

PRE-SERVICE SCIENCE TEACHERS' PERCEPTIONS OF THE PROBLEMS THAT THEY FACE IN THEIR TRAINING

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ABSTRACT – The teaching and learning of science is reported to be problematic in South Africa. Quite a number of scholars have focused on the views given by in-service teachers. It is possible that the problems might be a result of the problems that pre-service teachers face during training. The aim of this qualitative study is to explore the problems that pre-service science teachers face during training in a South African university. These problems might be compromising their teaching when they qualify. The researcher used critical discourse analysis as the theoretical framework. The data were collected using semi-structured interviews and focus group interviews. The interview data were then analysed using content analysis. The significance of the study lies in its potential to address issues related to science teacher training. This in the long run has the potential to address the problems that science teachers face in South Africa. The results indicate that there is insufficient planning in the teaching training course. The study concluded that the pre-service teachers received inadequately planned training, and often fail to relate their teaching methodology to their content modules.

Keywords: Social justice; Pre-service science teachers; Racial segregation; Training system; Policy; Perceptions; Critical discourse analysis

1. INTRODUCTION

The training of teachers in South Africa is reported in the literature to have faced a number of issues (Chisholm, 2015; Jansen & Christie, 1999; Robinson, 2003). The issues in question are related to the previous education dispensation under apartheid that focused on differentiated and race-oriented education systems. The amalgamation of these diverse systems at the end of apartheid, came with a number of successes and failures (Chetty & Lubben, 2010; Hay & Fourie, 2002). One of the topical issues in the South African education discourse has been the training of science teachers. During the apartheid years, the blacks were not expected to learn any elaborate science content in accordance with the premises of the Bantu Education Act which sought to train them just enough to be literate (Low, 1958; Nkomo, 1981).

One of results of the problematic training of science teachers in South Africa has been the low achievement of learners in science and mathematics. As mentioned earlier, this has been exacerbated by the compromised quality of the teachers that came out of the system (de Beer, 2002; Muwanga-Zake, 2000; Mji & Makgatho, 2006). Quite a number of scholars have focused on the views given by in-service science teachers (Adler, Pournara, Taylor, Thorne & Moletsane, 2009; Muwanga-Zake, 2000), especially those trained during the apartheid years. Nonetheless, it has also been reported in the literature that even the teachers trained after democracy still face problems in the teaching of science (Muwanga-Zake, 2000; Mji & Makgatho, 2006). It is possible therefore that the problems might still lie with the pre-service science teacher training. The aim of this study is to explore the issues and problems that pre-service science teachers face during their training in a South African university. The objective of the study is to find solutions to these issues and problems and thus improve science teacher training. In this regard, the study is guided by the following question:

What are the self-reported problems and issues that pre-service science teachers face?

2. CONCEPTUAL FRAMEWORK

The problems of science education in South Africa

Despite the declaration of science education as a national priority (de Beer, 2002), South Africa still faces immense problems in their implementation of a strategy to achieve this. One of the key avenues that could be followed to address this, is the improvement of science teacher training within the universities. Since the problems that are experienced during teacher training are sometimes experienced in the schools, it might be necessary to explore the problems faced in science teaching and learning in high schools as a preamble to the exploration of the problems that are faced during teacher training in the universities.

2.1 Underqualified Teachers

As reported by de Beer (2002), by 1996, only 32% of the science teachers in South Africa were qualified and competent to teach the subject. He goes ahead to lay blame on the previous policy of apartheid that tended to offer Bantu education to the non-white population. Similar findings were reported by Muwanga-Zake (2004) and De Beer (2007) both of whom lament the incompetence of the South African science teachers. The outcome of this unfortunate situation was the continued poor performance of South African learners in standard tests such as Progress in International Reading Literacy Study (PIRLS) and Trends in International Mathematics and Science Study (TIMSS) (Spaull, 2013; Taylor, 2008). It is important to analyse such occurrence in the wake that it is these very learners who are enrolled into the universities. In a way, their perceptions of the problems that they face within the university system would be partly indicative of their prior schooling experiences. As elaborated by de Beer (2002), if South Africa has to meet its intended wish of increasing natural scientists, engineers and science teachers, there is a need to address how they learn science within the school system.

2.2 Inadequate physical and human resources

As indicated in the literature, approximately 70% of South African schools do not have either the infrastructure or the apparatus to teach science in a manner and standard that is recommended the world over (De Beer, 1993). The situation is made worse by the continued curriculum change, especially the implementation of the current curriculum (Curriculum and Assessment Policy Statement, CAPS) which emphasises the need for the implementation of the inquiry-based approach (Warnich & Meyer, 2013). The inquiry-based approach is hailed for high learner achievements when implemented sufficiently and properly, while on the other hand, its potential gains are overcome by the high demands that it places in terms of the resources, time, teacher and learner skills. In a longitudinal study that was carried out by Muwanga-Zake (2000) regarding the extent to which science was professionally taught in the South African education system, the issue of teacher incompetence to implement the inquiry-based approach is one of the key findings. Similar findings were also reported elsewhere in the literature (Mji & Makgatho, 2006). Of concern was that even in circumstances where the apparatus and facilities were available, teachers lacked the basic skills to teach using those apparatus or even to assemble the apparatus kits (de Beer, 2007).

Given that background, it implies that resource shortage in South Africa is along two dimensions: human resources and physical resources. The issue of resources in South Africa is exacerbated by the rate at which new learners enter the school system every year. The country is estimated to have an average of 250 000 new learners per year, which translates to 300 new schools per year and 8000 new teachers per year (de Beer, 2002).

2.3 Inappropriate teaching and assessment approaches

The issue of poor performance by South African learners in science is also attributable to the way they are introduced and taught science. Scholars such as Hodson (1990) have commented that in the

majority of cases, science is taught following a chalk-and-talk approach. This view has also been found by Mamutse (2015) in his analysis of how improvised materials could be used to teach science in township schools. In accordance with this approach, the teacher is regarded as the canon in the learning process, with the learners being regarded as disciples who have to follow instructions as they are given. Learners simply have to memorise content and regurgitate it during tests and examinations (King, 1993; Saulnier, 2008; Schwerdt & Wuppermann, 2011). In the literature the use of this approach is also associated with inflexible assessment approaches where the teacher controls all the assessment and the learners have very little input (Heritage, 2007). Mamutse (2015) has reported that teachers felt that they are under a heavy burden from the school management team (SMT) and also from the Department of Education officials whose focus is on the attainment of higher pass rates. In the teachers' explanation, what matters to the authorities are the results to the extent that teaching is not sufficiently considered. In that regard, teachers face rushed teaching schedules that do not allow inclusive teaching.

2.4 Society's portrayal of science as a subject

One of the key problems that learners face in science is the subject's stereotyped nature and status in society, including within schools. This happens often to learners from disadvantaged backgrounds and also to female learners (Brainard & Carlin, 1998; Johnson, 2007; Kahle & Lakes, 1983). Science is generally regarded as a unique subject that is done by the academically-gifted students, whose thinking skills may not be matched by the general students. Given the issue of poor teaching reported above, it would become quite difficult for learners who come from poor schools to do science. Even in the case where they might amass the courage to do it at the beginning of their tertiary education, they would be susceptible to drop it given the attitude that they would be receiving from other students and from the staff.

2.5 Language of learning and teaching (LOLT)

One of the key issues that are reported in the literature as negatively affecting the teaching and learning in South African schools and also the world over, is the language of teaching and learning (Fleisch, 2008; Norton, 1997; Phillipson, 1996). South Africa has 11 official languages and this implies that it has on average very much diverse classrooms. The adoption of English as the official language of teaching and learning presents a variety of problems for learners (Nekhwevha, 1999; Reagan, 1986). In essence, learners have to learn both English language and the science content. In science subjects such as Biology which have an elaborate terminology base this would present a lot of problems to the learners all of which dove-tail towards compromising their understanding of the intended outcomes. The use of the vernacular in learning which has been hailed by authors such as Luthuli (1981) has however faced a lot of challenges in their implementation.

A close analysis of the factors that have been stated above give one indication: they are all related to teacher training. Like indicated earlier, in order to conceptualise the problems that the pre-service science teachers are currently facing, it might be prudent to first explore the problems that they faced when they were learners. The author believes the students are in a better position to define their current problems based on their previous experiences. Regarding the problems that are faced in higher education in South Africa one of the key issues that has been mentioned is overcrowded lecture rooms. The implication of this is that the tuition would not be tailored along individual levels given the size of the classes. In a study that was carried by Marais (2016) he explored the problems that pre-service teachers face, and one of the key issues is overcrowding. These students face overcrowding during their lectures and also face it when they start teaching. The implication is that their training is done in overcrowded lecture rooms and likewise their teaching also takes place in overcrowded classrooms.

The other problem that has become common in the South African higher education is the diminishing funding trends. As explained by Olsen (2000), as the number of students increased, the level of funding for higher education has tended to decrease. The nature of this inverse proportional relationship is

alleged to be responsible for the large classes mentioned above. As common with those trends, the quality of the training has diminished as well (Olsen, 1988). This has been described by Morrow (2015) as the absence of epistemological access. Morrow explains that though the institutional barriers for enrolment have been removed with the coming of democracy, a new kind of barrier however emerged. This barrier he reiterates, involves access to the knowledge that is being availed within the higher education institutions. Morrow's assessment agrees with what Clark (1998) regards as the failure of education to be the redistributor of opportunity across populations. Given the multiplicity of problems that learners (especially those from previously disadvantaged groups) face, which lead to a compromised learning, they lack a fundamental base to access the knowledge in the higher education institutions. This has been described by Maassen and Cloete (2006) as the consequential lack of intellectual capacity by the students that leads to poor performance in higher education. As a result there have been widespread accusations and allegations of poor quality and effectiveness in higher education in South Africa (Maassen & Cloete, 2006).

3. METHODOLOGY

The present study used a case study methodology. It aims to distil design principles that might inform science teacher training following a design-based approach (DBR). According to Reeves (2000) the advantage of DBR is that it fosters both interactivity and collaboration with the learners in the addressing of the problems and issues that they face. Figure 1 shows that this paradigm has four stages (Reeves, 2000):

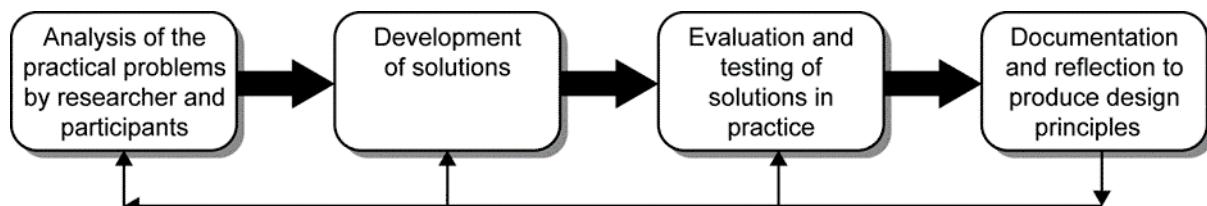


Figure 1: Design-based research stages followed in the study

To contextualise this study, the following steps were followed in accordance with the Reeves' model illustrated in Figure 1 above.

- (a) Analysis of the pre-service science teachers' perceptions of the issues that they face in their training.
- (b) Development of solutions collaboratively with the pre-service teachers.
- (c) Evaluation and testing of solutions in practice during training.
- (d) Collaborative documentation and reflection to produce design principles.

This paper will only focus on the first stage: the analysis of the pre-service teachers' perceptions of the issues and problems that they face in their training.

3.1 Data collection and analysis

20 pre-service third year Life Sciences teachers in a South African university participated in the study. Purposive and convenient sampling (Cohen, Manion & Morrison, 2000; Jupp, 2006) were used. According this sampling technique, the criteria for participant selection are pre-determined by the researcher (Tongco, 2007). The selection of this group of participants was also determined by their easy availability. Three focus group interviews that lasted for around 45 minutes and four individual interviews that lasted for between 20 and 30 minutes were conducted. Both the focus group and the individual interviews were semi-structured. An interview guide was pre-planned for each one of them respectively. After getting the consent of the participants, the interviews were both video and audio recorded. Thereafter, the data were transcribed and analysed using Atlas.ti. The analysis of the data followed Saldaña's approach (Saldaña, 2009) as illustrated in Figure 2 below.

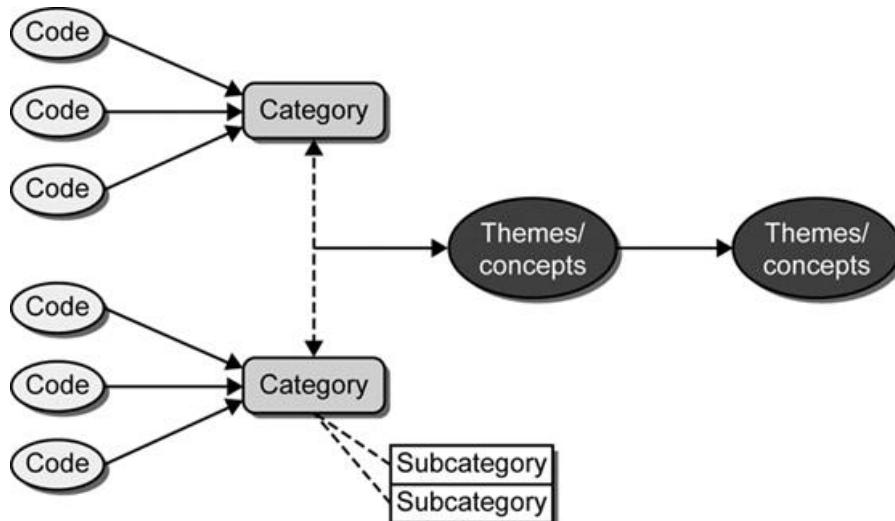


Figure 2: The Saldaña model (Saldaña, 2009)

As illustrated in figure 2 above, the analysis of the data involved coding and re-coding of the transcripts. Subsequently, related codes were clustered together into categories. Finally, the related categories were clustered together into themes (Saldaña, 2009). To improve the trustworthiness of the data analysis, independent coders were also involved in checking the whole analysis process.

The analysis of the findings was informed by Critical Discourse Analysis (CDA). As explained by Wodak and Meyer (2001), CDA avails tools that use language and spoken words as key tools to understand an individual or a group's thoughts and actions. This view has been extended by Van Dijk (2001) when he mentions that CDA paves a platform for the analysis of power relations within a group or among individuals, as depicted by the ways through which they use language. He goes further to mention that this theory looks at social power relations including the ways in which dominance and submissions are embedded and expected within a group of people, including the ways and the roles that the members of such a group performs in order to either constrain or perpetuate these inequalities. From the views of Lucke (1996), this approach intends to generate and perpetuate systems through which individuals within given circumstances come to understand how the nature of interactions and power relations as they unfold within a system and context of language (Wodak & Meyer, 2001).

The main tenets of the CDA theory have been laid down and summarised by Fairclough and Wodak (1997: 271-80) as follows:

1. CDA addresses social problems
2. Power relations are discursive
3. Discourse constitutes society and culture
4. Discourse does ideological work
5. Discourse is historical
6. The link between text and society is mediated
7. Discourse analysis is interpretative and explanatory
8. Discourse is a form of social action.

I found the CDA relevant to this context, given the historical nature and context of the South African education system, particularly teacher training which has been largely influenced by apartheid policies.

Following the analysis, seven themes emerged from the data analysis, and under this, all of the data were addressed. To improve the validity and reliability of the data analysis, the interview transcripts were coded and recoded three times. In addition to that, three experienced senior researchers were asked to check the accuracy of both coding and the analysis processes. The researchers suggested that

some modifications such as recoding be done, which were then implemented. The themes are then discussed in the form of assertions.

4. RESULTS AND DISCUSSION

In this section the results obtained from analysing the interview data according to critical discourse analysis are outlined and analysed in the form of assertions. Verbatim extracts representing the generality of the views of the sample shall be used to support the assertions. The assertions are: Language issues; Racial attitude; Unfair application of policies; Large classes; and Incongruent school practicum experiences. Acronyms such as P1, P2, and so forth are used to represent Participant 1, Participant 2, and so forth.

4.1 Language issues

From both the focus group and the individual interviews, the participants made it clear that they felt that the language was giving them a lot of problems during their training. Quite a number of them felt that though the official prescribed language is English, quite a number of their lecturers were giving them problems in the way they talk and in the way they structured the questions. This is discernible in the following verbatim extracts:

We feel that the way the assessments are made is to set us up for failure. Some of the lectures give us the implication that our vernacular languages are sub-standard. This is clear when you answer to a question during discussions and the lecturer or even some of the tutors shows you that you do not meet the required grade (P1).

We need to be taught in a manner that seeks our understanding. We need some clarification of many concepts sometimes in our languages (P7).

The language problems that pre-service teachers face during training have also been reported by Moats (1994). His study reveals that even experienced teachers also struggle with the use of English language when they try to explain certain concepts to their learners. In a related study, Atkinson (1987) recommends that pre-service teachers should be trained to use translation especially in the cases where they will be teaching in a second language. Atkinson's study agrees with the study by Kim and Elder (2005) where they found out that teachers struggle to teach using a language that is not their own home language. They go on to recommend the need to pay attention to language mastery during teacher training.

4.2 Racial attitude

The students expressed issues pertaining to how they are treated in manners that resemble racial stereotyping and underrating. They maintained that some of their lecturers are intolerant when it comes to the black students.

We feel that there is still a lot of racial antagonism in this institution. From the administrators to the lecturers we feel that they look at us as if we were second class human beings. They do not pay attention to our needs and it looks like they do not care (P3).

We feel racially unaccepted here. But this is our country. It is not fair. One day we shall rise against this. We need to be recognised as the people that we certainly are (P5).

The issue of race is a big issue here. Some of the lecturers give us the blacks the impression that we may never be able to do certain things. I have noticed that a lot during the practical work. They feel we are too stupid to do certain things in the lab (P6).

The issue of race during teacher training especially of black teachers has been reported elsewhere. In a study conducted by Kohli (2016) on race relations during teacher training in the United States of America (USA), he concluded that black pre-service teachers often drop from the training due to negative racial treatments that they face from the instructors. Similar findings were found by Patton (2015) when he used Critical Race Theory (CRT) to analyse the influence of race relations in higher education in the USA.

4.3 Unfair application of policies

The participants felt that the way the policies are planned and implemented is technically to remove them from the system. They complained about the unfair treatment that they face during assessment submission and the extent to which the system segregated them from achieving high in their work. It is their feeling that the system is setting them up to become unsuccessful.

The application of policies in our training is not fair. This is most visible when we submit work. For instance if a black student is late for submission may be because they have attended a funeral or they have failed to get bus fare to come to campus, they will be scored a zero; if it is non-black they will be given an opportunity. The same is true with tests (P4).

The way the policies are planned is to ensure that we become bored and drop out. We are always on the receiving end (P2).

This system is segregatory. They do not care about us. We face a lot of challenges to do this course but nobody cares about us. The government should do something (P8).

The concerns expressed by the students however correlate with the results found by Dixon, Durrheim and Tredoux (2007:1) in their study of how racial injustices still manifest within South African institutions. This finding also agrees with the findings reported by Talbot and Durrheim (2012) when they analysed the persistence of stereotypes linked to race across South African institutions. They concluded that racial stereotypes within the country possess momentous inertia despite the proclamation of policies that seek to disband such attitudes. Other studies examining racial stereotypes in higher education in South Africa have also concluded the same (Durrheim, Tredoux, Foster & Dixon, 2011; Mabokela & Mawila, 2004; Moloto, Brink, & Nel, 2014; Slabbert, 2002).

4.4 Large classes

The participants indicated that one of the biggest issues troubling them pertains to the class sizes. They elaborated that class sizes are too big to the extent that in most cases the people at the back of the classes do not hear what the lecturers will be saying. They complained that apart from missing quite a lot in terms of tuition, they also miss a lot in terms of instructions. The students complained that it is worse when it comes to laboratory activities. Some of their views are reported below:

The classes are very big and eish we find it difficult to concentrate let alone understand (S11).

I feel like this is mass production in education. The university just wants to be in the news that it is improving teacher numbers in the country. On the ground it is not the same (S7).

In the lab sometimes we are just put into groups and they say we must make it work. I personally find it difficult to work like that during a practical investigation. We just have to do it for marks. (S4).

The issues that the students raised with regard to class sizes have been reported widely in studies on the restructuring of higher education in post-colonial Africa. In a related study Mohamedbhai (2008)

referred to as the massification of higher education in Africa, where the emphasis is now more on quantitative than qualitative productivity. The predominance of big classes in higher education and the consequential effect on the quality of the graduates has also been reported elsewhere (Alam, 2009).

4.5 Incongruent school practicum experiences

The students felt that the school practicum sessions were quite difficult to them. They indicated that the way the sessions were planned had the assumption that they already had prior knowledge of what to do. It was mentioned that when the students are sent to the schools, the mentor teachers hardly help them. The students feel that the mentor teachers appear to regard them as an extra load and consequently, they hardly benefit from them. The students also expressed dismay at the disjuncture between the school practicum experience and the knowledge that they get from their teaching methodology and practicum modules. Their views are expressed below:

I feel like the school experience is rather a waste of time. When we go to the schools, the mentors dump their classes on us and they vanish. We have to do everything by ourselves (P8).

I do not know why we have to go to the schools and then we learn nothing. Something must be done. (P14)

The way things are done in the schools and the way we are taught how to do things are worlds apart. The mentor teachers laugh at the way we do the lesson planning and other things; they say it is a waste of time. (P13).

The problematic nature of school practicum has been reported in the literature (Ryan, Toohey & Hughes, 1996) and issues such as the inappropriateness of the planning and lack of supervision are some of the highlighted issues. In a longitudinal study of the problems faced by pre-service teachers Veenman (1984) reports that these teachers often suffer from reality shock which is often compounded by the negative attitudes that they get from the mentor teachers. Analyzing how to improve these problems, Meiklejohn et al (2012) recommended the need to induct pre-service teachers into the process of mindfulness. They argue that this would allow them to adapt without facing frustration.

5. RECOMMENDATIONS AND CONCLUSION

This study which sought to explore the problems that pre-service science teachers are facing in their training has come up with a number of those problems. Students have expressed concern over issues such as race, and the general fairness during training. These issues have been found to be similarly reported in other settings the world over. However, authorities have to consider that the teacher training in question is happening in a country that is setting its policies democratically after a long period of racial segregation-driven policy implementation. In that regard, issues such as language and racial attitude which have been complained about would be best addressed in order to build an inclusive education system that caters for all irrespective of their ethnicity. The author recommends that the university should monitor its transformation policy and if possible actually establish a transformation office that would be responsible for monitoring the development of harmonious collaborations among all individuals within the university. It is also recommended that the Faculty of Education should keep an eye on how teaching practice is being conducted to ensure that the experience that the students get in the schools would be relevant to what they learn in theory and vice-versa. In terms of large classes, the university should try as much as possible to recruit more

lecturers so that the class sizes are reasonable enough to ensure the successful acquisition of the skills that the pre-service teachers would need in the schools.

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