The Science Topics Perceived Difficult by Junior High School Students at Techiman North District: Effects on the teaching and learning of Science.

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Abstract: This study was conducted to identify integrated science curriculum topics perceived difficult and its effect by the Junior High students in the Techiman North District. One hundred and seventy-six students in JHS 3 from eight randomly selected schools were used. The study involved both quantitative and qualitative data collection. A 45-item questionnaire was administered to respondents. A sampling interview was conducted to determine the effect of the topics difficulty. The findings that most chemistry and Biology topics in the science curriculum were perceived to be very difficult. No practical teaching, too much content were also perceived to the causes and poor attitude towards science subject and getting poor grades in final examinations were some of the effects. It therefore, recommended that emphasising on inquiry science instruction in Basic Schools could help students a lot.

1. Introduction

Science is regarded by many as an essential component in their portfolio of skills and qualifications, one that can help secure successful post-basic school progression in both science and non-science related careers. According to the National Foundation for Educational Research (2011) report, pupils suggested that success in science at school would enhance their chances of securing places at (more prestigious) universities. A number of research studies in 2000s reported a decline in engagement with science, technology, engineering and mathematics (STEM) study and subsequent choices to pursue science-related careers (e.g. Roberts Review, 2002; Stagg et al., 2003).

In this modern era, it has become obvious that science has become the backbone for the prosperity in each and every field of life. For this purpose, our pupils will have to pay attention on their studies during their educational career. Science is an important area in the field education for the pupils of Junior high school levels. After the Junior high school, these pupils have to select such fields which lead to their professional career. These pupils have to perform different activities at this level. These activities provide pupils different concepts related to science as well as scientific enquiry. According to Bennett and Hogarth (2005) science education is helpful for the pupils in understanding science ideas. The processes and ideas of science are of great importance to everybody in three ways (Bennett and Hogarth, 2005). The first is in their personal lives, for example so that they can validly identify the components of a healthy life-style. The second is in their civic lives, so that they take an informed part in social decisions, for example on future options for electricity supply. The third is in their economic lives, where they need to be able to respond positively to changes in the science-related aspects of their employment. If happens that science teaching and learning is sufficiently challenging and interesting, genuine high achievement will become more widespread and will become apparent through pupils’ creativity, lateral thinking, and persistence (Gluckman, 2011). It is apparently true that if teachers are not able to answer children’s questions at primary school with confidence and enthusiasm, then children detect that lack of confidence and enthusiasm and that spirit of enquiry can be lost.

A number of factors that influence pupils’ interest with science teaching and learning have been highlighted in the literature. Several sources have identified the quality of the educational experience provided by the teacher as a key factor determining pupils’ interest in science teaching and learning (Osborne et al., 2003; Bennett and Hogarth, 2005; Teaching and Learning Research Programme, 2006; Springate et al., 2008; Butt et al., 2010). The Wellcome Trust Monitor (Butt et al., 2010) found in their report that ‘good’ teachers influence them to learn science, while by a ‘bad’ teacher ‘put off’. However, the study was not able to identify what constituted ‘bad’ teaching.

The next most influential factor affecting pupils interest in science teaching and learning has been the quality of the learning context, in particular, the content and relevance of the science curriculum, assessment strategies and the availability of, or access to, science courses of study (NFER, 2011). According to the NFER (2011) report Science was seen as being ‘content heavy’, and ‘theory learning without its practicals.'
The report also suggests that pupils believed that science teaching and learning is on learning hard facts. Moreover, pupils’ interest varies across subjects but pupils’ interest levels also vary within the subjects according to the topic being studied. For example, a number of pupils disliked the topics on plants in biology, preferring to learn about animal or human biology. Practical work is inevitable in the study of science. In the context of the scope of the study area basic school pupils suffer a lot regarding practical lessons in the science teaching and learning. NFER (2011) stated that pupils’ preference for more interactive and practical work, for example, experiments, presentations, debate and group work
The advent of educational reform in the 1980s in the country saw a move towards the presentation of science teaching and learning at basic school as taught in integrated approach, therefore gave rise to integrated science consisted of biology, chemistry, physics and Agriculture. In this case, pupils’ interests also vary across these disciplines. Chemistry is one of the most important branches of science; it enables learners to understand what happened around them. But According to Tabar (2002) many pupils believe chemistry proves to be a difficult subject for them. Because chemistry topics are generally related to or based on the structure of matter and commonly incorporate many abstract concepts, which are central to further learning in both chemistry and other sciences (Taber, 2002). Many pupils think and say, “Physics is difficult.” (Ornek, Robinson, & Haugan, 2008). The reason being that Physics as a discipline requires learners to employ a variety of methods of understanding and to translate from one to the other words, tables of numbers, graphs, equations, diagrams, maps. Physics requires the ability to use algebra and geometry and to go from the specific to the general and back (Ornek, Robinson, & Haugan, 2008).

Biology has also been perceived as difficult discipline by some pupils who have been investigated by many researchers since 80s such researchers are Johnstone and Mahmoud (1980), Finley, Stewart and Yarroch (1982), Lazarowitz and Penso (1992), Bahar.Johnstone and Hansell (1999). Of course, several reasons that needs to be mentioned. There are lot factors that might affect perception as well as meaningful science teaching and learning. For instance, there is no doubt that motivation to learn is an important factor controlling the success of science teaching and learning. Teachers face problems when their students do not have all the motivation to seek to understand. However, the difficulty of a topic, as perceived by students, will be a major factor in their ability and willingness to learn it (Johnstone & Kellett, 1980). White (1993) expresses that factors such as attitude, skill, and knowledge, physical state and needs factors as a result lead to misunderstanding of the science concepts. From Johnstone (1991) point of view, the difficulties in science may be lead to the problems of perception and thinking of science as a subject.

Several studies indicate that Working Memory Capacity (WMC) affects the performance of the pupils and it causes difficulties in terms of understanding when it is overloaded (Johnstone & El Banna, 1986; Johnstone, Sleet & Vianna, 1994) Careless use of language can also contribute overloading WMC. Unfamiliar vocabulary or familiar vocabulary in different context, using negative expressions during teaching can affect science teaching and learning (Johnstone & Selepeng, 2001; Aşcı, özkan and Tekkaya , 2001). According to Çapa (2000) presumably certain factors such as terminologies in the textbooks create difficulties not only in learning genetics but also other concepts in biology, such as respiration and photosynthesis.

In the opinion of Aşcı, özkan and Tekkaya ,2001) possible sources of pupils” difficulties in science teaching and learning topics can be attributed mainly to the content school science curriculum, teaching and learning strategies, textbooks, and insufficient laboratory conditions and equipment. In addition, students’ motivation and interest must be also taken into consideration. Other source of learning difficulties of pupils may be related to the presence of large numbers of foreign terms in textbooks.

2. Statement of the Problem
In Ghana, the national exam results for pupils in Basic Education Certificate Examination (BECCE) shows low performance in science (WAEC, 2008, 2011, 2012). Trends in International Mathematics and Science Study (TIMSS 2003 & 2007) (MOESS, 2008) also show the similar results. In addition, the results in all general terms’ exams for both primary and junior high school pupils were also found low achievement in science.

As stated before, studies related to the science topics that are perceived as difficult by the pupils were carried out at the level of secondary school and university level. There are only a few studies done at international and national levels related to these difficulties related to science topics at basic school schools. Also the science curriculum that was developed in 2007 has being applied at primary levels 1-6. And JHS levels with new science and technology topics introduced at various levels. Therefore, diagnosing the topics that are difficult for the pupils might give some indications about the 2007 science curriculum reform.
4. Purpose of the study
The general purpose of the study is to identify topics perceived as difficult by pupils in Junior High schools. Therefore, this study was designed to answer the following research questions:

1. What topics in the integrated Science Syllabus were difficult for pupils to learn?
2. What are the causes of difficulty in the teaching and learning of the topics?
3. What effect does the difficulty in the topics has on their perceptions towards the teaching and learning of science?

5. METHODOLOGY

Design of the Study
Qualitative and quantitative research methods were used in this Study. The quantitative approach was used to determine the difficult topics in the integrated science syllabus and the possible perceive cause of the difficulty in the teaching and learning of the topics while qualitative approach was used to determine the effect of the difficulty in the topics on their perceptions with science teaching and learning.

Sample
This study consisted of 176 JHS 3 pupils from 8 different high schools. The 8 junior high schools were randomly selected from Techiman North District and once the school is selected all the pupils in JHS 3 became the subject of the study. Table 1 shows the distribution of the students in terms of gender and their total. The true names of the schools are not used. Instead a code is given to each school. In this study the JHS 3 pupils were preferred as sample because they were taught the whole science topics from JHS1 to JHS 3.

Table1: Sex distribution of the sample

<table>
<thead>
<tr>
<th>School</th>
<th>Boy</th>
<th>Girls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIJ</td>
<td>13</td>
<td>11</td>
<td>24</td>
</tr>
<tr>
<td>TP</td>
<td>17</td>
<td>15</td>
<td>32</td>
</tr>
<tr>
<td>AA</td>
<td>9</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>TBRC</td>
<td>11</td>
<td>15</td>
<td>26</td>
</tr>
<tr>
<td>TDA</td>
<td>14</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>GWI</td>
<td>9</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>VI</td>
<td>5</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>JP</td>
<td>17</td>
<td>11</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>95</td>
<td>81</td>
<td>176</td>
</tr>
</tbody>
</table>

Instrumentation
Both interview and questionnaire were used in this study. The interview was used to ascertain the cause of the difficulty in the teaching and learning of the topics. To determine pupils’ learning difficulties, Junior high school integrated syllabus (CRDD, 2007b) was examined and 48 topics were identified and used to build the questionnaire. Pupils’ were asked to rate seven items possibly related to pupils’ perceived causes of the difficulty in the teaching and learning of the science topics in order as 1 lowest cause to 5 highest cause. In the first part of the instrument developed, there were 48 items corresponding to these topics and pupils were asked to indicate their view of difficulty. Pupils were asked to indicate their view of difficulty of each by using four defined headings:

1. Easy (I understood it without difficulty)
2. Moderate (I had difficulty, but I understand it now)
3. Difficult (I still do not understand it)
4. I did not study this topic.

To calculate the percentage of the pupils who had studied the topic recording it as difficult the following formula (Johnstone & Mahmoud, 1980; Bahar et al., 1999) is used:

\[
\text{Index of relative difficulty} = \frac{N_d \times 100}{N_t - N_n}
\]

Nt= Total number of pupils in the sample
Nn= Number of pupils who had not studied the topic
Nd= Number of pupils saying difficult

5. Presentation of Results

Research question one: What topics in the integrated Science Syllabus were difficult for pupils to learn?

The list of the topics (Sixteen in total) that their difficulty (TDI) values are above 50% is given in Table 2.
As can be seen from the Table 2, sixteen topics were perceived as difficult by the pupils since their Total Difficulty Index exceeded 50%. Six out of 16 topics are related to Chemistry; Chemical Compound, Metals and Non-metals, Carbon Cycle and Conversion of Energy. The rest are Acids, Base and Salts, and Electrical Energy. Six topics out of sixteen topics are related to Biology. These are Respiratory system of Humans, Circulatory System of Humans, Infection diseases and Digestion in Animals. Others are Food and Nutrition and Dentition in Human. Two topics are related to Agriculture. The most perceived difficult topic is chemical Compounds with Total Difficulty Index (TDI) value of 88.48%, followed by Basic Electronics (TDI, 82.72). The Respiratory system of Humans and Circulatory System of Humans also followed with Total Difficulty Index (TDI) value of 81.92% and 81.25% respectively. Pests and Parasites and Electrical Energy are the least perceived difficulty with Total Difficulty Index (TDI) value of 51.16% each. From the Table 3, conclusion was made that most chemistry and Biology topics in the science syllabus were perceived by pupils to be very difficult.

Research question two: What are the causes of difficulty in the teaching and learning of the topics?

One of the purposes of this research study is to find out the causes of pupils’ difficulties in the teaching and learning of the science topics. To achieve this aim pupils were asked to rate seven (7) items related to the causes of the difficulty in the topics from 1 to 5 (1 being lowest cause and 5 the highest cause). The findings are presented in Table 4.

Table 3: The summary of pupils’ perceived causes of the topics difficulty

<table>
<thead>
<tr>
<th>S/N</th>
<th>Item</th>
<th>N</th>
<th>Mean</th>
<th>St.D</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>No practical/ abstract teaching</td>
<td>176</td>
<td>4.47</td>
<td>0.74</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>No teaching and learning materials</td>
<td>176</td>
<td>3.57</td>
<td>1.26</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Few/ No Textbooks</td>
<td>176</td>
<td>3.37</td>
<td>1.16</td>
<td>3</td>
</tr>
</tbody>
</table>

Research question three: What effect does the difficulty in the topics has on their perceptions towards the teaching and learning of science?

Another purpose of this research study is to find out effects the difficulty in the topics has on their perceptions with respect to science teaching and learning. To achieve this aim the semi structured interviews were carried out. Three students were randomly selected by hand pick from each school after the questionnaire for the interview. The following findings were revealed by analyzing the
conversations during interviews with students. From these interviews, a number of indicators emerged that might give clues to reveal the effects difficulties in the topics on the perception of the science teaching and learning; poor attitude towards science subject, getting poor grades in final examinations, low motivation to learn, and negative effects on national development.

The effect of the poor attitude towards science teaching and learning
Almost all students who were interviewed mentioned that the science covers a lot of knowledge. They had to learn too much during class sessions about concepts, principles, theory, natural events, formulas etc. The difficulties in the most topics deter some pupils to like the subject. Therefore, they perceived that science is a difficult subject which make them developed poor attitude towards the subject. Almost all desired to lessen this content of the topics that they may handle. A couple of examples regarding pupils’ ideas can be given as follows:

“… Science is always a difficult subject for me as I had to learn too many abstract concepts. For instance, the formation of chemical compounds is very difficult for me to understand”. Another pupil also made this remark:

“In fact, initially, I decided to study science in my career but many pupils fail a lot in both BECE and WAESSCE so I have changed my mind”

Considerable numbers of students in the sample interviewed had negative attitudes toward science. Many of pupils stated that their first experience in the difficulty in some topics might have an effect in this negative attitude.

“…when I had learning difficulties in a science topic I was thinking that the other topics will cause the same problems to me. Then I was giving up studying…”

Getting poor grades in Examinations: Eight out of ten pupils emphasized strongly that they were unhappy with the too much content of a topic. Sometimes teachers were not able to complete the syllabus before the year ends. Moreover science demands a lot from students during the exams unlike the English, Religious and Moral Education and others. For example one girl has this to say “I personally dislike science as subject in the school because it is the subject that most all the time pupils fail and we don’t get good grade in the exams. The topics are too many and we don’t complete before the year ends”

Low motivation to learn science: Seven out of ten pupils emphasized strongly that they were not unhappy with the difficult terminologies that are found in the science topics and this does not motivate them to learn the subject even in the home. They also mentioned that teachers used unknown terminologies that do not have alternatives words for its explanations. From their point of view some terms look alike words.

One of the examples of the pupils’ views is “…From my point of view the language and using terminology is everything for learning. Though the some topics are enjoyable to learn science however there are a lot of them that have difficult terminologies and unfamiliar words like Pepsin, Ptyalin, Bronchioles and the names of the compounds.

Negative effects on national development: Nine out of ten pupils emphasized that the difficulties in the topics has effects on the national development since science and technology are determining a country’s economic situation. Therefore, they were with the view that if pupils were not able to understand science topics in the classroom, they will not study science in the future. Some of their views are as follows: “...I was taught in JHS one about the disciplines of science. That is if you want to be a nurse, doctor, engineer, pilot, etc all need learn science, I hope if the country will develop science plays a very important role”. “... if you have problem with science subject it will affect the nation. I think the government will not get more people to study science course at the higher education”.

Discussion of findings

Topics pupils perceived to be difficult in science teaching and learning
It is rather unfortunate that there is little opportunity for a comparison of the results of this study as there is no research that was conducted at the Junior High School level in Ghana. However, it could be seen that the common difficulties can be found in Biology, Physics, chemistry and Agriculture could be true in Senior High levels and in the international studies. The results presented in this study, suggest that junior high school pupils face difficulties in the science teaching and learning topics. These topics were mostly Chemistry and Biology topics. The topics that were perceived to be difficult in Chemistry were Chemical Compound, Metals and Non-metals, Carbon Cycle, Conversion of Energy, Electrical Energy and Acids, Base and Salts. Topics in Biology that pupils perceived as difficult were Respiratory system of Humans, Circulatory System of Humans, Infection diseases, Digestion in Animals, Food and Nutrition and Denition in Human, Basic Electronics and Magnetism were perceived as difficult in Physic. This finding supported the earlier findings of Tabar
The finding has also confirmed the earlier assertion of Bahar, Johnstone and Hansell (1999) and Asci, Özkan and Tekkaya, (2001) that biology topics were also found to be difficult for pupils to learn. Again, the findings also confirmed that “Physics is difficult.” (Ornek, Robinson, & Haugan, 2008). Of course, one question that many people could ask is “Why are some science topics difficult to learn? Several reasons might answer the question. There are lot factors that might affect perception as well as meaningful learning. This led the researcher to identify the perceived causes of the topics difficulties.

Pupils’ perceived causes of their difficulty in teaching and learning of the science topics

Indeed, several causes might have been reviewed. Such possible causes were: content of the school science curriculum, teaching and learning strategies, textbooks, and insufficient laboratory conditions and equipment and students' motivation and interest. Other factors such as terminologies in the textbooks, limited time for teaching also affect pupils understanding of a topic. This current study found out that, No practical/abstract teaching, No teaching and learning materials, Few/No Textbooks and Too much content of the topic were some of the major cause of their difficulties in the science topics. These findings affirmed the previous findings of Aşcı, özkan and Tekkaya (2001) and Çapa (2000).

The effects of the perceptions of the topic difficulty on the teaching and learning of science

The findings revealed that poor attitude towards science subject, getting poor grades in final examinations, low motivation to learn have negative effects on national development. White (1993, cited in Bahar & Polat, 2007) expresses that factors such as attitude, skill, and knowledge, physical state and needs might affect learning. This current finding concurred with the earlier findings of Johnstone and Kellett (1980), Johnstone (1991) and White (1993). Indeed, perception of students is something that educators should consider it as crucial influential factor that could either positively or negatively affect the teaching and learning outcomes.

Conclusion and Recommendation

It is not being suggested here that the integrated science can be made simple by avoiding teaching difficult topics. But the possible sources of pupils’ difficulties in science topics can be attributed mainly to the teaching-learning strategies, textbooks, and insufficient practical lessons. In addition, pupils’ motivation and interest must be also taken into consideration. When pupils had difficulties in learning some topics, they will definitely have no interest in that lesson. It is important to notice that language and terminology in science specially, in scientific fields generally, might have destructive effect on pupils for whom language and terminology are not part of their native languages. Indeed, local language for explanation of the concept will also enhance understanding and boost their moral in the subject. Another important reason behind of the difficulties that were mentioned by pupils is the time allowed to teach integrated science and the overloading of the content. Because of this reason pupils were given no time for active involvement in the experiments and teachers adopt teacher-centred teaching approaches. This calls for more time to teach some topics in the syllabus.

Therefore, it is imperative that Basic school Science teachers must teach the subject in a dynamic approach, and must be supported by instructional materials, practical or laboratory lessons that will actively engage pupils in learning processes but not as teacher-centred approach. It is therefore, recommended that school authorities should emphasise on inquiry science instruction in Basic Schools to bring more understanding to pupils in the teaching and learning of science.

References


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