



THE IMPLEMENTATION OF SCIENTIFIC INQUIRY SKILLS IN PRIMARY TEACHER TRAINING COLLEGES IN KENYA

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ABSTRACT

This report investigates the implementation of scientific inquiry skills in a primary teacher training college, as a possible solution to transforming science education in primary classrooms. The current practice is that primary science tutors prepare pre-primary science teachers who do not have the prerequisite skills. According to this report, scientific inquiry skills are required for extensive and diverse learner-centred interactions and hands-on activities that centre on the application of science to improve a learner's scientific literacy. The study sought to identify the scientific inquiry skills that primary science tutors need to develop in pre-service primary science teachers. Five scientific inquiry skills were targeted: observation, questioning, experimentation, investigation and critical thinking. A qualitative approach and a case study design were used. Data was collected using semi-structured face-to-face interviews, classroom observation, focus group discussion and document analysis. The findings revealed inadequate utilisation of scientific inquiry skills in the pre-service science classroom, due to inadequate exposure of primary science tutors to such scientific inquiry skills in the Initial Teacher Education curriculum. This report suggests that there is a need to integrate and utilise, adequate scientific inquiry skills in the Initial Teacher Education curriculum, in order to adequately prepare primary science tutors. It is also necessary to integrate scientific inquiry skills in the in-service retraining of primary science tutors and in the induction course for those entering primary teacher preparation colleges.

Keywords: *Scientific inquiry skills, scientific literacy, primary science tutors, pre-service primary science teachers, initial teacher education.*

INTRODUCTION

The need to realise good learning outcomes by developing scientific literacy in pre-service primary science teachers cannot be ignored. However, the teaching of “right” facts prevents many teachers in sub-Saharan Africa from using approaches that develop important inquiry skills (Vavrus, Mathew & Barlett, 2011). This results in insufficient comprehension of the learned science concepts.

According to Mwangi (2011), there is inadequate understanding of the knowledge and skills of primary teacher education tutors with regard to pedagogical knowledge and skills, hence the need for research on primary teacher education tutors' classroom teaching practices. Furthermore, UNESCO's Technical Paper 2 of 2005 states that, there is a need for innovative experiments and investigation regarding learning and teaching the science curriculum.

The Kenya Vision 2030 aims at transforming Kenya into a newly industrialised middle-income country by 2030 (Government of Kenya, 2007). Investing in science education is critical and necessitates the preparation of primary science tutors who can actively engage pre-service primary science teachers in learner-centred approaches by implementing scientific inquiry skills.

According to Ng'asike (2012), primary science tutors are public university graduates who are trained as secondary school science teachers. The majority lack appropriate skills for the science instruction of pre-service primary teachers, since their training in the Initial Teacher Education curriculum was intended for secondary school teaching.

This report argues that a primary science tutor education curriculum that is embedded in the Initial Teacher Education programme and places special emphasis on the implementation of scientific inquiry skills would ensure that these skills are put into practice during the preparation of pre-service primary science teachers. Therefore, the research question posed by the author was: “What scientific inquiry skills do primary science tutors impart to pre-service primary science teachers during science lessons, and to what extent do these skills agree with the expected scientific inquiry skills teachers need in order to facilitate learners' learning?”



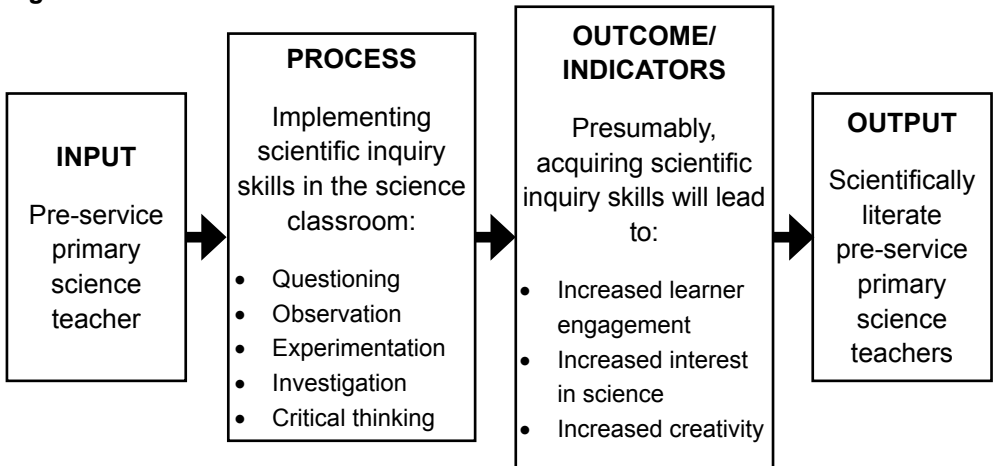
LITERATURE REVIEW

Scientific inquiry learning starts with the know-how of observation, which is acknowledged as an essential basic skill in primary science (Johnston, 2005; Boo, 2006). According to Doherty (2011), experiments provide active hands-on, minds-on learning that facilitates scientific thinking in learners other than memorising facts. Inquiry-oriented investigations actively involve students in learning, raising their interest in science and developing critical thinking skills (Hackling, Goodrum & Rennie, 2001). In addition, implementing investigative pedagogical approaches enhances active learning and not the passive receipt of knowledge (Ng’asike, 2012).

An inquiry-based classroom promotes critical thinking skills, which empowers students to become self-determining and lifelong learners (Belleau & Otero, 2013). Although science educators continue to state the need for teaching science as inquiry, classroom practices have shown little proof of realizing this (Bybee, 2010). Furthermore, in Kenya, pre-service primary science teachers do not have sufficient conceptual understanding of science process skills (Chebalengula, Mumba & Mbewe, 2011). However, few studies, if any, discuss the implementation of scientific inquiry skills by primary science tutors in teacher training colleges. This is the significance of this study.

CONCEPTUAL FRAMEWORK

Figure 1



Source: Author

According to Kiggins (2007), teacher-learner engagement can enhance learner motivation – and therefore active participation in their lessons. In Figure 1, the pre-service primary science teachers are the “input” that the primary teacher training college takes through the “process”, which is the implementation of scientific inquiry skills. This would result in increased active learner engagement, which promotes interest in science and creativity; hence, scientifically literate pre-service primary science teachers would be regarded as the “output”.

METHOD

A qualitative approach and a case study design were used. The instruments used were a semi-structured face-to-face interview with a science tutor, two classroom observations of the primary science tutor during the science lessons with 74 pre-service primary science teachers, a focus group discussion with 6 pre-service primary science teachers and document analysis of the Primary Teacher Education Ministry of Education (MOE) science syllabus and science tutor's schemes of work. The data was consequently transcribed and coded. The codes were clearly read to come up with categories, which were later organised into themes.

RESULTS

This report revealed that observation was found to be the most used scientific inquiry skill during the science lessons, especially during tutor demonstrations. The primary science tutor utilised more closed-ended questions than open-ended questions. There was no probing to facilitate an in-depth understanding of the concepts and active learning.

Experimentation was not a common scientific inquiry skill and only a few experiments were listed as a learning activity. In addition, classroom observation revealed that there was no evidence of experiments being done. Investigation was not a regular scientific inquiry skill used during the science lessons and the pre-service primary science teachers perceived it as an unnecessary scientific inquiry skill for teaching science in a primary classroom. Further analysis of the schemes of work showed that the science tutor had not included investigation as learning and teaching activity.

Minimal development of critical thinking in the preparation of pre-service primary science teachers was revealed. Classroom observation revealed that critical



thinking was rarely utilized, and only through a few open-ended questions that were posed. The scheme of work analysis showed that most of the questions listed elicited only factual information about the science concepts taught. Nonetheless, the analysis of the MOE's Primary Teacher Education science syllabus revealed that pre-service primary science teachers should be taught to develop critical thinking and creativity in addressing emerging issues in science.

DISCUSSION OF FINDINGS

Key findings revealed that the recommended scientific inquiry skills, which are the "process" in the conceptual framework (see Figure 1) and are supposed to be imparted by the teacher, were not adequately implemented in preparation for achieving the "output" of the conceptual framework, in other words, scientifically literate pre-service primary science teachers.

It was established that more use was made of closed-ended questions than open-ended questions. Open-ended questions should be prepared that they elicit various opinions from the learners and stimulate the exploration of various options before making a decision (Morgan & Saxton, 2006).

Classroom observation further revealed that the participant pre-service primary science teachers were mainly engaged in observation during tutor demonstrations. In addition, exposure to only a few experiments was found to be a contributing factor to the inadequate utilisation of observation, which provides a powerful tool for acquiring insight into situations (Cohen, Manion & Morrison, 2007).

Investigation was found to be rare, which denies pre-service primary science teachers exposure to the analysis and interpretation of hands-on, minds-on activities. The use of investigations would expose them to thinking and reasoning critically to evaluate scientific concepts and so develop their scientific literacy skills (Hackling, et al., 2001).

Critical thinking was found to be used minimally in the preparation of pre-service primary science teachers. The use of critical thinking elicits meaningful science learning when it is well utilised in the preparation of pre-service primary science teachers (Murcia, 2005). Furthermore, if teachers are trained to acquire critical thinking skills, they would be able to question the scientific claims made by others.

CONCLUSION

This report attested to the fact that there is minimal implementation of scientific inquiry skills, like experimentation, investigation and critical thinking in the pre-service training of science teachers. In addition, there was little evidence of effort being made to implement the skills of observation and questioning.

Based on the findings, it was determined that the Initial Teacher Education curriculum may be adequate in terms of ensuring that primary science tutors have the essential science pedagogical content knowledge and adequate skills necessary for practice. However, in light of this report, there is a need to establish an initial primary science tutor's curriculum that includes scientific inquiry skills in the Initial Teacher Education Programme. These skills should also be implemented in the in-service re-training of existing primary science tutors, as well as in an induction course for those entering primary teacher preparation colleges.



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