

Integrating TESSA Science OERs in the Secondary School Curriculum in Kenya for Effective Pedagogy

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Abstract

Teacher Education in Sub-Saharan Africa (TESSA) is a research and development initiative creating Open Educational Resources (OERs) for teachers and teacher educators in Sub-Saharan African countries. The project focuses on interactive pedagogical skills for Teacher Education programmes. It seeks to promote effective pedagogy through interactive curriculum materials intended to enhance learners' participation in the learning process. TESSA Secondary Science was initiated in 2010 following the success of TESSA Primary Project to support pre-service, in-service and practicing secondary science teachers. TESSA Secondary Science is the focus of this paper. The activity-based TESSA OERs focus on five themes; probing students' understanding, making science practical, making science relevant and real, problem solving and creativity, and dealing with challenging concepts. In Egerton University, Kenya the TESSA materials are used by Science Teacher educators to enhance pedagogical skills of pre-service teacher trainees during subject methods training, micro-teaching lessons and practicum. The use of the materials is expected to be further extended by teachers when they join the teaching profession. A monitoring and evaluation survey revealed that student teachers were using the TESSA OERs during practicum and this helped to actively involve learners. However, student teachers encountered challenges. These include lack of electricity and internet connectivity, and poor ICT infrastructure in some schools. The use of TESSA OERs may be useful in teacher preparation in the 21st century. There is need to deal with the challenges encountered to enable use of the TESSA Materials to enhance active learning.

Keywords; Integrating, TESSA Science OERs, Curriculum, Effective Pedagogy

Introduction

It is argued that the provision of good quality education depends on effective teacher education, which is a direct outcome of the teacher education programmes. Indeed, evidence suggests that teacher quality is an important factor in learners' success (Kini&Podolsky, 2016; Arends, Winnaar & Mosimege, 2017). Good quality curriculum materials can support teachers in making the crucial link between theory and practice; between what they know and believe and how they teach in the classroom (Stutchbury & Ngman-Wara, 2012). The use of quality teaching/learning materials should, therefore, be emphasized in the training of pre-service teachers. Research indicates that low achievement, especially in science subjects, may be due to lack of sound pedagogical skills of teachers and use of relevant learning resources (Wambugu, Changeiywo & Ndiritu, 2013; Kibos, Wachanga & Changeiywo (2015). The teaching/learning approaches commonly used in Sub-Saharan African schools are mainly expository in nature, thus encouraging learners to become passive recipients rather than active participants in the learning process (Orora, Keraro & Wachanga, 2014; Hassler, Hennessy & Hofmann (2018). Such approaches do not actively engage learners in the learning process and appear to deny them an opportunity to take responsibility for their own learning. Effective and meaningful learning of science at secondary school level is crucial in the preparation of learners for the world of work and successful living in the modern and technological society (Sailin & Mahmor, 2016).

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This paper, therefore, argues for the use of active learning approaches and learning resources that place learners in active rather than passive roles in science lessons. This may have a substantial impact upon student achievement and even motivation to learn.

In order to place learners at the center of the learning process and become active participants in the classroom, a pedagogical paradigm shift is required. This is a learner-centered classroom where pupil-teacher interactions lead to construction of knowledge through active inquiry. Active learning is claimed to be anchored in the constructivist theory of learning. Constructivist Learning Theory used by various researchers has been shown to result into better results in terms of student's achievement and success during learning of any course (Carr, Palmer & Hagel, 2015; Demirci1i, &Gümüş, 2017, Elander & Cronje 2016). The constructivist theory has its theoretical foundations on Piaget's theory of 'genetic epistemology'. According to Vygotsky (1978), Driver and Bell (1986), Solomon (1987), Good & Brophy (1995), the principle tenets of constructivism are: i) learning is an active and social process; ii) the responsibility of learning resides with the learner; iii) the role of a teacher is to facilitate the learning process by creating an appropriate learning environment; and, iv) learners' prior conceptions play a significant role in the learning process. This suggests that firstly, learners should be actively engaged in learning in small social groups, to engage them in negotiations of meanings of concepts and materials encountered as they actively construct new knowledge for themselves; second, learners have a responsibility to choose to be actively involved in the learning process and should be willing and prepared to learn; third. A teacher should plan for activities that actively engage learners and facilitate conceptual change; and finally, it is a teacher's responsibility to probe learners' prior conceptions to facilitate the provision of appropriate learning experiences that can enhance conceptual change. This calls for a teacher to carefully select appropriate learning resources. This paper claims that the use of this approach enhances partnership (teachers and students negotiating and learning together) thus encouraging learners to appreciate the relevance of learning to real life enabling them deal with challenging concepts. The constructivist theory guided the development of TESSA OERs based on five themes which include: probing students' understanding; making science practical; making science relevant and real; problem solving and creativity; and, dealing with challenging concepts.

TESSA is a research and development initiative that has created OERs for teachers and teacher educators working in Sub-Saharan African countries. The project focuses on interactive pedagogical skills for Teacher Education programmes through promoting effective pedagogy and interactive curriculum learning resources intended to learners' participation.. TESSA has focused on bringing together the affordances of increasingly available connectivity in the region, the advent of OERs and aspects of the digital communications. This has led to the creation of original audience-specific OERs to support teacher education. User engagement and interaction is through the TESSA website. Core TESSA content consists of online, text-based study units, developing and improving teachers' practices, competencies and skills. The TESSA materials are designed to be a pedagogic toolkit of skills and information to enhance the professional knowledge (both subject and pedagogic) of teachers.

TESSA learning resources were developed collaboratively by teacher educators from the participating institutions in five countries in Sub-Saharan Africa namely Kenya, Uganda, Zambia, Tanzania and Ghana. Teacher educators, in each of the respective institutions versioned the OERs to fit in their own teacher education programmes. The TESSA secondary science resources (OERs) are available on: <http://www.tessafrica.net>

In Egerton University the teacher educators use the TESSA OERs in the training of pre-service teachers. This is done during the methods of teaching courses where student teachers are introduced to the use of teaching and learning resources. Later, student teachers undergo further training during microteaching where they are expected to use the TESSA OERs in their lesson presentations. Student teachers then proceed to practice in schools for their school experience (teaching practice). Teaching practice is a core component of all pre-service teacher education programmes. Through teaching practice, a novice teacher is expected to inculcate a viable pedagogic experience to effectively support students to learn in a real classroom situation. The use of TESSA OERs during teaching practice is, indeed, meant to enhance the pedagogical experiences of pre-service student teachers. The use of the learning materials is further expected to be extended by teachers after completion of the teacher education programme as they join the teaching profession. Student teachers are encouraged to use the TESSA OERs to enhance their teaching. Use of the materials incorporates active learning, this means, therefore, that student teachers are engaged in designing teaching strategies that provides them with an opportunity to engage in the same style of learning they are designing for their students (Darling-Hammond, Hyler& Gardner, 2017).

It is anticipated that those teachers already practicing with the TESSA resources, would guide other teachers who are less familiar with TESSA OERs, to use them in their science lessons. The TESSA resources target some topics in the lower secondary science curriculum, but teachers may apply the same approach to other topics in the curriculum.

However, this novel initiative faces a number of challenges in its implementation by teacher educators during micro teaching and practicum sessions and also for practicing teachers. These challenges include internet connectivity and lack of electricity in many secondary schools, lack of requisite ICT skills and infrastructure, teachers' attitudes in view of their traditional pedagogical practices, class size, classroom organization and administrators' attitudes towards the OERs. This study investigated the gap in the case of using TESSA OERs in learner-centered set ups among teacher educators in Egerton University during microteaching, pre-service teachers during their practicum and practicing teachers in selected schools in Nakuru County, Kenya.

Methodology

An induction workshop on the implementation and use of the OERs was held in Egerton University for teacher educators and practicing teachers from selected schools within Nakuru County. The teacher educators were encouraged to use the TESSA OERs during the methods course and also Microteaching of the third-year students. The students proceeded on for their teaching practice and an evaluation on the use of TESSA OERs was carried out at the end of the three-month Teaching Practice period to evaluate the extent and success of the use of the materials during the training of the student teachers, the micro teaching and the teaching practice.

The study adopted a descriptive survey design utilizing qualitative research design techniques. Data from which we draw this paper was collected from teacher educators working with the pre-service student teachers and were using TESSA OERs. The focus was on the use of these learning resources by the pre-service student teachers during teaching practice. Further, evaluation of how the OERs are used by practicing teachers was also done. Purposive sampling was used to select student teachers on teaching practice and practicing teachers who had earlier been introduced to TESSA OERs. Teacher Questionnaire was used to collect data from student teachers on teaching practice together with class observation. The practicing teachers were interviewed by the researchers. Data was analyzed using descriptive statistics and presented in frequency distribution tables and percentages.

The Findings

The results of analyzed data indicate that the sampled student teachers actually used the TESSA OERs. This means that they were introduced to the OERs by their respective teacher educators.

The respondents were asked to specify the TESSA materials they used. Figure 1 indicates that majority used the Physics OERs. This was followed by the Chemistry and Biology OERs respectively. This may be attributed to how much teacher educators used the TESSA materials in their training. Findings indicate that student teachers who were equipped with the TESSA OERs during their preparation tended to incorporate them in the teaching and learning process. The classroom observations done during teaching practice assessment by the researchers indicated that the lesson presentations of student teachers who used TESSA OERs were active and learners were motivated.

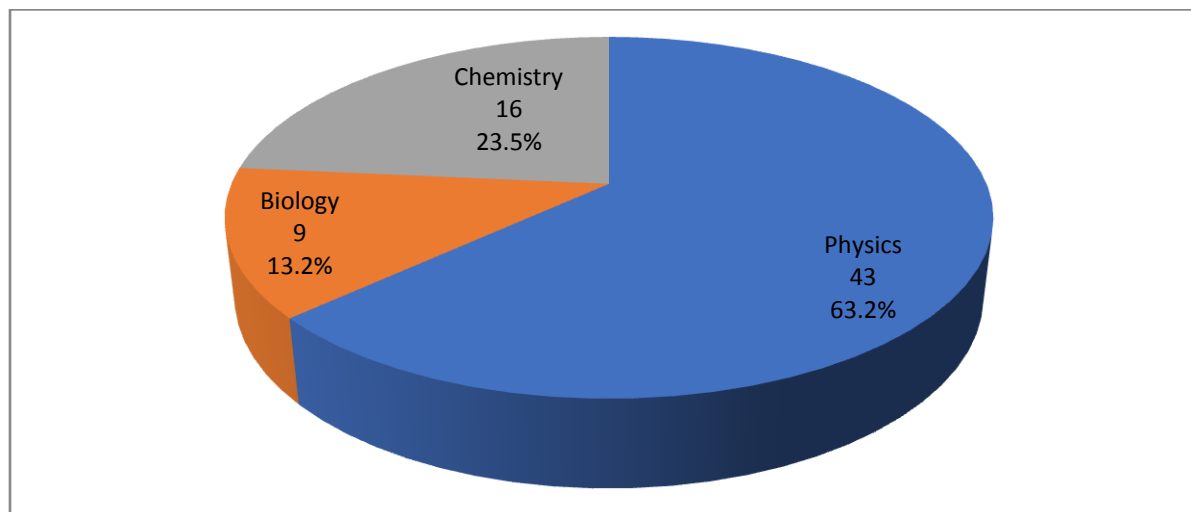


Figure 1. Subject based TESSA OERs used by student teachers on teaching practice
 The student teacher questionnaire also focused on the level of awareness, use and challenges encountered in the use of TESSA OERs

Table 1: The Extent of the use of TESSA OERs.

Table 1: The Student Teachers’ use of TESSA OERs during Teaching Practicing

Statement	Agreed	Undecided	Disagree
I am aware of the TESSA materials	82.1 (55)	6.0 (4)	11.9 (8)
I used TESSA materials during my teaching methods course	70.0 (49)	8.6 (6)	21.4 (15)
I used TESSA materials during my Micro Teaching	62.3 (43)	8.7 (6)	29 (20)
I used TESSA materials during my Teaching Practice	68.6 (48)	10 (7)	29.0 (20)
TESSA materials are useful in teaching	81.2 (56)	11.6 (8)	7.2 (5)
TESSA materials will have value to me as a teacher	88.6 (62)	7.1 (5)	4.3(3)

The findings from Table 1 show that student teachers were aware of the learning resources and used them during their methods course and also used them during their Microteaching and teaching practice. Student teachers felt that the learning materials were of value to them as teachers.

The learning materials were found to provide an appropriate opportunity for learners to construct meanings for themselves and build on what they already knew. In addition, the OERs allowed learners to share and exchange ideas with each other in the learning process. Because the OERs are activity based, it was found that learners were able to develop science process skills through active involvement in learning activities. Learners are, therefore, in a position to question their prior conceptions as they tackle the tasks. This facilitates smooth transition from misconceptions to conventionally acceptable scientific conceptions. The OERs place emphasis on small group activities. This allows learners to work in mixed ability groups and thus enhance the learning of weak learners as they learn from their more able colleagues and in addition, it boosts their self-esteem.

The use of TESSA secondary science OERs presented a number of challenges to both teachers and learners. The pre-service teachers found it difficult to use TESSA OERs during their school experience because they lacked cooperating teachers who had the knowledge of TESSA OERs in their respective schools. They, therefore, found themselves introducing a new pedagogical skill. Many schools lacked ICT infrastructure such as computers, power and internet connectivity. They, therefore, had to rely on the print copies of materials that were provided by the university. As a result, there was limited use of the materials. In addition, students would not actively interact with the materials. Many practicing teachers in secondary school lacked requisite ICT skills. Therefore, even for those schools which have computers and internet connectivity, there is bound to be limited use of the web-based resources. At the same time, teachers were unwilling to embrace new practices because of the examination-oriented system of education.

Another group of teachers taught as they did previously but tried to relate what they were doing to the use of the OERs, albeit superficially. Some of the practicing teachers found the TESSA approach challenging and felt that they needed further training on their use. The large class sizes too posed challenges. The average class size in most schools was fifty (50) students. While the Kenyan educational policies encourage learner centered teaching/learning approaches, the schools maintained the traditional sitting arrangement and, indeed, the large class sizes complicated the problem of re-organization for meaningful group activities.

Teacher educators while using the TESSA OERs during microteaching found them useful in training of effective learner centered teaching/learning strategy. The pre-service teachers embraced the themes in science subjects but it was a challenge for those teaching mathematics and geography.

Conclusion

On the basis of the findings of this study, it is concluded that teachers were unable to use the TESSA OERs because they were not aware of their existence. In addition, a majority of them lacked requisite ICT skills hence were denied the opportunity of taking advantage of OERs. Most schools, especially those in the rural areas lack electricity, ICT infrastructure and internet connectivity. This denies them the opportunity to use teaching/learning resources that reside in the worldwide web. This thus, limited the use of TESSA OERS in the teaching and learning process in the schools. A majority of the school administrators and teachers were found to have an ICT phobia. This further limit the likelihood of the learning resources on the worldwide web.

Recommendations

It is recommended that teacher educators need to embrace the TESSA OERs and incorporate them in their pre-service teacher education programmes. Further, continuous professional development (CPD) programmes for teachers on integration ICT in teaching and use of the OERs would also play a key role in enhancing teacher quality and thus, a great improvement in pedagogical skills for the 21st education. For future studies, there is a need for consideration of supplying schools with electricity, internet connectivity and the requisite ICT infrastructure to enhance ICT integration in teaching and learning.

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