Science Teacher Educators: A Shift towards Student-centredness

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The introduction of modularization at universities and an outcomes-based education at schools in South Africa were based on the expectation that science teacher educators would make attempts at changing their teaching styles from a teacher-centred approach to a learner-centred approach. I conducted research as a science teacher educator to establish the extent to which eleven science teacher educators (lecturers) at three universities in a province in South Africa responded to the policy changes, and to which policy change in particular. An analysis of the observations showed that some science teacher educators had made appropriate changes for learner-centredness through a role-modeling process while others continued in a traditional teacher-centred approach. It was obvious that the shift to learner-centredness was more a response to school-related expectations of change and not necessarily to those of modularization at a higher education (university) level.

Curriculum Change in South Africa

Post-colonial political and social changes have invariably been accompanied by curriculum changes in several African countries. In the South African context the new democratically elected government adopted a sophisticated outcomes-based education (as opposed to an existing objectives model) that required competent teachers and educational resources that were almost non-existent among disadvantaged communities. The South African Government was compelled to engage with large scale educational reforms to change the education system to conform with the expectations of an outcomes-based education (OBE) which it believed would be the only possible solution to empower its former disadvantaged majority who were victims of a destructive Apartheid education.

There were widespread criticisms in the country denouncing the newly introduced curriculum in 1996 (Jansen, 1998; Pendlebury, 1998). This curriculum known as Curriculum 2005 (C2005), was implemented in 1997 to Grade 1 and with the intention of a completed cycle by 2005 (Grade 9). It offered Natural Sciences as a Learning Area for study from Grades 1 to 9. Apparent claims of curriculum failure were addressed through a proposed revision of the curriculum by Chisholm (2000) with a proposal that universities should include aspects of school curriculum (OBE) in its curriculum for teacher education. Grades 10 and 11 have been exposed to an OBE curriculum progressively since 2006 with the current Grade 12 classes participating in such a curriculum for the first time in the history of South African education. Grades 10 to 12 comprise the Further Education and Training band while Grades 1 to 9 make up the General Education and Training band in the education system (Department of Education, 2003).

Part of the curriculum revision in higher education imposed by the National Qualifications Framework (NQF) was the conversion of university subjects and courses to modules. The process was intended to improve portability and credit for achievement, in comparison with year-long subjects. Modules were to be redesigned in terms of outcomes, according to guidelines of the South African Qualifications Authority (SAQA), and were to shift towards continuous assessment practices. Universities had to write their module plans according to given templates and submit these for registration with SAQA. Schools and teacher education establishments located at universities were expected to follow the Norms and Standards for Educators (NSE) (Department of Education, 2000). The NSE is a policy document which prescribed outcomes for practising teachers and student teachers in terms of seven roles and three as-

sociated competencies. The modularization process and the Norms and Standards for Educators (NSE) were intended to provoke the same kinds of change that the science teacher educators were expected to make in response to C2005, its revision and final National Curriculum Statements (NCS) for grades 10 to 12. It has to be emphasized at this stage that the revised NCS and the final NCS were developed to embrace the same principles of OBE as the controversial C2005 but with a more practical approach for teachers to follow.

Abandoning Traditional Practices

A central goal of C2005, the NSE and the NQF is to produce critical thinkers who are prepared to examine various ways of solving real life problems (Department of Education, 1997). In a study of teacher education in the Northern Province of South Africa, Gozo (1997:2) expressed serious doubts as to whether teacher educators at colleges and universities would be able to change and abandon the methods they have become accustomed to. He recommended that teacher educators be given assistance in their attempts to meet the new requirements. He saw needs for universities to take the lead by organizing seminars and debates on the new curriculum for their own staff. Gozo (ibid) also concluded that:

> It is however important to note that if teacher education institutions could provide data that showed that their programmes did in fact succeed in making progress towards the achievement of important outcomes, the credibility, status and professionalism of teacher education and teachers would be immeasurably enhanced. Who needs this more than the teacher education programmes and teachers of the new South Africa?

The traditional teacher education model was out of step with OBE and incapable of dealing adequately with social change (Smith, 2000:7). However, some universities and science teacher educators (and a few Colleges of Education) had already deviated from the traditional pattern (Levy, 1992), for example, by:

- overcoming expository teaching methods with learner-centred strategies informed by appropriate learning theories such as constructivism to generate meaningful learning in science,
- role modeling learner-centred strategies for science teaching,

The strategies listed above conform to some of the expectations of OBE. In science teacher education on an INSET level, only 10% of practicing science teachers in South Africa were influenced by such teacher development strategies which were driven by Non-Government Organizations (Welch, 2002). The purpose of this paper is establish the extent to which science teacher educators had changed their practices to develop learner-centredness among their student science teachers.

Literature Review and the Theoretical Frame

Ducharme and Ducharme (1996) refer to teacher educators as individuals who represent the higher education faculty responsible for teacher preparation. With respect to science teacher educators I accept Fensham's (1992) and de Feiter's (2002) view for the purpose of this paper that this group of academics are university-based and base my study on such a community of educators whose role is to educate science teachers at the pre-service and in-service level at universities.

Change theories and other theories that account for changes among persons such as science teacher educators serve as the lens through which the analysis is interpreted and represented. These theories work together. Traditional Change Theory (Chin and Benne, 1969), Adaptive Change Theory (Heifetz,1994), and Advanced Change Theory (Hooijberg, Hunt and Dodge, 1997) are among the change theories that are pertinent to my study. Other theories such as theories in action (Argyris, 1996), Complexity Theory (Fullan, 2000) and a theory of academic change (Conrad, 1978) are useful in understanding change in academic and other settings. Constructivism as a learning theory, integral to the new curriculum policies, is an important component of the theoretical frame for interpreting teacher educator change. C. Malcolm, Professor of Science Education at the University of KwaZulu-Natal, views constructivism as a key rationale for OBE in the South African context due to its learner-centred emphasis that derives from cooperative learning (Personal Communication, October, 2005).

The documentation on C2005 (Department of Education, 1997) uses the following phrases related to learner-centredness:

- learner-centredness means that the learners are active participants in the learning process.
- learner-centred methodology enables learners to develop their own skills and understanding in contrast to a teacher-centred environment in which the teacher is dominant and uses the "show and tell" or "chalk and talk" approaches to education.

Together with the Critical Outcomes, learner-centredness implies the use of teaching strategies such as group work,

class discussions and problem-based learning, and at the same time underlines participatory democracy as a cornerstone of classroom life.

Methodology

I found Erickson's (1986) views on interpretive research to be relevant to the purpose of this study. He claims that interpretive research is not a methodology, but that it should be viewed as a technique or an approach to research because the research technique does not constitute a research method. Erickson (ibid) also states that, interpretive research can involve both qualitative methods and quantification to support the research. The latter relationship of interpretive research to quantitative aspects appealed to me because it enhanced my analysis of the data when I used a constant comparative technique.

The Observation Schedule

An interview schedule and an observation schedule were used as research instruments for the cross-case study with each science teacher educator being used as a case in the study. For ethical reasons, each of the three institutions involved in the study is referred to by a letter of the alphabet (Institutions A, B and C) and each science teacher educator through a number attached to the letter (eg. A1, B3, or C2). Science teacher educators were observed teaching science education topics in preparation of student science teachers for teaching the Natural Sciences Learning Area from Grades Four to Nine. The data was collected in 2003 as part of my doctoral study.

The observation schedule was structured to determine the extent to which science teacher educators integrated aspects of the curriculum change process related to learner-centredness into their lecture programmes. Another purpose of the observations of their teaching was to seek consistency in terms of claims made by science teacher educators during interviews. This concerned teaching and learning and whether they translated their beliefs concerning this in practice as teachers or lecturers themselves (Theory in Action, Argyris, 1996).

I have to admit that I was able to observe A1, A2, A3, B2, B3 and C4 teaching two separate lessons. It was not possible for me to observe the others teaching twice due to time constraints on their side and distance for me to travel especially to Institution B, a distant rural campus. I tried to overcome the validity (authenticity) and reliability factor by interviewing their student science teachers after the lecture and with permission from all the science teacher educators. Information yielded from the student science teachers indicated that most of the science teacher educators attempted both teacher and learner-centred approaches at different times. The exception was B2.

Observations of the Science Teacher Educators' Class Teaching

Table 1 summarises in this section indicates observations of the science teacher educators' teaching in their classes of student science teachers. It is also the product of interviews based on their teaching approaches and observations which are represented as a cross case study with each science teacher educator being a case in the study. The roles and competencies of the NSE, teaching approaches and constructivist engagements are used as categories related to my observations. An observed positive response is represented as a 'Y' (YES) response, while a negative response is represented as 'N' (No). In describing the teaching, I have called it 'teacher centred' when the approach was essentially transmission of knowledge from the science teacher educator to the students, and 'learner centred' when the students participated in the lesson, contributing ideas and knowledge with a degree of control of the content, pace and development of the lesson.

A2, C2, C3 and C4 presented lessons that reflected a balance between teacher-centredness and learner-centredness. A1 and B3 adopted a traditional stance in their teaching, although it was not totally lecture dominated. While A1 claimed to be a good role-model for learner-centredness, his practice proved contradictory. B3 claimed that he was not a good role-model for learner-centredness, and this was evident in his teaching. B2 presented a traditional lecture and this corresponded with his claim that he did not see the need to role-model learner-centredness since he felt comfortable with lecturing.

A2, A3, B4 and C1 engaged their student science teachers using techniques in keeping with principles of constructivism. Like a few others, they also facilitated an interactive dialogue among the student science teachers. In terms of this, A2's performance was contradictory to his claims that he was a poor role model of learner-centredness.

Table 1 also shows that ten of the science teacher educators attempted learner-centred features most of the time, while seven displayed teacher-centred tendencies some of the time. This is an indication of movement from traditional lecturing. It is in keeping with the NQF and the policies of modularization in higher education, as well as being consistent with the principles of OBE and C2005. Most of the science teacher educators claimed that they had changed to learner-centred approaches prior to the introduction of

CATEGORIES	A1	A2	A3	B1	B2	B3	B4	C1	C2	C3	C4	T
Teaching Approach												
Teacher-centred	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	7
Learner-centred	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	10
Used a questioning technique	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y	8
Interactive dialogue	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	9
Role-modelled OBE	N	Y	Y	N	N	N	Y	Y	Y	N	N	5
Learning Theories												
Used constructivism	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	9
Used cooperative learning	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	8
Problem solving	N	Y	N	Y	N	N	N	Y	N	Y	Y	5
Norms and Standards												
1. Competencies												
Practical competence	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11
Foundational competence	N	Y	N	N	N	N	Y	N	Y	Y	N	4
Reflexive competence	N	Y	N	N	N	N	Y	N	N	N	N	2
2. Roles												
learning mediator	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11
Interpreter and designer	Y	N	N	Y	N	N	Y	N	Y	Y	N	5
Leader, administrator, manager	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11
Scholar, researcher, lifelong Learner	N	Y	N	Y	Y	N	N	Y	N	Y	Y	6
Community, citizenship, pastoral role	N	N	N	N	N	N	N	N	N	N	N	0
Assessor	Y	Y	N	N	N	N	N	N	Y	N	N	3
Learning Area subject discipline	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11

Key: N = No, Y = Yes, T= Total

Table 1. A quantification of qualitative judgments based on observations of teaching

C2005 and modularization, and that the new curriculum served to focus and accelerate the changes.

The prescribed competencies and roles of the Norms and Standards for educators were given little direct attention (see Table 1), beyond those roles and competencies which have long been standard practices in science teacher education programmes. All eleven science teacher educators demonstrated and encouraged roles related to practical competence, learning mediator, leader, administrator and manager, and a learning area specialist. There was no evidence of science teacher educators using the lecture as an opportunity to develop in their students "community, citizenship and pastoral roles". Table 1 shows that there were some attempts by five science teacher educators (A1, B1, B4, C2, and C3) to develop the role of teachers as "interpreters and designers" of curriculum.

An Explanation of the Changes

When interviewed about their responses to learner-centredness, most of the science teacher educators claimed that they had changed their approaches after student science teachers demanded that they role-model such an approach during "lectures" for them (the student science teachers) to emulate during their classroom teaching! The change to a learner-centred approach by the science teacher educators was therefore not a direct response to the university's policy but that of an indirect response to the new school-related curriculum policy. I have to emphasize that the imperatives for teacher education in South Africa are not the same as that for schools. Science teacher educators were therefore not obliged to conform with mandatory regulations governing changes in school curriculum policy such as the introduction of OBE through C2005, the revised NCS and the FET.

However, the changes marked by C2005 were much more compelling and much more demanding for the science teacher educators than the changes in higher education. They understood C2005 as a large scale reform designed to reach all the primary schools and junior secondary schools

nationally in South Africa. Perhaps it was the ambitious nature of C2005 that made the demands of it acceptable.

Science teacher educators as university lecturers, are also accountable to a number of different groups, authorities and ideals at the same time. There is formal accountability (within the institutional management system), professional accountability (to do their job well), moral accountability (to the institution and schools, learners, society, etc.), and personal loyalties (to groups, ideals, self-concept, etc.). The idea of accountability, interpreted broadly (so that perhaps responsibility is a better term), provides a framework for examining the science teacher educators' motivations and actions. According to Piscatelli and Craciun (2002), humans will direct themselves if they are committed to the goals of the organization. If a job is satisfying, the result will be commitment to the organization. Under proper conditions, humans seek responsibility and so sense accountability. The science teacher educators in my study used their professional responsibility to address the issues related to C2005 for reasons expressed above and to follow.

Professionalism, almost by definition, is an expectation that all science teacher educators are expected to fulfill. The science teacher educators, therefore, while responding to institutional demands for change in terms of modularization of courses and the NSE, were deeply concerned about ensuring that they made attempts to understand curriculum change as it pertained to schools. This was accomplished despite the fact that they were not under direct institutional pressure to conform to school-based changes: it was a moral responsibility in preparing their students for the school and to the professional community to which they belonged. Hence, the deliberate shift towards learner-centredness in their classroom (lecture room) practice can best be explained through Adaptive Change Theory. According to Heifetz (1994) persons who surrender their present selves and, depending on the extent of the change required, put themselves in jeopardy by becoming part of an emergent system (such as the schooling system) have undergone adaptive change. The one science teacher educator (B2) who felt very comfortable using teacher-centred approaches most of the time can be accounted for by Traditional Change Theory in which Chin and Benne (1969) claim that people are guided by reason and will calculate whether it is in their best interest to change. None of the science teacher educators had made classroom changes that were of a radical nature.

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