaire were distributed to the teachers of the schools selected for the study and collected on-the-spot. 59 questionnaire were distributed and 58 were returned. The respondents were asked to indicate their level of agreement with the items in the questionnaire by ticking one of the options. The data collected were analyzed using means and standard deviations. Any questionnaire item with a mean equal to or greater than 2.50 was accepted while any with mean of 2.49 and below was rejected.