Students’ Perception of the Inclusion of Nanotechnology in the Senior Secondary School Agricultural Science Curriculum in Rivers State, Nigeria

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ABSTRACT
This study investigated students’ perception of the inclusion of nanotechnology topics in the senior secondary school Agricultural Science curriculum in Rivers State, Nigeria. The research work used survey design with a population of 180 students and a sample size of 60 derived by stratified proportionate sampling technique. The study was guided by three research questions and one hypothesis. The instrument for data collection was a structured questionnaire by the researcher with 15 items measured on a modified 4-point Likert scale. The instrument was validated by three experts. The reliability coefficient of the instrument 0.74 was calculated using Cronbach-alpha. Data analysis was done using mean and standard deviation and the hypothesis tested using t-test. Findings revealed that the objectives of the topics on nanotechnology are adequate, the nanotechnology topics to be included in the curriculum are learnable by the students and also teachable by the teachers as well as that the Agricultural Science teachers already possess the requisite knowledge they would need to teach the topics on nanotechnology if included the senior secondary school Agricultural Science curriculum. The paper therefore, recommended that curriculum planners should include nanotechnology topics in the national curriculum, Agricultural science teachers should utilize local materials when implementing the curriculum, other resources persons who are not professional teachers be asked to help in the curriculum implementation, education stakeholders should partner with government to provide facilities for teaching of the nanotechnology topics and collaboration among member bodies using nanoscience should be encouraged.

Keywords: Students’ Perception, Nanotechnology, Agricultural Science Curriculum

INTRODUCTION
The introduction of the Advanced Teacher Colleges (ATCs), made the educational policy makers to agree that Agriculture could be very important in the secondary school education curriculum, so they included it in the curriculum and in order for its implementation to be properly done, the need arose for agriculture teachers. The ATCs were now handed this responsibility. Along the line, Agriculture was made a core subject in the secondary school curriculum when it was understood to be a very vital subject at the wake of the introduction of 6-3-3-4 system of education in Senior Secondary schools.

To enhance the effective implementation of the subject, the curriculum of the senior secondary school Agricultural science was made up of three content areas: major concepts of production, protection and economics (Umoh&Etuik, 2003). But as time went on with further curriculum designing and development processes, these areas were now expanded to six major content aspects to include topics in basic agricultural concepts, crop production, animal production, agricultural ecology and systems, agricultural engineering, and agricultural economics and extension.
The foregoing simply means that when societal needs increase since the society is dynamic, trends change and there is usually an aspiration to meet such demand through the inclusion of more relevant topics to an existing curriculum and this may have been necessitated by the issue of knowledge explosion which according to Dike (2018) is a huge problem for educators to handle in that new facts and discoveries are being made and are also churned out everyday through research and development activities. Often, such knowledge are enhancing in facing modern realities and making the students aware of the state of affairs in the world. So, to avoid the curriculum becoming rusty, a regular review practice in the field of curriculum has been said to be good enough by Amadioha (2010) who said that the content of any curriculum is a multiple representation of the intentions and needs of the society to be taught to her younger generations in form of knowledge, skills, attitudes and values that would guarantee the progressive advancement of that society, so that from generation to generation the society would have wealth of learning experiences to be taught and their cultural practices bequeathed to the younger generation. Also Ivowi (2006) had said that curriculum review is important because it may have been necessitated as a time to time review in order for it to capture the most relevant and practical evolution in a society or as a result of a call for the inclusion of an area that has been seen to be pertinent and very essential for inclusion in the curriculum of a people. Therefore, this kind of review can be an addition to the existing contents and/or topics or a substitution of an old content for a new one.

The National Policy on Education (FRN, 2004) has stated as part of the goals of secondary school education in Nigeria the inclusion of contents that would guarantee: useful living within the society and for higher education by offering a curriculum that is diversified to take care of the differences in talent opportunities and futures roles of the people, therefore, the curriculum planners have gone ahead to add agricultural science as one of the vocational subjects in the senior secondary school curriculum which by implication is a way of encouraging every student to make agricultural science a subject of choice especially because with it every students at one level or the other during their educational life would have been encouraged to become a farmer, which is another dimension that would strengthen the world of science and technology, and food security and currently one way that researches have proven for nations to technologically advance better in food production, processing and preservation for future use is through nanotechnology which is the reason lobbying for the inclusion of nanotechnology topics in the agricultural science for senior secondary schools curriculum may be a wise suggestion particularly again because it has been proven by researches to be a very effective means of improving agricultural production, it is said to be environmentally friendly, and that it is very efficient in food processing and safety regulations.

Nanotechnology is a field that has found relevance in different other fields of study. Its definition is only relative as it is conceived as relating to materials, processes and systems that find worth at a scale of 100nm or less. A nanometer is one billionth of a matter. Hence, nano represents the size of between 1 and 100nm (Saurabh, Bijendra, Yadav & Gupta, 2015). It suitability for use in agricultural production is hinged on its capacity to increase the quality and quantity of yields, help in the reduction of soil erosion, and water and air pollution curbed (NANOAP, 2017). The other is that it has biosecurity capacity, in the processes of food processing and safety regulation practices (Prasad, Bhattacharyya & Nguyen, 2017). Alo (2016) has disclosed some functions that nanotechnology could play in a developing country like Nigeria as energy storage, production and conversion, enhancement of agricultural productivity, water treatment and remediation as well as the diagnosis and treatment of diseases. These functions that nanotechnology fills make the researchers feel nanotechnology has a lot of potentials that can help Nigeria as nation solve some of the teething problems faced at the moment by the nation. So it would be a good start to use senior secondary school Agricultural Science as the pivot on which nanotechnology would stand to reach the younger generation in secondary schools and to profit the entire nation by laying a good foundation for a better higher education in the field of agriculture and allied professions.

In the senior secondary schools, the curriculum of agricultural science is implemented by professional teachers. These teachers are expected to guide the teaching and learning in Agriculture according to the content and objectives given in the curriculum which is usually in Nigeria, a product of an agency of government called Nigeria Education Research and Development Council (NERDC), this same agency
has advanced that geopolitical zones or states could teach students, crop or animal related themes/topics which they may find to enhance local needs and production in their curriculum contents (NERDC, 2009), hence, the suggestion for the inclusion of nanotechnology topics in the senior secondary school agricultural science as a necessity. Students’ perception of nanotechnology topics has to do with the way they view or understand topics on nanotechnology for inclusion in the Agricultural science curriculum. Consequently, analysis in various researches carried out by experts in other parts of the world and the one done in Nigeria (Prasad, Bhattacharyya & Nguyen, 2017; NANOAP, 2017&Alo, 2016)show that nanotechnology is very vital to man’s existence in the 21st century as it can contribute to areas like food safety and bio-security, material science, food processing and product development, pest and disease control and of course animal health. Han (2014) who researched the inclusion of biomass education found out that teachers were interested to have in the Agricultural science curriculum topics on nanotechnology. Again, Hingant&Albe (2010) did a research on the topics on nanotechnology and suggested that the topics should be included in the curriculum because they are very essential in this era. For Mutambukin (2014), it was revealed that nanotechnology topics inclusion increased students’ interest and attitude in undergraduate chemistry. Considering these revelations, there is need to consider the perception of the agricultural science students who would be the ones to learn the nanotechnology topics in the senior secondary school agricultural science if the inclusion is done, therefore, the need to ascertain the perception of students on the inclusion of nanotechnology in the senior secondary school agricultural science curriculum in Rivers State, Nigeria.

Purpose of the Study
The purpose of this study was to investigate students’ perception of the inclusion of nanotechnology topics in the senior secondary school agricultural science curriculum in Rivers State, Nigeria, specifically, the study sought to determine students’:

1. Perception of the objectives of nanotechnology topics for inclusion in the senior secondary school agricultural science curriculum in Rivers State, Nigeria.
2. Perception of students on the content of nanotechnology topics as relevant to agriculture for inclusion in the senior secondary school agricultural science curriculum in Rivers State, Nigeria.
3. Perception of the knowledge of their teachers on the content of nanotechnology topics for inclusion in the senior secondary school agricultural science curriculum in Rivers State, Nigeria.

Research Questions
The following research questions guided this study:

1. What is the perception of students of the objectives of nanotechnology topics for inclusion in the Senior Secondary School Agricultural Science curriculum in Rivers State, Nigeria?
2. What is the perception of the students on the content of nanotechnology topics as relevant to agriculture for inclusion in Senior Secondary School agricultural science curriculum in Rivers State, Nigeria?
3. What is the perception of the students on the extent of knowledge of their teachers on nanotechnology topics for inclusion in the Senior Secondary School Agricultural Science curriculum in Rivers State, Nigeria?

Hypothesis
This hypothesis guided this study at (P≥ 0.05):

H0: There is no significant difference on the perception of male and female students on how knowledgeable their teachers are on nanotechnology topics for inclusion in the Senior Secondary School Agricultural Science Curriculum in Rivers State, Nigeria.

RESEARCH METHOD
The study was carried out in senior secondary schools in Rivers State, Nigeria in 2019, particularly, in Six (6) public Senior Secondary School in Obio/Akpor. The population for the study consists of 180 senior secondary school students in six (6) secondary schools in Obio/Akpor Local Government Area, Rivers State, Nigeria. The sample for the study is made up of 60 students drawn using the stratified proportionate...
sampling technique since the sample consist of various subgroups, yet bearing similar features from different school in the entire population. This instrument used by the researcher for data collection was a questionnaire titled: Students’ Perception of Nanotechnology Topics Inclusion in the Curriculum Question (TPNTIC) which was constructed by the researcher. It consist of 15 items which were arranged in two sections A and B. section A contains the biodata, while sections B consist of two subgroups on perception of the objectives of nanotechnology content and the other on the teachers’ knowledge of nanotechnology topics for inclusion in the Senior Secondary School Agricultural Science curriculum. The questionnaire was built on a modified four point Likert Scale, namely Include All (IA), Include Majority (IM), Include Few (IF) and Include Non (IN) and the other scale is All (A), Majority (M), Few (F), None (N), and the levels of responses are weighted as 4, 3, 2, 1 respectively. The instrument was face validated by three experts, two from Agricultural Education Unit of the Science Education Department of Rivers State University, Nkpolu Port Harcourt and one from the Federal College Education (Teaching) Omoku, Rivers State. The suggestions given were used in producing the final copy of the instrument. Cronbach alpha was used in calculating the reliability which gave an alpha value of 0.74 which was considered high. The instrument was administered and collected by the researcher. The data obtained were analyzed using, mean and standard deviation for answering the research questions and the hypothesis tasted using t-test

**RESULTS**

**Research Question 1:** What is the perception of students of the objectives of nanotechnology topics for inclusion in the Senior Secondary School Agricultural Science curriculum in Rivers State, Nigeria?

Table 1: Showing the mean, standard deviation and remark for students’ perception of the objectives of nanotechnology topics inclusion in the Agricultural Science curriculum in Rivers State, Nigeria.

<table>
<thead>
<tr>
<th>S/N</th>
<th>ITEMS</th>
<th>MEAN</th>
<th>SD</th>
<th>N</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The objectives for crop and animal production will be useful to be in the curriculum.</td>
<td>3.12</td>
<td>1.17</td>
<td>60</td>
<td>IA</td>
</tr>
<tr>
<td>2.</td>
<td>The objectives for erosion are suitable enough for learning and for inclusion in the curriculum.</td>
<td>3.63</td>
<td>1.28</td>
<td>60</td>
<td>IA</td>
</tr>
<tr>
<td>3.</td>
<td>The objectives on pollution are adequate to satisfy learning and for inclusion in the curriculum.</td>
<td>3.05</td>
<td>1.24</td>
<td>60</td>
<td>IM</td>
</tr>
<tr>
<td>4.</td>
<td>The objectives on biosecurity is adequate to be included in the curriculum</td>
<td>3.54</td>
<td>1.27</td>
<td>60</td>
<td>IA</td>
</tr>
<tr>
<td>5.</td>
<td>The objectives on safety will be relevant to be included in the curriculum</td>
<td>3.48</td>
<td>1.35</td>
<td>60</td>
<td>IA</td>
</tr>
<tr>
<td>6.</td>
<td>The objectives on crop and animal processing would be needed for inclusion in the curriculum</td>
<td>2.67</td>
<td>1.15</td>
<td>60</td>
<td>IM</td>
</tr>
</tbody>
</table>

**Grand Mean and SD**

<table>
<thead>
<tr>
<th>S/N</th>
<th>ITEMS</th>
<th>MEAN</th>
<th>SD</th>
<th>N</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Grand Mean and SD</strong></td>
<td><strong>3.25</strong></td>
<td><strong>1.24</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 above show items 1 to 5 as being strongly requested for its topics to be included in the senior secondary school Agricultural Science curriculum while item 6 are topics that were moderately being requested for to be included in the curriculum. The grand mean and standard deviation results are indicative that students in Obio/Akor L.G.A. Rivers State appreciate the inclusion of nanotechnology topics in the senior secondary school Agricultural Science curriculum.
Research Question 2: What is the perception of the students on the content of nanotechnology topics as relevant to agriculture for inclusion in Senior Secondary School agricultural science curriculum in Rivers State, Nigeria?

Table 2: Showing the mean, standard deviation and remark for students’ perception on the content of nanotechnology topics for inclusion in the Agricultural Science curriculum in Rivers State, Nigeria.

<table>
<thead>
<tr>
<th>S/N</th>
<th>ITEMS</th>
<th>MEAN</th>
<th>SD</th>
<th>N</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The coverage of the topics is enough for teaching and learning to allow for inclusion in the curriculum.</td>
<td>3.25</td>
<td>1.23</td>
<td>60</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>The language of the content is adequate for the intellectual level of the students.</td>
<td>3.56</td>
<td>1.32</td>
<td>60</td>
<td>A</td>
</tr>
<tr>
<td>3</td>
<td>The structure and organization of the topics is adequate for inclusion in the curriculum.</td>
<td>3.58</td>
<td>1.36</td>
<td>60</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Mean and SD</strong></td>
<td><strong>3.46</strong></td>
<td><strong>1.30</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2 results presented are showing that the perception of students is that the content of nanotechnology topics to be included in the senior secondary school agricultural science curriculum is adequate for teaching and learning, the language of the topics in suitable for the students to be able to learn well and that the structuring of the topics was well done for used. And with a grand mean of 3.23 and standard deviation of 1.30, it shows the students agree to the content of the nanotechnology topics as suitable enough for their learnability.

Research Question 3: What is the perception of the students of the extent of knowledge of their teachers on nanotechnology topics for inclusion in the Senior Secondary School Agricultural Science curriculum in Rivers State, Nigeria?

Table 3: Showing the mean, standard deviation and remark on the knowledge of teachers on nanotechnology topics for inclusion in the Agricultural Science curriculum in Rivers State, Nigeria.

<table>
<thead>
<tr>
<th>S/N</th>
<th>ITEMS</th>
<th>MEAN</th>
<th>SD</th>
<th>N</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The teachers are prepared to teach all the topics on nanotechnology</td>
<td>3.33</td>
<td>1.25</td>
<td>60</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>The teachers regularly upgrade their knowledge of nanotechnology</td>
<td>3.64</td>
<td>1.51</td>
<td>60</td>
<td>A</td>
</tr>
<tr>
<td>3</td>
<td>The teachers are familiar with all the facilities for teaching nanotechnology topics</td>
<td>3.47</td>
<td>1.37</td>
<td>60</td>
<td>A</td>
</tr>
<tr>
<td>4</td>
<td>My school has all the facilities needed for my teachers to teach all the nanotechnology topics</td>
<td>2.82</td>
<td>1.1</td>
<td>60</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Mean and SD</strong></td>
<td><strong>3.32</strong></td>
<td><strong>1.30</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3 results as presented here shows that most of the Agricultural Science students in Obio/Akpor L.G.A. Rivers State, Nigeria agrees to have the requisite knowledge for teaching nanotechnology topics if it is included in the curriculum. The grand mean 3.32 is indicative of the confidence with which they are sure they believe their teachers can handle any topics on nanotechnology that may be included in the senior secondary school Agricultural science curriculum.

Hypothesis

$H_0$: There is no significant difference on the perception of male and female students on how knowledgeable their teachers are on nanotechnology topics for inclusion in the Senior Secondary School Agricultural Science Curriculum in Rivers State, Nigeria.

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Table 4: t-test analysis of the perception of the male and female students of how knowledgeable their teachers are on nanotechnology for inclusion in the senior secondary school Agricultural science curriculum.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
<th>Df</th>
<th>SE</th>
<th>t-calculated</th>
<th>t-critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>2.43</td>
<td>3.41</td>
<td>60</td>
<td>58</td>
<td>22.34</td>
<td>0.28</td>
<td>2.00</td>
</tr>
<tr>
<td>Female</td>
<td>2.62</td>
<td>4.54</td>
<td>60</td>
<td>58</td>
<td>22.34</td>
<td>0.28</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Table 4 above reveals that the calculated value of 0.28 is less than the critical value of 2.00 at 0.05 significant level. The null hypothesis is therefore retained. This implies that there is no significant difference on the perception of the male and female students on the knowledge of their teachers on nanotechnology topics to be included in the Senior Secondary School Agricultural Science Curriculum.

DISCUSSION OF FINDINGS

Results from table 1 above reveal that the objectives on crop and animal production were adequate, the objectives on soil erosion are suitable, the biosecurity topics to be included are adequate, the safety topics are good enough and the processing topics for inclusions are adequate for inclusion in senior secondary school Agricultural Science curriculum. This perception may be coming on the ground of the value in terms of the academic advancement, improvement interest and change in attitude for the positive by the students because of the learning of this content, therefore, they desire that nanotechnology topics be included in the curriculum of Agricultural Science. The perception agrees with the findings of Mutambukin (2014) who found out that the inclusion of the nanotechnology topics in the curriculum led to improvement in students’ interest in chemistry.

The response of the students to research questions 2 shows that topics on nanotechnology would be a veritable tool in enhancing the extent of learning that the students get involved in as all the students accepted that the topics are learnable, that the language of preparation is within the learning capacity of their learnability and that the structural and organizational arrangement of the topics is good enough for them. This confirms the findings of (Prasad, Bhattacharyya & Nguyen, 2017; NANOAP, 2017&Alo , 2016) who after conducting a research concluded that nontechnology is very important to man’s living in the 21st century as it can contribute to areas like food safety and bio-security, material science, food processing and product development, pest and disease control and of course animal health.

The results from table 3 indicates that the Agricultural Science students in Obio/Akpor L.G.A. Rivers State, Nigeria believe that their teachers have adequate knowledge, preparation and can effectively maximize teaching facilities at their disposal for teaching nanotechnology topics in a way that would enhance the learnability of their students on Agricultural Science in senior secondary school if nanotechnology topics are included in the curriculum. This seem to be in agreement with the findings ofAlo (2016) who disclosed that some functions that nanotechnology could play in a developing country like Nigeria include energy storage, production and conversion, enhancement of agricultural productivity, water treatment and remediation as well as the diagnosis and treatment of diseases, therefore all such topics are perceived to be already related to the what the teachers know and can teach to their students even without undergoing any further trainings. While the hypothesis results showed no significant difference between the perception of the male and female students of how knowledgeable their teachers are on nanotechnology topics to be included in the Agricultural science curriculum, what the researchers considers as a good omen for the teaching and learning of senior secondary school Agricultural Science in Rivers State, Nigeria.

CONCLUSION

The result of this study shows that nanotechnology would be helping the teaching of senior secondary school Agricultural Science curriculum in Rivers State, Nigeria as perceived by the students especially going by the recommendation of the NERDC which says that states could develop their curriculum further in a way that is suitable for them and would allow for advancement of the locality they live in.
Furthermore, because most topics on nanotechnology does not seem to be what will be difficult for teachers to teach, it also seem the learnability of the topics is possible for the students too, so it becomes very easy for this study to conclude by encouraging the Rivers State curriculum developers to include nanotechnology topics in next review of the senior secondary school curriculum on Agricultural Science.

RECOMMENDATIONS
The following are the recommendations supporting this study:

1. Curriculum planners should consider the inclusion of nanotechnology topics in the curriculum of all the science subjects particularly Agricultural science.
2. The Agricultural science teachers at the senior secondary school should be creative and innovative in implementing the topics on nanotechnology.
3. Other resources person should be invited to facilitate the teaching and learning of the topics that are industry related included in the curriculum when nanotechnology topics would have been included.
4. Education stakeholders should endeavor to support the government in the provision of teaching and learning facilities to make learning to make students learn better.
5. There should be collaboration among the organizational bodies of the fields of study to partner and advance the benefits of nanotechnology to man.

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