

A Comparative Study of South African and Zimbabwean Science Teacher Education Programmes: Some Theoretical Reflections

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Doi:10.5901/mjss.2013.v4n13p317

Abstract

Science teacher education programmes need to be improved considering the vital role science teachers play in training scientists of tomorrow. This discussion focuses on teacher training programs in Zimbabwe and South Africa with special reference to Bindura University of Science Education (BUSE) in Zimbabwe and the University of South Africa (UNISA). Anecdotal documents from these two universities were compared to find similarities and differences and inferences made thereafter. The hope is that educationists in both countries can insight from this analysis in an endeavor to improve the education systems in their respective countries.

Keywords: Teacher education, Science programmes, Unisa, Buse

1. Introduction

Concerns regarding the quality of science teachers in the region and abroad have been raised on numerous occasions. Several studies have pointed out that the majority of science teachers experience difficulties when teaching content at secondary school level (Jita & Ndjalane, 2009; Taylor & Vinjevold, 1999). Successful teaching is influenced by sufficient teacher expertise of content knowledge in science domains. The issues of what kind of knowledge is adequate for making effective instructional decisions or designing appropriate learning environments are on the agenda of current research world-wide (Ball, Lubinski & Mewborn, 2001; Lehtinen, 2008).

The discussion here focuses mainly on two areas pertaining science teacher education in Zimbabwe and South Africa. The first part of the paper is an overview of the Zimbabwean Education System since independence followed by Science Teacher Education at Bindura University of Science Education (BUSE). Complimentary efforts by sister institutions in science teacher education are also highlighted. The second part looks at the South African Education system with special reference to teacher education at the University of South Africa (UNISA). Science teacher training programmes from other South African universities will also be highlighted. The reasons for choosing these two major universities from the two countries are quite obvious; they dominate science teacher education programs in their respective countries.

UNISA is said to produce more teachers than any other South African university due to its open and distance education programmes as enrolment numbers are not restricted by physical space and resources whilst BUSE is the official state university in Zimbabwe responsible for the national science education in the country. Anecdotal documents from these two universities will be compared to find similarities and differences and the inferences made thereafter.

2. Literature Review

This section explores projectile motion or force and motion and the classroom practice diagnostic framework.

2.1 An overview of the education system in Zimbabwe

In 1980 the new government in Zimbabwe inherited a system of education that was racially biased and unequal in both

governance and financing as well as the quality rendered to the different racial groups, UNESCO (2001). In response to these anomalies, the post independence government of Zimbabwe adopted the policy of education which made education a basic human right thus she committed herself to universal and equal educational opportunity for all. To achieve this goal it was imperative to engage in rigorous teacher training programmes both for primary and secondary schools. Obaya (2010) notes that teachers are essential players in promoting quality education. It means therefore that they play an important role in educational reform. Teacher availability challenges remained a major problem in developing countries (Obaya, 2010). However, many developing countries have embarked on large education reforms aimed at rapidly expanding the supplying of education, achieving equity in the provision of education and significantly improving the quality of education, Tiogson (2008). To this end Zimbabwe is not an exception.

Teacher training institutions in Zimbabwe fall under the ministry of higher education (MHE). The MHE's mission statement is; To provide, regulate and facilitate tertiary education and training through the planning, development and implementation of effective policies, the provision of resources and management of institutions in order to meet the human resource requirements of the economy and equip individuals to meet their full potentials (UNESCO, 2001:5).

Guided by this mission statement a marked improvement in the number of students enrolled in teacher education programmes has been witnessed over the past decades. During the first decade of independence, university enrolment increased by 300%, secondary school by 841% and primary schools by 79%. UNESCO (2001). Universities increased from one in 1990 to eight by 2001 to cater for an equally higher number of school leavers. The enrolment increased from 9000 in 1989 to 33000 in the year 2000. In the same document it is also noted that The National Council for Higher Education Act of 1990 was established to cater for higher education with some of its functions being to ensure the maintenance of appropriate standards with regards to teaching, exams and academic qualifications in institutions of higher learning. The act thus was established to ensure that the national goals in education were achieved. One of them being the establishment of a strong scientific and technological base through the teaching and strengthening of the teaching of science and mathematics. This can only be achieved through the development of problem –solving skills and the promotion of innovative teaching and learning methodologies in science. Of note is that a lot of work has been done by the Zimbabwean government in education from independence to date despite the political, economic and social challenges encountered in this journey

2.2 Historical background of Education in South Africa

Education in South Africa was separated into racial lines prior to democracy in 1994. Thus there were different education systems for Whites, Indians, Colored (mixed race) and black people. Funding for education was differentiated on a declining scale for different races following the above order. Whites received the highest funding per capita and Blacks the lowest. The result was that Education for black people was under-resourced and inferior.

Resources were worse in the rural areas because the government did not even provide school buildings. Communities had to build schools without government funding. Only children whose parents made a contribution to the "building fund" would be allowed to attend the schools. Communities insisted that parents who never contributed to the building fund should contribute to the fund before their children could be allowed to attend the school even if the buildings were completed. This action deprived many children opportunities to attend school and this could have had some contribution to the present skills' shortage in South Africa

Teacher education was the responsibility of Colleges of Education during the apartheid era. For blacks these colleges offered content at a level no better than the level at which these teachers were going to teach. An inability to cope with subject content at the level where teachers are supposed to teach is often attributed primarily to this fact.

The struggle for democracy in South Africa is perceived to have affected the availability of competent teachers. The vast majority of teachers at school today were students during class boycotts of the 80's where they were too involved in the struggle against apartheid to give serious attention to their own education as students. A combination of the struggle against Apartheid, poor education under the Colleges of Education and inadequate government spending on education contributed are thus perceived to have contributed towards the poor state of education for the majority of the population.

Before 1994, the curriculum implemented for Blacks was known as Nated 550 and generally considered inferior to that received by other South African race groups. The democratic South African government has spent a lot of money and made several changes to the curriculum for varying reasons, first it was to cleanse the curriculum from its apartheid past, then to introduce the Outcomes Based Education (OBE), followed by its revision to streamline it, and finally to improve its implementation (Chisholm, 2003 & DOE, 2002). Criticism against this curriculum was that it did not promote

teaching for understanding. Curriculum 2005 based on Outcomes Based principles was introduced in 1996 amidst wide criticism (Jansen, 1998). The main motivation of introducing Outcomes Based Education was to encourage learner-centeredness (DoE, 2002). However teacher training was inadequate, class sizes were large with poor facilities which complicated the implementation of the approach (Jansen, 1998). The terminology used in the OBE approach was also a challenge to the teachers (Jansen, 2008). To overcome the challenges the Department of Education experienced with the implementation of the OBE approach the curriculum statement was revised and replaced by the National Curriculum Statement (NCS) and the Revised National Curriculum Statement (RNCS) for the grade R to 9 in 2002 (DBE, 2011). In 2012 Caps replaced the NCS and RNCS because it combined the two national curriculum statements as well as updating them (DBE, 2011).

3. Research Methodology

In this paper we analysed the documents from the University of Bindura as well as those from the University of South Africa. We focused on the science teacher programmes from both the university for example the prospectus that detailed what the entrance requirements will be. We thereafter made findings from what came out of the documents analysis.

4. Findings

4.1 Science Teacher Education in Zimbabwe

The turn into the new millennium has seen an explosion of universities in Zimbabwe with quite a number involved in science teacher education. Science education is considered as a vital tool for development across the world, Maringe (2005). Kerr (2007) advocates for a strong foundation for scientific and technological literacy as the responsibility of the national education system which in turn must be supported by a strong teaching force in science and technology. It is therefore imperative to have well trained science teachers, essential for preparing students to function effectively in an ever-changing technological and information environment. It is crucial to train science teachers who are compliant with the changing technological and information environment as the world is becoming a global village. Universities have a major role to play in the training of science teachers. As a result of the assumption that school science constitutes the foundation for an efficient functioning in a technology and information driven society, the training of quality science teachers has been recognised as a key goal and focus in teacher education programmes in many countries, Wang et al (2003). Universities and colleges in Zimbabwe are responding to needs of a changing economic and technological environment, Phuti (2007). A gap however always exists between what students want to know about technology and what teacher education departments teach, Maringe (2005).

Bindura University of Science education (BUSE) is the leading institution in the training of science teachers in Zimbabwe since its inception in 1996. Some science teachers are also trained in colleges of education under the supervision of the Department of Teacher Education of the University of Zimbabwe. Midlands State University, Chinhoyi University of Technology and Great Zimbabwe University have departments of science teacher education complementing efforts of BUSE on science teacher training.

4.2 Teacher Training in South Africa

Since the advent of democracy, Teacher Education has been the responsibility of the universities under the democratically elected government. South African universities offer the following three pre-service teacher education programmes namely ACE, BEd & PGC. Each of the programs is briefly described below.

4.2.1 Advanced Certificate in Education (ACE):

This qualification is offered to students who either have a three year teaching qualification or a four year teaching qualification. Moreover the qualification must have a school subject as a principal teaching subject. Students learn how to teach school subject, computer literacy, facilitation and management of practical work as well as how to integrate environmental education into their teaching. Students who take an ace programme are usually practicing teachers hence they do not take teaching practice modules.

4.2.2 Bachelor of Education (BEEd):

The programme is open to students who have obtained a senior certificate with matriculation exemption or National Senior Certificate (NSC) with degree admission. Students learn educational themes for example inclusive education. They also learn professional studies such as environmental education. They also take school subjects of which this differs in terms of the phase; at foundation, intermediate and senior phase they take three approved school subjects which include two official languages. At FET phase they take three school subject which must be taken at first year and the other one at first and second year or second year.

4.2.3 Postgraduate Certificate in Education (PGC).

This one year qualification is taken by students who have completed a degree and wish to qualify as professional teachers. Students must have a grade 12 certificate and a recognised degree with at least two school subjects with one on second year level. Students learn educational themes for example educator as researcher, educator as assessor and educator as leader, manager and administrator. Furthermore they are expected to take school subject modules. Students are also expected to register for two modules of teaching practice.

South African universities follow different curricula. In order to maintain an acceptable standard of education amongst the universities the Higher Education Quality Committee, HEQC, (Higher education Act; 1997) is responsible for quality assurance of education in South Africa and has the authority to deregister any qualification from any university which does not meet the required standard

4.3 Bindura University of Science Education

The origins of Bindura University of Science Education can be found in the Zimbabwe/Cuba teacher training programme. Beginning in the mid 1980s, Zimbabwean student teachers were sent to Cuba for training in science education (SARUA, 2007). This was a national strategy to increase the number of science teachers as the institutions in the country were not meeting the annual requirements of teachers to man science classes in the country. After 10 years of Zimbabwean school leavers receiving teacher education in Cuba the program was relocated to Zimbabwe. Bindura University of Science Education was established in 1996 as a university college of the University of Zimbabwe with the mandate of training secondary school science teachers. The college acquired University status in February 2000 through an act of parliament (BUCSE,1999). Among other ideals the university exists to produce "a high level person power in Science Education with special emphasis on biology, chemistry, geography, Mathematics, Physics and Computer Science Education" (BUCSE,1999:6).

According to the Bindura University of Science Education (BUSE) 2011 prospectus, the faculty of science education is responsible for the training of science teachers. There are four undergraduate and three post graduate postgraduate programmes offered by the faculty. The undergraduate programmes include a diploma in science education (Dip.Sci.Ed). The program consists of 5 semesters of fulltime study and one semester (2 school terms) of teaching practice. To be eligible for the programme prospective candidates must have at least 5 'O' level passes including a science subject and English language. To be admitted for a combination with mathematics, an 'O' level pass in Mathematics is required. The diploma is done in three years.

The university is also offering three undergraduate studies in science education. One is the Bachelor of Science education (Bsc.Ed-four years). The program consists of 8 semesters of full time study of which one semester in the fourth year is reserved for full-time teaching practice referred to as Applied Science Education. Prospective students will be expected to study any two of the following science subjects where one will be a major and the other a minor: Physics, Chemistry, Biology, Computer Science, Geography and Mathematics. Normally students who enroll for this program are high school leavers with passes in 'A' level science. The program consists of a total of 11 professional courses and 28 subject content courses. The major subject at least 20 courses, minor subject at least 8 courses up to part 2.

The other undergraduate programme is the bachelor of science education(Bsc.Ed-three years).This program is designed to cater for in-service science teachers with diplomas or certificates in a science education (specializing in one of the following subjects: Physics, Chemistry, Biology, Computer Science, Geography or Mathematics) from a teacher's college. Students do at least 24 courses in the subject area. The professional component consists of at least 5 courses in Education including a minimum of 5 weeks of applied science education which involves attachment at an 'A' level school. The other three year programme offered by the university is the Bachelor of Science education (BSCED) general degree.

This general degree program is designed for candidates with at least one 'A' level science subject (from Physics, Chemistry, Biology, Computer Science, Geography and Mathematics). In addition the candidates must have a pass in any other 'A' level subject. Unlike the honours programs these students do not do a course in research methods and a project otherwise some of the sections are similar to those doing an honours degree. The program targets candidates fresh from high school.

In response to brain drain of mainly science teachers in Zimbabwe to regional and international destinations, Bindura University of Science Education introduced the Virtual and Open Distance Learning (VODL) programme aimed at training science teachers at their door step, to fill in the gap as a result of the mass exodus of qualified personnel. The university realized the need to target remote areas where the few remaining science teachers shun. It was the demand for large numbers of science teachers within a short timeframe in Zimbabwe's rural schools that gave birth to the BUSE VODL programme. Through targeted recruitment, BUSE's VODL programme sought to train relief teachers already serving in the area in the hope that personal history and family connections would entice them to continue teaching in these areas after attaining their teacher certification, according to Mhishi, Bhukuvhani and Sana (2012). The program started with three centers in Mashonaland central province where the university is located. Other centers have since been opened in Matabeleland provinces as preliminary survey showed that there was a critical shortage of science teachers in those areas. The programs offered at these centers are a diploma in science education and a degree in Science education.

The post graduate programmes offered are the diploma in education, Master of Science Education in Curriculum studies and Master of Science Education. In the masters' programmes, students do nine taught courses and a mini-dissertation with a weighting of 40%. In all its programmes, BUSE values the promotion of innovative teaching and learning methodologies as a central part of continuous process of improving quality in science teacher training programmes. The need for quality teachers is a key objective of teacher preparation programmes, (Moore, 2004; Maringe, 2005 and Obaya, 2010). According to Ibdapo-Obe (2007), there is need for continuous curricula review in teacher education to match changes within other sectors. BUSE responded well to this aspect by introducing courses such as introduction to computer science (CS101), HIV/AIDS education (HS101) and Citizenship education and conflict transformation (PC108) for all students doing undergraduate studies as they were found relevant in this dynamic society. Policies on teacher education have always stressed a judicious combination of academic (or subject matter) knowledge and professional subject (educational foundations and pedagogy), Obaya (2010). In addition to these, BUSE has adopted the concept of broad based knowledge by incorporating courses in ICT, HIV/AIDS and citizenship education for a holistic science teacher training programme.

Constructivism, inquiry and reflective practice have become dominant in science teaching and training, (Maringe 2005, Nyaumwe and Mletwa, D.K 2010). The pedagogical courses offered at BUSE are grounded on the constructivist approaches to teaching and learning of science. Philosophy of science is recognised as a key contribution to the transformation of science education and must contribute a central focus in science teacher programmes. (Maringe 2005). BUSE is offering courses in history and philosophy of science as some of the professional component courses. It is also important to focus on preparing science teachers to become active researchers thus the need to develop science teachers with a research capacity. BUSE offers courses in research methodology and students are also expected to carry-out research projects in partial fulfillment of the requirements of their degree/diploma programmes.

It is however necessary to note that, despite the efforts to train quality science teachers using a diversified curriculum in response to the changing needs of the society, problems are always encountered. Teacher education programmes attract very few people mainly because of low remuneration and recognition of teachers, Ibdapo-Obe (2007). BUSE started in 1996 with an enrolment of 125 prospective pre-service teachers but by 2011 less than 10 students have enrolled for the Bsc.Ed under the conventional programme. The low enrolment numbers have been alarming to the extent that some subject areas are facing extinction. Producing quality science teachers would require measures that boost the image of the teacher in society-education polices specifically addressing teacher issues, putting teachers at a social par with other liberal professions and providing conditions of work that are in conformity with the ILO or UNESCO Joint Recommendations concerning the status of teachers, Obaya (2010). Like any other university in Zimbabwe, BUSE has been experiencing problems of inadequate funding impacting negatively on its efforts to train quality science teachers. Resources (human, infrastructure and equipment) are limited endangering the survival of some programmes.

Debates on the balance of the time spent between subject content coverage and the teaching practice period have been ongoing (Rowan, 2002 and Maringe 2005). Some critiques have argued that the time allocated for teaching practice at BUSE is not enough as compared to coverage of subject content. Questions have been raised on the rationality of

deploying students to one school for a period of 12 or 5 weeks depending on the programme. This is noted as weakness by Maringe (2005) who argues that in England, trainees have experience in at least two schools in an attempt to develop a rounded appreciation of diversity in education environment and also allows for a practical development of reflective practice. Mudavanhu and Zezekwa (2009) noted the need for strengthening the mentoring roles in science teacher training at BUSE particularly around issues concerning work- shopping of mentors.

Science teacher programmes need to be improved considering the vital role science teachers play in training scientists of tomorrow. It must also be noted that no education system can rise above the level of its teachers hence their crucial role in society.

4.4 Teacher Education at the University of South Africa

Because of its distance education mode of training, UNISA trains more teachers than the remaining South African universities combined. UNISA offers degrees in a wide variety of disciplines. However, the focus of this study will be on Science Education.

Teacher Education for Science teachers at the University of South Africa is a joint responsibility of the College of Education and the College of Mathematics and Science, Engineering and Environmental Sciences. The College of Education is responsible for the subject methodology, content related to educational management and management of diversity and discipline while the College of Mathematics and Science, Engineering and Environmental Sciences for subject content. The content is identical to that offered to students registered for science degrees. BEd students intending to teach Physical Sciences are required to have a minimum pass of either 1st year chemistry and 2nd year physics or 1st year physics and 2nd year chemistry. Pre-service teachers in South Africa are expected to complete 12 weeks of teaching practice at schools. BEd students participate in teaching practice each year of their 4 year study while PGCE students would have participated only during their PGCE year for ten weeks.

The Teaching Practice module gives students an opportunity to put theory into practice. Mentors are appointed for the students at their chosen schools and assessed by either UNISA lecturers or UNISA appointed supervisors. If the school is used for the first time by UNISA, the UNISA representative coming to assess the student also assesses the suitability of the school for future use by UNISA students. The criteria being used is that the school is functional enough for students to benefit meaningfully from practice at the school. At the end of the year students are expected to send in the workbooks for the modules they chose for their programmes which contain a minimum of two lesson plans. The third lesson plan is a compulsory lesson plan based on Teacher Education in the Sub Saharan Africa (TESSA) materials. TESSA materials are intended to enhance the teaching skills of teachers and to expose potential teachers to teaching strategies in the sub-Saharan Africa. Teacher Education modules offered by the College of Education at UNISA follow constructivism principles. Constructivism, inquiry and reflective practice have become dominant in science teaching and training (Maringe 2005; Nyaumwe & Mtetwa, 2010).

4.5 Insights from theoretical expositions of science teacher training programs

The Zimbabwean and the South African governments realised the need to rectify anomalies in their education systems soon after independence. In both countries there was a massive increase in enrolment of pre-service and in-service teachers to pursue degree programs in teacher education at university level. The two countries also realised the importance of establishing a strong scientific and technological base through teaching and strengthening of the teaching of science and mathematics education as one of the national goals in education.

To achieve this, it is imperative to have continued professional teacher development according to Morrow (2008). It remains to be seen whether the attainment of higher qualifications by teachers in both countries can translate to an improvement in education as noted by Maringe (2005), Morrow (2008). According to UNESCO (2006) of all the countries in the world, sub Saharan African countries are experiencing the most severe shortage of teachers. The situation is even more critical in South Africa to the extent that the country relies more on expatriate teachers mainly from the region running away from political and economic problems in their respective countries. The issue of limited resources for teacher training is common in both countries. To fully implement the constructivist approach in science teacher training it becomes necessary to have adequate resources in terms of educational technologies, general infrastructure, practical equipment, vehicles for use on applied science education just to mention a few. The situation is even more critical in Zimbabwe because of the economic melt-down.

Countries in the SADC region are making some efforts to move towards a common curriculum at tertiary level.

Quite a number of similarities can be noted regarding science teacher training programs in Zimbabwe and South Africa. In both countries the training programs have three major sections of learning the subject content, theory of education and teaching practice. The time spent on each of the three sections varies from one university to the other but in almost all cases more emphasis is on subject content than teaching practice and theory of education. This is to give the student teacher adequate content knowledge, theoretical perspectives and interactional strategies. Even if the student teacher master the skill teaching it is more important to teach correct content. The teaching practice component enables the student teachers to practice what they have learnt with mentors and supervisor guiding them through the process. Hence when students graduate they will have all the three components that are the practical experience, theoretical knowledge as well as content knowledge to be efficient teachers. In South Africa, the South African Qualification Authority (SAQA) is responsible for quality assurance of education and has the authority to deregister any qualification from any university which does not meet the required standard. In Zimbabwe, this responsibility rests with the recently established Zimbabwe Council of Higher Education (ZIMCHE).

An overall picture gives quite a number of similarities regarding teacher training programs in the two countries but a deeper analysis reveals quite a number of differences. Unlike in South African universities, undergraduate programs at BUSE include a diploma in science education (DipScEd) to cater for students with only ordinary level qualifications (including a pass in science) whilst degree programs are taken by those with advanced level qualifications. The idea of training diploma students was muted after realising critical shortage of science teachers in the country. Advanced level science is attracting fewer students at high school because of limited resources mainly human and infrastructure. The idea of taking diploma students thus was seen as going to bridge this gap since after serving for at least two years, the diploma holders are expected to enroll for degree programs for further professional development. The three year diploma programme in South Africa was stopped as it was viewed as offering content which is inferior whilst the four year higher diploma in education was discontinued with preference being on the BEd degree for reasons explained somewhere in the paper.

Looking at the program structure, students at BUSE do more subject content courses than their counter-parts at UNISA. It is however interesting to note that UNISA provides more time for teaching practice where it runs from first year to final year unlike at BUSE where it is done only during the first semester of the final year. It remains to be seen the effects of such practices from these institution because of the ongoing debate that a good teacher is one with good content base while others argue that application through teaching practice is more important-see arguments from Rowan(2002), Moore(2004) and Maringe(2005). It becomes necessary to balance the time spent on subject content and teaching practice during a teacher training program. At BUSE and UNISA the departments of education are standalone departments offering courses in theory of education and subject content is offered independently by science departments. UNISA also offers subject methodology in the College of Education. The situation is not the same in all South African universities, for example at the University of the Witwatersrand where content and education courses are offered in the School of Education. Unlike BUSE and UNISA, the University of the Witwatersrand avoids early specialisation in content but rather offers integrated Life and Physical Sciences in the 1st three years while students only specialise in their final year.

Zimbabwe has gone strides in establishing a university responsible for science education which is not the case in South Africa where all public South African universities to a different extents offer a degree course in science education. A course in history and philosophy of science offered at BUSE forms the basis of understanding the nature and principles of science. BUSE also offer courses in HIV/AIDS, citizenship education and conflict transformation to all undergraduate students in line with immersing global trends in education. The holistic approach to science teacher training is important in the sense that the graduate will not only be an expert in the art and skill of teaching but will be in a position to fit well in the society. The same can be done at UNISA. The comparison will not be complete without looking at issues on entry qualification gaps as this impact strongly on the final product produced by a training institution. In South Africa, a mark of 40% is considered to be a pass to enroll for an undergraduate degree program. This is not the case in Zimbabwe where an exam mark of 50% is the cut-off point for a pass. It means therefore that the training institutions enroll totally different caliber of students which may result in totally different final products.

5. Conclusion

In conclusion improving the status of teachers is key to improve the standards (UNESCO, 2006).The quality of an education system depends on the quality of teachers. It must also be noted that no education system can raise above the level of its teachers hence their crucial role in society. The distinct finding of the paper is the different focus of BUSE and

UNISA, with UNISA having more emphasis on the practical experience and BUSE on the content knowledge. This could be a good foundation to focus on the graduands from these institutions to determine the impact of the focus of the two universities.

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