Enhancing the Learning of Under-qualified Science Teachers in Eastern Cape Province

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Abstract

In South Africa today, teachers must have a minimum of matric + 4 years training. In addition, the introduction of a National Curriculum Statement has meant that many teachers find themselves under-qualified and incompetent to answer children's questions, leading them to apply for up-grade programmes. The students studying the ACE (Science) qualification at the University of Fort Hare require knowledge and practical expertise to give them the confidence to teach natural sciences. However, as the ACE qualification is a two-year, part time programme, with between 18 and 20 contact sessions a year there is insufficient time to cover the content in sufficient detail. Contact sessions are designed to give the students practical experience of the topic in question and experience at facilitating learning. The problem was that students came to contact sessions unprepared, and so could not cope with the practical work. Providing notes was not the solution as the ACE students did not study, preferring to rely on the old style of rote learning at the last moment. A solution came in the form of interactive notes which covered the content, but included activities for the students. These included simple experiments, done with everyday items that illustrated the concept, reading notes and viewing PowerPoint slides that had been prepared and placed on the university network, and directing the students to useful websites. Students were required to complete a small section in readiness for their contact session at which practical work and teaching methodology would be shared and discussed. This paper explores the students' perceptions of this strategy, and the extent to which the strategy helped students to apply their learning in their classroom. The recordings of the first cycle showed that students who lived close to the university and who could spend time on the university intranet, fared better than those who lived out of town. For out-of-town students, another strategy had to be found. In the second cycle of this Action Research, with another cohort of ACE students, students are again supplied with the interactive notes, but are being introduced to using WebCT. The major hurdle is to develop the students' computer skills sufficiently for them to access the university website and the WebCT programme. The second part of this paper explores the attitudes of the second cohort of students to using WebCT to enhance their learning of natural science.

Introduction

The education system in South Africa is undergoing rapid change in an attempt to redress the imbalances of the past. The first attempt at transforming the education system was made in the form of Curriculum 2005 (South Africa, 1995) which was introduced in schools in 1997, starting in the Foundation Phase (Grades R-3). Founded on transformational outcomes-based education principles, C2005 was designed to develop seven critical outcomes and five developmental outcomes enshrined in the Constitution. However, the new curriculum required a very different kind of teacher from the past system and a very different kind of learner. Both teachers and learners were confused and many teachers were incapable of implementing the curriculum as intended.[1] To add to the confusion, the initial training was done too fast and by trainers who did not fully understand the curriculum documents.

In 2002 the Revised National Curriculum Statement (RNCS) was introduced with simplified learning outcomes and more guidance on content for each Learning Area. (South Africa, 2002). However, many teachers are either unqualified, or under-qualified; many schools lack resources, and teachers simply gave up (Cole, *et al.*. 2006). Much of the confusion continues (Burton, 2006, 2007).

South African Higher Education Institutions (HEI's) have been tasked with upgrading the qualifications of the teachers who received only two or three years post-matric education (South Africa 1997). Qualifications such as the Advanced Certificate in Education (ACE) are used to upgrade teachers' qualifications to four years post-matric. It is with this aspect that this study is concerned. Teachers who elect to join the ACE (Science) programme are typically 30-50 years old, having experienced the inadequate apartheid education system followed by inadequate teacher training. Many of them did not do science at school and of those who did, very few conducted practical work. As a result, content knowledge is generally poor with teachers admitting to leaving out the sections that they do not understand themselves. (Pers. Comm., Burton, 2007)

[1] Many teachers interpreted 'learners are responsible for their own learning' to mean that they could set work and leave the classroom!

My experience is that when the students (teachers) enter their first year of study the majority are not computer literate, their literacy and numeracy skills are weak and they are not accustomed to the level of independent study required by the programme. It requires imaginative strategies to develop the students into life-long learners without putting them under too much stress. This study is the story of my Action Research journey towards finding a strategy that will enhance the students' chances of success on the ACE (Science) programme and encouraging the students to implement their new learning in their schools. I refer to the students as *my* students but this is not meant in a maternalistic sense. I work closely with my students and they become part of my life – some of them long after they have completed their ACE.

Action Research Literature Review

The aim of action research is to develop reflective practitioners (Taylor *et al..,* 2006) - people who think about what they are doing and how to do it better. This requires the practitioner to be the change agent in a very specific situation and therefore the insight gained from action research cannot be generalised. I subscribe to Schwab's perspective of change in higher education practice which requires both wisdom and responsibility. Schwab posits four facets:

- Make changes in small steps so that the programme maintains coherence,
- Begin with diagnosing a problem in the curriculum
- Generate new alternatives to the problem
- Assess the students' responses to the change. (Schwab, in Zuber-Skerritt, 1992).

Zuber-Skerritt claims that high quality education is not a result of the level of the education being offered, but relies to a large extent on the students' intellectual independence, and that this is only achieved when the student is able to reflect on their learning, understand *how* they learn, and test their learning against that of other people in the community. I have found this to be my experience of working with ACE students.

Action research, according to Zuber-Skerritt, is based on action learning. It is holistic, seeing theory and practice as mutually inclusive. She cites Kemmis's injunction that all participants must be involved in all stages. I found this difficult to do at the start of the cycle which included a new cohort of students. In addition, while my students can have a say in what they would like to deal with in more detail, the ACE qualification has outcomes specified by the national Council for Higher Education (CHE).

According to Zuber-Skerritt there are three types of action research. I have practised all three. At first my action plan was designed to improve my teaching. In the first cycle, which was an example of Technical Action Research, the students were entirely dependent on me for the design of the programme. In the second cycle I used the students' journals and evaluations as a way of assessing the success of my action plan, which was now focused on improving the teachers' self-reflection as well as their content knowledge. Zuber-Skerritt describes this as Practical Action Research. In the third cycle I believe that I am practising what Kemmis (in Zuber-Skerritt) calls 'true' action research as I have become far more critical of the organisational constraints facing me in my teaching and my students in their learning[2]. I am closer now to the CRASP model developed by Zuber-Skerritt as I am involved in researching my own practice, with the aim of improving myself, the students' learning and the curriculum, with the hoped-for outcome of achieving social change in local primary schools. Becoming involved in emancipatory action research requires me to involve my students as much as possible and that requires me to know who my students are – adult learners.

Adult Learners

Nafukho *et al.* claim that teaching adults, and African adults in particular, requires that the following six principles are taken in to account:

1. Students need to understand why they are studying and where they will be at the end.
2. The lecturer needs to understand the concept of *ubuntu* -African students tend to prefer to work in small groups.
3. Adults bring a wealth of cultural and personal experience with them which can enhance learning.

[2] The East London campus is growing faster than buildings can be procured and renovated. At the present time here are insufficient computers and inadequate teaching facilities for science education.

4. Adults choose to study for personal growth and not only for economic reasons.
5. The new learning should have a direct impact on the student's life. [According to Morrison (2003), a problem-solving approach to learning enhances assimilation.]
6. Adult students are motivated to learn mainly for internal reasons such as self-esteem, increased job satisfaction or improved quality of life and not only for external reasons.

Nafukho *et al.* page 10 – 15)

While I acknowledge these principles, my experience does not bear out principle 6. The main reason for claiming this is that teachers have to have a four-year qualification in order to teach in South African schools and by achieving the qualification, the students protect their jobs and receive an increase in salary.

As part of the redressing of apartheid many organisations provide bursaries for teachers to upgrade their qualifications. With the promise of a bursary to cover the fees many students register without the self-motivation to persevere when either the course or their life gets tough. In each cycle a number of students have dropped out.

The Advanced Certificate in Education (Science)

The ACE programme is a two-year part time qualification with approximately 22 contact sessions which are held over the weekends, and accounts for approximately 30% of the notional time[3]. The time available is insufficient for the amount of redress required and so information is placed on the university intranet which the students can access in their own time. This strategy was used as an introduction to computer-based learning which I feel is necessary to assist those students who live far from campus, but also to provide the students with experience of constructing their own knowledge from the Internet. I have learned that the allure of the Internet is far more powerful than that of books, particularly where visual material is concerned. The ACE (Science) qualification has developed into blended learning - e-learning blended with contact sessions.

e-Learning

Holmes & Gardner define e-Learning as 'on-line access to learning resources, anywhere, any place any time' (page 13). The philosophy behind e-learning is similar to that of adult education: viz. students know why they are learning, they can control their learning, learn in their own time and gain personal benefit from the activity. e-Learning requires a degree of discipline from the learner. Blended learning, on the other hand, helps to alleviate the boredom of individual contact with a screen and provides the group contact so necessary for African learners. (social aspects of learning Vitgostky). For me, the advantage of using some e-Learning strategies is that my students can prepare for a contact session by covering the content for that session. Then, in the class we can do practical activities, explore teaching strategies, design learning strategies suitable for their class conditions, discuss content-related issues and answer questions. I have found that this can reduce the amount of time needed to develop the students' competence (Driscoll & Carliner, 2005). In addition, students gain computer skills to seek further information for themselves and they develop higher order thinking skills as they have to analyse and evaluate the information they find before choosing to use it.

Another advantage is that where students require 'drill' exercises, such as in mathematics, they can do these at their own pace and in their own time, but still collaborate with colleagues if they want to. A further advantage is that each student can explore the topic as far as *they* want to; it removes the constraints of time and travel, allowing rural students the same access to information as their urban colleagues. The situation at Fort Hare is not as rosy as painted here. Many students do not make the most of the opportunities afforded to them; most students do not have access to computers or the Internet, either at school or at home and many cannot afford to pay for computer lessons. ACE students require knowledge and practical expertise to give them the confidence they need to teach natural sciences and achieve the learning outcomes for the grade they teach. A solution needed to be found for the problems that threatened the quality of the ACE programme. I decided to engage in collaborative action research.

[3] Notional time is calculated from the number of credits for the qualification – 10 hours per credit. The ACE qualification bears 120 credits (60 credits per year) and requires 600 notional hours per year.

Research Question

I knew that the nature of action research meant that the research question would change with time and so I was satisfied with finding the answer to the broad question:

How can I help my students to become effective change agents in the new South Africa?

The Study

This case study takes the form of qualitative, collaborative Action Research over three cohorts of part-time students, covering a period of five years, to date. My adventure started as an informal enquiry into my own practice. The plan of action was designed without the collaboration of the students. This first cohort evaluated the plan and contributed to the plan for the second cohort. However, each year in the first contact session the students were asked to state their expectations of the programme and these were taken into account. I also told them what I was doing and why I was doing it and requested that they keep me informed of how they were experiencing the course. I used student's portfolio entries, personal conversations, examination results and the course evaluations to verify (or not) my reflections. The analysis of these tools guided the plan for the second cycle of action. This plan was repeated with the third cycle, with only the focused research question changing, as I sought to become a catalyst for change in the Eastern Cape.

For the first cycle of research my research focus was *"Will providing material for study improve my students' content knowledge?"* I concentrated on providing the students with handouts on the content.
While still keeping in mind my overarching research questions, the focus changed in the second cycle and I posed the question, *"Will providing interactive content notes and requiring students to reflect in a journal on the process of learning achieve change in students' assimilation and application of knowledge?"* For the third cycle the focus changed again as I gained greater insight into my own teaching and learning as well as those of my students. The question now is, *"Will using WebCT improve student learning and application of knowledge?"*

Findings

To make it easier to see the structure of each cycle I have chosen to present my findings for each cycle in tabular form with comments in italics. Since this research is seeking to develop my own 'best practice', I shall use as my primary source of data, my own reflections, and corroborate or not these findings with data gathered from a variety of sources. While I am aware that every student's voice is important, I have selected comments that express what the majority of students wrote, but also include other views, where these are expressed. I shall also comment on the validity and reliability of each as I do so.

Summary of Data

CYCLE 1: (19 students) 2002/2003 Research question: *Will the provision of detailed resource notes improve my students' content knowledge and improve their teaching?*
Plan of action: Photocopied content handouts; Practical work using recycled materials / improvised materials; Teaching science in a standard classroom modelled; Week-long computer courses; Assignments to be word-processed; student portfolio compiled (including a journal).

My Reflections	End of Course Evaluation	Portfolio/Journal	November Examination Mark
Practical work is very important. Very little improvement in content knowledge and understanding compared to past years Primary school teachers found text too dense, language difficult Content was not covered in sufficient detail Computer literacy only	No formal evaluation was done at the end of this course.	I have never seen down a microscope before. *[No primary schools and very few senior schools have microscopes. Only two students had ever used a microscope before]* I tried using the jigsaw method of teaching and it worked. My learners enjoyed it. *[Students were encouraged to try the different teaching and learning strategies that were demonstrated]* I am a Biology teacher. This new work [Geog] is difficult for me. *[Many senior school teachers found it difficult to think globally, preferring to stay 'within their*	Ave: 52% (Min 43%, Max 66%)

marginally improved.		*box'.]*	

Fig. 1: Cycle 1. 2002-2003

I need to find a way to ensure that students cover all the prescribed content and apply their learning in their classroom.

CYCLE 2: (20 students) 2005/2006 *Will providing interactive content notes and visual material and requiring students to reflect in a journal on the process of learning achieve change in students' assimilation and application of knowledge?*

Plan of Action: Concentrate on GET Band (GR – 9); Interactive content books prepared for each theme in Natural Sciences; Visual material and extra notes for content placed on university intranet; Introduce WWW as the starting point for computer skills; Short tests on each unit for each theme; Model different teaching strategies; Literacy courses in year 2; Journal to encourage reflection.

My Reflections	**End of course Evaluation**	**Journal**	**November Examination Mark**
Everyone found the visual material either quite helpful, very helpful or extremely helpful Teachers copied notes and visuals for use at home and in schools where computers were available Most students found the journal 'quite helpful; two students did not find them helpful Content knowledge and understanding improved Computer skills improved significantly WWW encouraged personal research. The work books were successful but I need to set regular tests to ensure that students keep up with the work and prepare for the contact sessions. Any extra time will have to be virtual.	Concepts that were difficult to understand became clearer as most information was clarified by pictures. Most of the information is there in the computer. I am confident about the teaching methods used in science. I can now be a facilitator and not a teacher and learners still learn. … I have downloaded some material to help even with my own kids. Copied visual material Life and Living is giving me a hard time, I'm not a Biologist I have gained vast knowledge especially the Earth and Beyond. *[Most students had not done Geography at school and found this section challenging.]* … I did experience some difficulties in Chemistry. … Unlike females who are open, my feelings about my studies and my work were a closed book to my lecturer…. we need to organise more time for contact sessions	I applied the teaching method Noreen demonstrated with my class. The lecture notes were too difficult. We are second language speakers.	Ave: 56% (Min 25%, Max 75%)

Fig 2: Cycle 2 2005-2006

CYCLE 3: (21 students) 2007/2008 *Will 'blended learning' using WebCT improve student learning and application of knowledge?*

Plan of Action: Continue with interactive theme books [2 per year]; Contact sessions used for discussion and more advanced practical work; Literacy courses in first term; Introduce 'Harry Wong' tests; Issue a SA text book on Science teaching; Computer skills integrated with intranet resources and course content; Class email

list set up for class communication; WebCT introduced to encourage more [virtual] contact time; No journals; Site visits.

My Reflections	Mid-year Evaluations	Site visits
Knowledge growing for most Computer skills greatly improved but not enough to introduce WebCT in 1st semester *[The majority of students do not have internet at home, in their community or at school. This suggests that introducing WebCT may be a bit ambitious, except for the administrative benefits]*. Site visits show that little change has occurred in the classroom. Talk and chalk. [Must find a way to improve classroom practice.] Mathematics generally weak Communication with students not good enough Need student journals to inform my teaching Need a way to encourage and challenge students to *do* science. Distance learners feel disadvantaged	I have gained a lot during this semester and I'm implementing it with my kids … I am going to practice the activities with the kids. Some [topics] were difficult to understand. My tutor helped me understand [Planet Earth and Beyond] and I am proud to say I acquired a lot. *[Many students expressed similar thoughts. One student claimed to still be having difficult: " I do not follow, so hard for me to conceptualise of what this is all about".]* Difficult but enjoyable. Broadens my knowledge personally [Planet Earth and Beyond]. I am able to do lesson plans and teach according to the lesson plan …I am trying my best to use the learner-centred approaches of teaching, though our learners are not used to them. *[Learner-centred teaching and learning strategies are modelled and students expected to practice them in class. This is not being done]*. I still struggle with some of the things e.g. exponentials. We need more time and more practice with mathematics. I have gained a lot of new things e.g. measurement, graphs etc. *[The mid-year test suggests that for most students mathematics is a problem]*. When I came here I knew NOTHING about computers … she taught us softly but ROUGHLY. We had to learn fast! I wish I can stay there [computer lab] and do my work every time. This [computer course] has been a hard exercise … but I am becoming used to doing the exercises on my own. … I am still learning but I'm very slow at operating [a computer] since it's the first time in my life. *[Many students requested more time to learn to use the various programmes. What is needed is learner-friendly tutorials. Perhaps the first thing to teach new students is how to access the Help menu!]* I am leaving [living] far away from the university and not having a computer at home I sometimes go without all the information from the science V-drive [university intranet] … The v-drive confuse me. It is better to use text books from the school …	Classes are arranged in groups for the visit. [A visit to the school for admin. Purposes showed the overcrowded classroom arranged in rows.] Learners seldom did group work, but rather worked individually, while seated in groups. Students sited lack of resources for not doing practical work, when household materials could have been used. *[Activities in the course work books all required easily obtained materials as to encourage students to use them in school.]*

Fig. 3: Cycle 3 2007-2008

2008: I will be able to expand WebCT as a support medium – blended learning, thus giving students more time to interact with resources. To improve skills and classroom practice I will introduce independent scientific research, which students can model for their learners. There is a need to hold district workshops in

using and managing science resources. I can initiate negotiations for ACE laptops with wireless connection for use in class so that we have instant access rather than having to find a spare place in crowded computer labs.

Comments

Journals

My students, generally, were not good at reflecting on their learning. They tended to write diaries. With time, some of the students began to write about what they were finding interesting, or their experience of attempting a teaching strategy that I had modelled, and this showed me that for those who were able to reflect (mainly the women in the class), my teaching methods and the plan of action were sound, but on the whole I gleaned little of worth.

The students commented in the evaluation that for some of them the journal was a waste of time, while others used it as a way of disciplining their study time. Others only saw the value towards the end of the two years when they looked back over what they had written and realised how they had changed.

I used reflective portfolios in the first cycle and journals in the second cycle, but because I was introducing WebCT in the third cycle, I chose not to use them. This has proved to be a mistake and showed me that in fact the journal is a very valuable tool for me to get to know my students as people. I miss not being able to have the one-on-one conversations that a journal affords.

Personal Conversations

Because of the informal nature of personal conversations, I did not always record what we had discussed. I therefore chose not to include these as I had no way of validating them. What I learned from conversations is how important it is for a teacher to share her enthusiasm for her subject with the students, particularly when topical issues related to the learning in class and students could see the relevance of what they were required to teach.

Examinations

Examination questions were based on Bloom's range of competences. Knowledge, understanding and application made up most of the content paper, while questions requiring application and synthesis were more often used in the Science education section. I have used examination marks very subjectively as each cohort was made up of very different people. However, as all the teachers on the course have come from the Eastern Cape, and attended similar schools and training colleges, there is a degree of similarity in their backgrounds. For this reason, I claim that if the average examination mark is improving, then the teaching strategy I am implementing must be having a positive effect.

Throughput

While most students completed the course in two years, a few needed to repeat a module (usually a science content field with which they were not familiar). On the whole the percentage throughput was very good. However, that did not mean that having achieved the qualification, the teacher was considered a specialist in the field, nor that the teacher actually implemented the new knowledge in the classroom. Further research into the sustainability of the qualification is needed.

Course Evaluations

The evaluations presented for me the most valid and reliable means of affirming (or not) my reflections, because as they were anonymous, the students could express their true feelings.

Conclusion

Action Research requires that in the final stage of each cycle that I reflect on the process. My critique of my study is that it was very involved with many aspects. I did not always keep notes as I should because I started by doing the research informally for my own development. The number of students enrolling in the course has increased slightly each year. Whereas we struggled in the past to attract teachers to study the 'hard' subject of Natural Sciences, we are now able to select students. For me this is an indication that the programme content is meeting a need and that the method of delivery is relevant to the teachers' needs. Perhaps I am beginning to function as a change agent in Eastern Cape education.

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