

# Ghanaian Junior High Science Teachers' Reflections on the Use of Tessa Secondary Science Modules

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**Abstract** The study investigated in-service Junior High School science teachers' reflections on the use of TESSA secondary science modules. The sample consisted of 34(8 females and 26 males) Junior High School science teachers in Winneba in Central Region of Ghana. Descriptive survey with mixed methods approach was used to collect data using questionnaire and focus group discussion as data collection instruments. The quantitative data collected were analysed through frequency counts and simple percentages while thematic approach was used to analyse the qualitative data. Among other findings, majority of the participants reported that the use of the TESSA resources provided innovative ways of presenting science lessons to their pupils. Also, the participants indicated that their pupils enjoyed and fully participated in these lessons. These notwithstanding, 94 % (32) of participants reported among other things that, accessibility of hard copies of resources would be a challenge to them since most schools did not have ICT tools from which they could print out materials. It is therefore recommended that copies of TESSA secondary science modules be made available in all schools for effective implementation by teachers.

**Keywords:** Junior High School science teachers, TESSA Modules

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## 1. Introduction

In recent years there have been considerable advances towards the achievement of Millennium Goal 2: universal primary education by 2015 (UNDP, 2011). Countries in Sub-Saharan Africa (SSA) that previously educated around 50% of primary aged children are now achieving 70-80%. Changes at a primary level in education in African mean that more children are completing their primary education, but there is a shortage of secondary school places, and crucially, insufficient secondary school teachers. Collins and Gillies (cited in Stutchbury & Ngman-Wara, 2012) suggest that pre-service training needs to be accelerated with shorter periods of pre-service education and a greater emphasis on in-service training. It is in this context that educative curriculum materials are likely to be increasingly important in sustaining effective teacher education (Stutchbury & Ngman-Wara, 2012). The TESSA secondary science modules come handy to support this call for effective science teaching.

It has been suggested that secondary education in Sub-Saharan Africa does not contribute as effectively to human capability development as it should as student achievement is low. Indeed, strong performance in mathematics and science in particular, is associated with economic growth. There is therefore an urgent need for expansion of secondary education in terms of schools, resources and the number of teachers, and a focus on

quality, particularly in science and mathematics. Collins and Gillies cited in Stutchbury and Ngman-Wara (2012) believe that the structure of the current system for training teachers will not allow for the necessary expansion. Secondary teacher training takes four years and involves subject knowledge development and pedagogic preparation. Criticisms of the programmes by Verspoor (2008) include:

1. an over-emphasis on theoretical studies which are not explicitly linked to practice;
2. insufficient supervision and mentoring;
3. the tendency of pre-service teachers to teach as they themselves were taught.

For these reason Collins and Gillies suggested that pre-service training needs to be accelerated with shorter periods of pre-service education and a greater emphasis on in-service training. They believe that pre-service programmes need to be re-designed with a greater emphasis on the practical application of the theory. TESSA Secondary Science is a project that has been designed to begin to address some of these challenges.

All countries in sub-Saharan Africa place emphasis on learner-centred education. So active learning approaches characterise their science, mathematics and technology curricula. Hence learner-centred education, participatory teaching, inquiry-based approaches, problem-solving and critical thinking are some of the key phrases that feature prominently in curriculum policy documents of these African countries (Ottevanger, Van Den Akker & Feiter, 2005). This is in line with current trends in science

education worldwide that learning is not a passive activity but an activity in which pupils actively construct knowledge through interaction with their existing knowledge, and ideas provided by materials, other pupils and the teacher (Ottevanger, Van Den Akker & Feiter, 2005). However reports from these countries, including Ghana, consistently describe the pedagogy that actually dominates the classroom as:

“largely traditional, teacher-centred and content-driven, with notes taking and sometimes a practical especially in preparation for the practical examination at the end of secondary; whole class teaching at all levels, in spite of the curriculum advising otherwise” (Ottevanger, Van Den Akker & Feiter, 2005; p.16).

Thus there is very little evidence of the formulated curriculum ideals. Three main reasons are often offered (Verspoor, 2008) to explain this:

1. Lack of teaching and learning materials and other resources so the teacher is often the learner’s only resource to learning.
2. Overloaded curriculum hence there is pressure on teachers to complete the syllabus so that cooperative teaching strategies are compromised.
3. Lack of teacher confidence with the subject matter prevents teachers from using a more learner-centred teaching approaches.

In addition to these, shortage of science teachers and number of teachers barely keep pace with rising numbers of pupils in the 1990s. Even where there are enough teachers many of them are untrained. Teaching is difficult especially for basic school teachers. For example because of high demands put on them, they often demonstrate

weak subject knowledge in science. Also, teacher education courses in Sub-Saharan Africa are rigorous and well-developed, but often highly theoretical in nature. Evidence shows that although teachers and teacher educators understand what constitutes effective pedagogy, the barriers to implementation are often considerable (Stutchbury & Ngman-Wara, 2012). Techniques are not always modelled on teacher education courses and the reasons why learner-centred approaches are not much in evidence in secondary schools, are well-rehearsed (Verspoor, cited in Ngman-Wara, 2011). TESSA secondary science modules aim to enhance and improve teaching and focus on developing teachers’ practice in curriculum areas.

### 1.1. TESSA Secondary Science Modules

The TESSA secondary science modules have been developed as part of the TESSA project and have been designed to support pre-service secondary science teachers in five Sub Saharan African countries. Colleagues from five partner institutions worked together to develop a structure for the materials. In recognition of the link between pedagogy and values and beliefs, the starting point was an agreed vision of an effective secondary science teacher. The vision articulated was of a creative teacher who put the learner at the centre of their work. Through collaborative discussion, a set of five pedagogical themes were identified that reflected the vision. The units are constructed around these themes as shown in [Table 1](#).

**Table 1. Themes and contexts that form the titles for the 15 TESSA Secondary Science**

THEMES	SUBJECTS		
	Physics	Chemistry	Biology
Probing pupils’ understanding	Properties of matter	Elements, Mixtures, and compounds	Classification and Adaptation
Making science practical	Measurement	Acids, Bases and Salts	Transport
Making science relevant to real life	Pressure	Combustion	Respiration
Problem solving and creativity	Forces	Atomic structure and the Periodic Table	Nutrition
Dealing with challenging ideas in science	Electricity and Magnetism	States of matter	cells

The modules or units include topics teachers find difficult to teach and they are constructed around five pedagogical themes. The total number of units was 15, three for each theme selected from Physics, Chemistry and Biology. The activities in the TESSA Secondary Science units support teachers to effectively teach. The materials are based on learner-centred teaching approaches and include activities and case studies that support effective teaching and learning of science and based on a model of change that has been proved to be effective in the primary context (Stutchbury & Ngman-Wara, 2012).

The materials are also geared towards developing diverse skills needed by the 21<sup>st</sup> century teacher. For instance, there are case studies in the modules that seek to develop problem solving, critical thinking, decision-making and problem solving skills, at the same time providing opportunities for linking theory to practice. Similarly, there are many activities in the modules that seek to promote: communication, collaboration, critical thinking, investigative or research skills, problem solving, creativity and innovative skills. Likewise, their use is

likely to develop in teacher reflective skills. All these are supposed to promote and build diverse skills in the teacher. As teachers facilitate these activities with their learners and model the behaviours, the learners invariably acquire these values and skills as well.

TESSA Secondary Science is underpinned by the belief that active approaches to learning are likely to produce better outcomes for pupils than teacher-led lessons in which pupils are passive participants. The role of the teacher is to support pupils in constructing understanding, taking into account prior knowledge and experience. Student teachers are being taught sound constructivist principles which recognise the importance of prior knowledge and good questioning techniques, the benefits of effective group work and the desirability of practical work in science, but that they find it difficult to apply these in practice and often view these techniques to be separate from their ‘real’ teaching (Stutchbury & Ngman-Wara, 2012). Constructivist approaches are rarely being modelled on teacher education courses, although they are certainly being talked about. It is clear, therefore, that a

development directed at the secondary sector is not only timely but could make a real contribution in terms of developing good practice. TESSA secondary science is targeted on pre-service teachers, although clearly the resources will also support in-service training and professional development. Indeed, the study was carried out to find out how the TESSA secondary science modules could support in-service Junior High School science teachers.

Effective teaching of ideas about science requires establishing a context where pupils can engage in reflective epistemic dialogue. The pedagogy that characterises the TESSA materials seeks to integrate effectively teacher science knowledge and professional performance in order to ensure improvement in science teaching and learning. The teaching strategies give priority to problem-solving, decision making, critical and reflective thinking. These are some of the strategies suggested in the Ghanaian Junior High School science syllabus (Curriculum Research Development Division, 2012).

The use of inappropriate methods, coupled with the inadequate supply of teaching learning materials (TLMs) for teaching of science in basic schools in Ghana is one of the major constraints for effective teaching and learning. Even where TLMs are available some teachers are not resourceful enough to apply appropriate methods of teaching during science lesson presentation. The TESSA secondary school science modules offer opportunities for Ghanaian junior high school teachers to develop and use innovate methods for effective teaching and learning of science. The TESSA secondary science modules were developed through collaboration and partnership among five African countries. The modules are being implemented in all partner countries which include Ghana. In Ghana, the implementation of the modules which commenced with pre-service teachers at the Basic Education Department of Education, University of Education, Winneba has been extended to in-service Junior High School science teachers. This study, investigated in-service teachers' reflections on the use of TESSA secondary science modules during a semester internship programme. The study was guided by the following research questions:

1. What is the perception of Junior High School science teachers of the TESSA secondary science materials?
2. How relevant are the TESSA secondary science modules to science teaching and learning at Junior High School level?

## 2. Methodology

### 2.1. Participants

Descriptive survey with mixed method approach was used to collect data using questionnaire and focus group discussions as data collection instruments. The sample consisted of 34(8 females and 26 males) science teachers from 34 Junior High Schools in the Effutu Municipality in the Central Region of Ghana. The participants were selected based upon purposeful sampling procedure. The teachers participated in a training workshop to popularize the TESSA secondary materials among public junior high

school science teachers in the Municipality. This was based on the fact that such schools are obliged to implement the Junior High School science syllabus provided by the government.

The participants ranged in age between 26 to 34 years old with a mean age of 28 years. Their years of teaching experience ranged from two years to 9 years with mean of 5 years. The teachers were of different academic and professional backgrounds. Ten obtained B.Ed (Science Ed) degree and the rest Diploma in Basic Education. The teachers participated in the study knowing that the outcome of the study would not affect their status as science teachers and their promotions. They remained anonymous throughout the study and after.

### 2.2. Data Collection Procedure

Two phases were involved in data collection. The first phase involved a study of the TESSA secondary science modules by the participants during a workshop organised for the participants. The workshop was to expose the participants to the TESSA secondary science modules and to have hands-on experience with the materials. The participants were taken through the rationale and principles that guided the development of the materials. They also studied the content of the materials and to locate topics and/or skills outlined in the Junior High Science (JHS) syllabus that matched with suitable themes. They were also taken through the activities and case studies in the modules. The participants then used the materials to prepare lessons for micro teaching sessions which were evaluated and revised. The revised lessons were used for micro teaching sessions which received formative feedback on how to improve the use of the TESSA resources (activities and case studies) and the integration of the resources. The lessons also offered an opportunity for the participants to evaluate and discuss the use of the materials in terms of their relevance, usability and suitability in the Ghanaian context.

The participants prepared and used similar lessons in their respective classes during the first term of the 2012/2013 academic year. The researchers visited the participants to observe their lessons.

The second phase of the study involved a second workshop to evaluate the use of the TESSA materials by the participants. Questionnaires on the relevance, usability and suitability of the materials in the Ghanaian context were administered to the participants followed by focus group discussions for further probe of some of their responses on the questionnaire. An advantage of using focus groups lies in their ability to generate rich data (Schultz & Mandzuk cited in Vågan, & Heggen, 2013). The synergetic effect of the participants engaged in discussions with each other often generates more elaborate accounts compared with individual interviews (Wilkinson, 2006) as was also our experience.

Three focus groups of ten participants each were held each lasting about 45minutes to one hour. The discussions focused on participants' perception of the resources in terms of their usefulness in participants' advance lesson preparation, their appropriateness with regard to the content, skills and values embodied in the Junior High School science syllabus and whether they promote

interactive science lessons, etc. the discussions were audio-recorded.

### 2.3. Data Analysis

The quantitative data collected through the questionnaire were organised into frequency counts and converted into percentages. These were used to answer research question one. The qualitative data collected through focus group discussions were subjected to content analysis to answer research question two. The audio-recorded discussions were transcribed verbatim. The transcripts were read severally and summarised under themes based on the areas covered by the discussion guide: teachers' perception, usefulness and relevance of modules, support for learner-centred teaching approaches and local context of teaching /learning materials.

The authors took a number of steps to ensure a consistent content analysis of the data including the use of the themes that guided the focus group discussions. We independently coded portions of the transcripts and compared and discussed discrepancies in the coding process. Member checking was used to ensure the validity of the results, whereby participants were asked to verify whether the transcripts represented their views (Krefting cited in Makandawire, Chantelle, Jenna, Luginaah, & Tobias, 2013).

## 3. Results and Discussion

### 1. What is the perception of Junior High School science teachers of the TESA secondary science materials?

The question sought to find out the participants' perception of the TESSA secondary science modules, that is, whether the materials could be useful for science teaching in Ghanaian Junior High Schools. It also sought the opinions of the participants as to whether the TESSA materials fitted into the context of the Ghanaian Junior High School science curriculum. The analysis of the participants' responses to the questionnaire resulted in two major findings as follows:

All participants indicated that the TESSA secondary science modules were excellent and that they provided adequate information on all topics treated. They also indicated that the activities suggested in the TESSA materials were similar to the teaching/learning activities contained in the Junior High School (JHS) science syllabus.

Almost all the participants (97 %) indicated that the TESSA secondary science modules would be very helpful and useful teaching learning resource that could be used to improve teachers' ability to teach science at the Junior High School level. They further indicated that the case studies component of the materials would be useful for advance lesson preparation since they appear to suggest alternative teaching approaches to facilitate pupils' participation during science lessons.

The findings suggest that the participants would be willing to adapt or adopt the materials as the case may. This is because of the similarity they found between the TESSA materials and the content of the JHS science syllabus. The congruence reported between the syllabus and the TESSA materials would make the latter acceptable

to the participants. According to Ajibola (2008), congruence of practice and content of innovative materials with teachers' practice and content knowledge make the innovative materials acceptable to the teacher. Also, the fact the participants indicated congruence between the TESSA materials and the JHS science syllabus also suggests the success of the embedding of the TESSA materials within the context of the syllabus.

### 2. How relevant are the TESSA secondary science modules to science teaching and learning at Junior High School level?

The question sought to find out how the materials facilitated the participants' classroom practices. Focus group discussion was used to obtain qualitative data to answer the research question. The data were organised around four main themes that emerged from the discussions. These were: teacher support and professional development; TESSA secondary science modules as useful teaching resource, relevance of TESSA materials with regard to local context and TESSA materials and learner-centred science teaching.

### 3.1. Teacher Support and Professional Development

The participants' views about the support TESSA secondary science modules provide the science teacher are overwhelming. Eighty percent of the participants acknowledged that JHS science teachers need average qualification in science to be able to use TESSA secondary science material in teaching secondary school science. This implies that science teachers lacking in content knowledge, pedagogical knowledge and pedagogical content knowledge will be able to promote active learning in classrooms with the support of these materials. This is because science teachers need to be proficient in these areas of professional knowledge to be able to use learner-centred teaching approaches (Chen, 2008; Salloum & BouJaoude, 2008).

Also, all participants indicated that the TESSA secondary science modules are very helpful and useful teaching learning resource that could be used to improve teachers' ability to teach science at the secondary level. During focus group discussion one of the participants said: 'I think I will become a better science teacher if I continue to use the TESSA secondary science materials for my science lessons'. While another participant testified that the materials made him to have a positive view about science and science teaching. This is well expressed in the following excerpt:

'My exposure to the TESSA secondary science materials has made me to have a different view of science and science teaching. I used to see science teaching as a daunting task but now my love for the subject has gone high and I think I can now teach the subject better than before'.

It can be deduced from this that the TESSA resources have been supportive to an extent of instilling confidence in the teacher. Also, from the views expressed the TESSA secondary science modules seemed to have positively affected the participant's attitude towards science and science teaching in one of the directions intended by the TESSA project.

### 3.2. TESSA Secondary Science Modules as Useful Teaching Resource

All participants indicated that the TESSA secondary science modules were excellent and provided adequate information on all topics they taught. This is supported by the following excerpt from the transcript:

'If I were taught science using the TESSA secondary science modules during my secondary school years, I believe I would have performed better in my science courses. If pupils of today will love studying science and have better achievement in the subject, then all secondary school teachers should be introduced to the TESSA secondary science modules'.

Majority of the participants (90%, 27) indicated that TESSA resources provided information on specific and the various teaching methods they used in their lessons. This is supported by the following evaluative statements made by two of the participants. One of the participants said:

'The TESSA secondary science material even provides information on specific activities teachers could use. The case studies provided information on how I could involve student in lessons. Due to this I did not find it difficult selecting teaching methods and techniques for the presentation of my lessons which were all provided by the TESSA secondary science material. This made me present a systematic and orderly lesson. I mean my lessons always had a smooth flow and I was very happy after every lesson delivery and so were my pupils'.

The other participant further amplified the above comments by the following evaluative statement:

'Most of our secondary science textbooks provide only information that teachers should present to pupils during lessons but provide no or little information on activities that could be used in presenting the information. This makes this TESSA secondary science material very exceptional'.

Overwhelming majority of the participants (93.3%, 28) reported that The TESSA secondary science material provides additional and more detailed information on topics for the teacher. Some of views shared by some of participants included:

'This is not the case in many of our Junior High school science textbooks. I have heard that additional information is provided in teachers' guide on the science textbooks. However, my colleagues and I can confirm the absence of these so-called teachers' guide in the schools we teach'.

Another participant had this to say:

'I do not believe the existence of the science teachers' guide because I have never come across any in my five years teaching experience. If they are in existence, why is the government not making it available in schools. I think the TESSA secondary science material provides adequate information a teacher requires for a successful lesson in science.'

The teachers' guides referred to in the above statements, provide additional information on topics considered difficult to the teacher.

### 3.3. TESSA Materials and Local Context

About 87% (26) of the participants observed that the TESSA secondary science material provides more

adequate information on how to select and use locally available materials and resources than the teacher's guides supplied to Junior High Schools by the Ghana Education Service. Again, they observed that the teaching/learning materials suggested by the TESSA resource are readily available and are cost effective. These observations are captured in the following excerpts from transcripts of the focus group discussion:

'There is no mention of sophisticated and non-available teaching learning material. All materials indicated to be used in activities are available. However for those that may not be available suggestions are made for local alternatives'. This assertion is buttressed by the following excerpt: 'I used three of the resources in the TESSA secondary science modules for my lessons and in all I was able to obtain materials from the local environment. I did not have to buy any material'.

### 3.4. TESSA Materials and Learner-Centred Science Teaching and Learning

The participants' found the TESSA secondary science modules useful in promoting pupils' involvement in instructional activities and development of process skills. Almost all the participants (96.7%, 29) indicated that the TESSA secondary science modules place emphasis on activity oriented methods and other learner-centered approaches of teaching. This view is exemplified by reflective statements made by three of the participants during the focus group discussions. One remarked that,

'Lessons in TESSA secondary science materials are presented in such a way that learner involvement is more emphasised as against teachers' involvement. I don't have to tell them or do everything for the pupils but I have to involve them to observe for themselves'.

Another remarked that:

'Most of the work I did was done during lesson preparation prior to the lesson presentation. During the lesson presentation, all I did was to serve as a guide. Pupils did all the work and presented their findings for discussion by the whole class'.

Yet another participant reported on how the TESSA resources promoted student involvement during science lessons: 'My pupils were always fully involved in my lessons. You could see the joy and excitement on their faces during science lessons due to various activities in the TESSA secondary science materials I engaged them in'.

Despite the favourable comments the participants made on the modules, a number of challenges emerged from the focus group discussions. The usefulness of the TESSA materials notwithstanding, majority of the participants (94%, 32) reported among other things that, accessibility of hard copies of the resources would be a challenge to them since most schools do not have ICT tools from which they could print out materials. It is therefore recommended that copies of TESSA secondary science modules be made available in all schools for effective implementation by teachers.

## 4. Conclusion and Recommendations

The ability to see relevance in and make practical applications of the elements of a curriculum document

may depend on a teacher's disposition to engage with change or an innovation and appropriate opportunities to become familiar with and apply the frameworks underpinning that change or innovation. This was the case in this study. To further strengthen the participants' disposition towards the TESSA secondary materials it is recommended that:

1. TESSA secondary science material should be made available for teachers use and proper sensitization should be done to help teachers in the Effutu Municipality to teach science effectively.

2. Also, the style used in writing the TESSA materials should be adopted in writing science textbooks for use in primary and Junior High Schools in the Municipality. This is likely to promote pupils' interest and improve their achievement in science.

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