

# An Investigation of the Teaching Approach Used by Tutors to Prepare Science and Mathematics Teachers during Training at Morogoro Teachers' College

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## Abstract

This paper investigated the teaching approach used by tutors to prepare science and mathematics teachers during training at Morogoro teachers' college. For six years consecutive the performance of science and mathematics in secondary school has become very poor even though the training colleges produce science and mathematics teachers every year to teach secondary schools. This brought a doubt on the teaching approach used by science and mathematics tutors in teachers' colleges to prepare science and mathematics teachers during training. The researcher conducted the study to see if the Science Processes Skills (SPS) are well applied during training of the prospective science and mathematics teachers. The study employed qualitative approach with a case study design. Key informant interview and focus group discussion were the main methods of data collection whereby 32 respondents were purposively involved in data collection. Content analysis was used to analyze data thematically. The study found that the science and mathematics teachers during training were not prepared by using scientific approach which was science process skills such as problem and inquiry. Other methods contrary to science process skills and competence based curriculum were used such as lecture method and rare question and answers. **Keywords:** Scientific Approach, Science Process Skills (SPS), Science and Mathematics, Tutors, Teachers, Competence Based Curriculum, Training Colleges

## 1. Introduction

Science and mathematics teachers are supposed to be well prepared in such a way that they can acquire science process skills such as problem solving and inquiry so that they can be able to equip or transfer the knowledge to their learners when teaching in the classrooms (Colley, 2006). One of the good methods of preparing these science and mathematics teachers during training is by using Science Process Skills (SPS), a method which hinges itself as a building-block of critical thinking and inquiry in science teaching and learning (Ostlund, 1992). On top of that, Science process skills are transferable skills that are applicable and reflect the behaviour of scientists as it ensures active student participation, sense of students to undertake responsibility in their own learning and increase the permanence of learning, also it helps the student to acquire different ways of conducting research and at the same time develop skills to problem solving and inquiry (Harlen, 1999). This implies that science and mathematics teachers' preparation should start from training college so that they can be equipped with different skills that they will be able to apply in their teaching processes and become successful in teaching science and mathematics in schools after graduation. Therefore, if a teacher becomes knowledgeable with proper scientific skills, they can teach students well in secondary schools using required approach like observations, problem solving, analysis, reflections on their work, drawing conclusions and generating findings and predictions (Welch, Klopfer, Aikenhead & Robinson, 1991). This is in line with the argument of Schoon (1996) who argued that an effective science and mathematics teacher should have the knowledge of the subject matter, teaching pedagogy, the learner, the school and the school environment.

Science process skills are based on scientific inquiry (Colley, 2006). Inquiry is an approach to teaching which can help science and mathematics teachers to understand the concepts and use of process skills and scientific reasoning when teaching in schools (Yager & Akcay, 2010). Teaching methods such as inquiry teaching, problem solving, problem based learning and project based learning relies on effective use of science process skills by students to complete an investigation (Colley, 2006). Inquiry science teaching involves theory and a lot of practical where students have to be involved in observing, collecting data, comparing and contrasting the data and hypothesizing (Cuevas, Lee, Hart & Deaktor, 2005). Colley (2006) further indicates that through inquiry-oriented methods science and mathematics teachers could help learners to build their interest in the materials and activities, and to encourage their thinking, questioning and discussion for a variety of investigatory paths which can fit the subject content matter and learners' intellectual level and apply it to everyday social problems.

In Tanzania, the performance of science and mathematics subjects is still very poor as the average performance of science and mathematics for six years is below 50% (MoEVT, 2014), however teacher colleges

produce science and mathematics teachers every year to teach secondary schools. For example, the average performance of science and mathematics subjects for six years from 2009 to 2014 are 16.2%, 38.8%, 46.1% and 49.5% for mathematics, biology, physics and chemistry respectively (MoEVT 2014). These imply that more than 50% of the students do not pass science and mathematics subject in secondary schools in spite of using Competence Based Curriculum which introduced in 2005 in secondary education and 2009 in teacher education. Many studies have been conducted to find out why science and mathematics subjects are poorly performed despite of having teachers from training colleges. The study conducted by Kagisi (2009) and Mdimba (2005) revealed that the science teaching approach is not used in classroom, only lecture method is used all the time which is not appropriate for teaching and learning science. Science and mathematics learners were not involved in the critical analysis of issues instead they possess pieces of information and facts which lead to memorization and failed to relate with the real life situation (Kahwa, 2009; Nanyoro & Chagu, 2003). The study conducted by Osaki (1999) on science and mathematics teachers found that most teachers lack skills on promotion of student centred teaching and learning procedures. The skills that were found to be lacking were observations, generation and testing of hypotheses through experiments, discussion of experimental results, analysis of data and writing reports of observations and experiments. Addition to that the study conducted by (Mafumiko, 2008) on teaching and learning revealed that learner centred approach as one of the science teaching and learning strategies which associated with mental involvement, thinking and cognitive processes, it has been reduced to physical and verbal involvement only.

Darling-Hammond (1997) observed that most science teachers are of poor quality which is one of the factors that inhibit the quality of science and mathematics education in schools, and that most teachers lack adequate background knowledge in the fields they are asked to teach or insufficient skills they need to teach their students following the poor preparation during training in their institutions. Ogunbowale (2001) pointed out that the broad scope of the science curriculum had not put emphasis on quantity of content coverage and this was a major constraint on inquiry approaches in science teaching and learning in Nigerian teacher colleges and schools. It is assumed that when teachers teach less content, they teach it better by introducing ideas and give examples in a variety of ways and thus encourage students' learning (Rutherford & Ahlgren, 1990; Wenning, 1997). In Tanzania, since 2007 the curriculum of teacher education is more of learner centred with a focus on learners' activities oriented (TIE, 2007), hence easy to use inquiry and science process skills to prepare science and mathematics teachers. Kasuga (2016) in his study on learner centred approach argued that teachers do not use a variety of highly recommended learner/learning strategies such as inquiry, demonstration, practical work, project work, field trips, and discussions. In most lessons, there is little evidence of increased participation in class of all groups of learners where the skill of asking questions and giving well-thought out answers is also not being developed in students. He also add the traditional lecture method, in which teachers talk and students listen dominates most classrooms which is not recommended on science and mathematics teaching and learning approach.

Before 2009 the science and mathematics teachers were prepared using the traditional content-laden and teacher centred curriculum of 1997 in which most of student teachers lacked competences in both subject matter and pedagogical skills in their preparation. The introduction of CBC in 2005 in secondary schools forced teacher training colleges to review their curriculum in 2009 which introduced CBC in Teachers colleges so that they could be able to prepare student teachers as these are supposed to go and teach in secondary schools using the competence based curriculum of 2005. Therefore, since 2009 the student teachers in science and mathematics are prepared using competence based curriculum which focuses on developing the student teachers' pedagogical knowledge and skills to cope up with competence based teaching and learning. Hence, the curriculum emphasizes context and inquiry based instructional methods in science and mathematics such as problem solving, critical thinking and use of outdoor activities so as to promote and help students to learn independently, creatively and/or innovatively.

Following the average performance of science and mathematics subjects being poor in secondary schools for six years and the studies which have been conducted explaining how the science and mathematics teachers failed to use proper teaching and learning approach in science and mathematics, it raised doubt whether the science and mathematics teachers were prepared well during training in teachers colleges, that is by using science process skills. If the science and mathematics teachers did not prepared well in science teaching and learning strategies it will be difficult to prepare students in secondary schools with the learning strategies in which he/she did not pass through during training.

Many studies have been conducted in different countries include Tanzania on the approaches used by science and mathematics teachers to teach secondary schools. There is no study so far conducted specific to investigate the approach used by tutors to prepare science and mathematics teachers during training in the college. Therefore this study aimed to fill the gap as it investigate the teaching approach used by tutors to prepare science and mathematics teachers during training.

## **2. General and Specific Objectives**

The general purpose of this study was to investigate the teaching approach used by tutors to prepare science and mathematics teachers during training. Specifically the study intended to investigate the teaching approach used by tutors to prepare science and mathematics teachers during training at Morogoro teachers college. The specific objective followed by the key research question which was:

- What are the teaching approaches used by tutors to prepare science and mathematics teachers during training at Morogoro teachers college?

## **3. Methodology**

### **3.1 Study Area**

This study was conducted at Morogoro Teachers' College which obtained through simple random among 7 public teachers' colleges offering science and mathematics training. 8 science and mathematics college tutors and 24 science and mathematics student teachers were purposively selected.

### **3.2 Research design and data collection**

The study employed a qualitative research approach where a case study research design was used. Qualitative data on the approach used by tutors to prepare science and mathematics teachers were collected by using key informant interviews and focus group discussion.

### **3.3 Data Analysis**

Content analysis was used to analyse data which were obtained through interviews and focus group discussions. In depth descriptions of specific themes based on research objective and related question was provided as most of the data were in form of word.

## **4. Results and Discussions**

### **4.1 The Teaching Approach Used by Tutors to Prepare Science and Mathematics Teachers during Training in Teachers' Colleges**

In this part the researcher investigated how the student teachers were being prepared in terms of teaching and learning methods during training so as to get pedagogical skills and to identify the common methods used by their tutors to deliver contents in the college that other science and mathematics students teachers could learn by imitating the methods, techniques and strategies used by their tutors and use them to teach science and mathematics after graduation.

During the interviews, six tutors indicated that the common methods which were used to deliver content to science and mathematics student teachers were 'lectures' and 'discussion methods' and the other two responded that they mostly used 'question and answers' and 'presentation' methods. This also was supported by the student teachers in their focus groups discussions that tutors used the lecture methods along with questions and answers in delivering content. Addition on that the questions are always answered by tutors as no one is able to respond. Regarding knowing how students are prepared in pedagogical content, five tutors revealed that the student teachers were prepared and became familiar with the teaching methods through observation where they observed their tutors teaching in the classrooms, through 'microteaching', 'demonstrations' and by orienting them on teaching methods without practice due to fixed time. Meanwhile 3 out of 8 responded that student teachers were becoming familiar with the teaching methods through their pedagogical subjects. All this implies that only few tutors oriented student teachers in the teaching methods as it is required because they have to be oriented in teaching and learning methods from their pedagogical subjects, other orientations including microteaching, demonstration and imitation are just added advantages to see how methods are practiced.

Moreover, in the focus group discussions both groups revealed that they went to the first year teaching practice before learning the teaching methods, which made them to experience difficulty in delivering subject matter using different approaches and thus suggested that the important topics, for example teaching and learning methods, should be taught at the beginning of their studies so as to be familiar with them because they were joining the teacher training colleges fresh from schools and they had never taught in the classroom before.

These findings imply that science and mathematics teachers during training are not prepared well with the scientific approach required to be used for science and mathematics teachers which is the Science Process Skills following the Competence Based Curriculum. The strategies such as problem solving, inquiry, observations, analysis, reflections on their work, hypothesis, drawing conclusions and generating findings and predictions do not used at all. Only lecture method dominated and few in discussion and question and answers. It will be very difficult for these teachers after graduation to teach by using Competence Based Curriculum as well as science process skills which they don't know themselves.

## 5. Conclusion and Recommendations

The study revealed that science and mathematics teachers during training in teachers college did not prepared using proper scientific approach which was Science Process Skills (SPS) following the competence based curriculum. The methods and techniques used to prepare them were not proper for science and mathematics for example the use of lecture method and questions and answers. For these reasons, it will be very difficult for science and mathematics teachers prepared through this approach during training to teach well science and mathematics in secondary school after graduation. Therefore, this could explain one of the reasons of having incompetent prospective science and mathematics teachers in the teaching profession in secondary schools. To overcome these, teachers training colleges should always conduct in house training for the professional development for science and mathematics tutors so as to be able to prepare science and mathematics teachers using Science Process Skills so that they can apply it when teaching science and mathematics in secondary schools after graduation.

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