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Re-envisioning African Higher Education: Alternative Paradigms, Emerging Trends and New Directions

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COVER

***Maasai* by Fernando Vicente**

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Re-envisioning African Higher Education: Alternative Paradigms, Emerging Trends and New Directions

Guest Editors
Rubby Dhunpath, Nyna Amin and
Thabo Msibi

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Editorial: Re-envisioning African Higher Education: Alternative Paradigms, Emerging Trends and New Directions

Rubby Dhunpath
Nyna Amin
Thabo Msibi

In recent years, higher education in Africa has emerged as a critical link to economic development, political agendas, social desires, national reconstruction moves and social justice imperatives. As the second largest continent on earth, and home to more than a billion people, Africa comprises 55 recognised countries, with a multitude of languages, cultures, belief systems and mores. Its major problems are the negative perceptions regarding iniquities, disease, under-development and poor governance structures. Somewhat relegated to the periphery, are the tangibles the continent can offer as the reservoir of immense natural resources, human capacity and potential.

Re-envisioning Africa in positive ways means that higher education needs to be conscripted towards the services of the continent by providing the intellectual guidance, knowledge and skills to catalyse the immanent potential. Higher education, from this perspective, has to shape, plan, design and produce human capital and knowledges that are relevant to Africa. This is no mean feat as the frontlines of the battles African higher education has to engage are at least, two-fold in nature: one, a commitment to the internal imperatives of Africa and two, engaging with the hegemony of northern epistemology, ontology, axiology, ethics, and validity measures. In other words, higher education has to be the imaginative source of alternative paradigms, new trends and directions.

Seeking alternative paradigms, we argue, has a starting point and that is to take ownership of knowledge production, for legitimacy and respect. For example, higher education institutions in Africa have been around for

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centuries. The earliest, the University of Al-Karaouine, in Morocco, established in 859AD, continues to offer programmes and to confer degrees. Despite a long and strong lineage debates about its authenticity as a 'university' are unabated and for many it is considered to be 'madrasa', (Makdisi 1970), opting instead to recognise the University of Bologna as the oldest university in the world. The conflict was settled somewhat by the recognition of both UNESCO and The Guinness Book of World records which granted the University of Al-Karaouine status as the oldest University in the world. But, depending on one's worldview, there is no consensus. Official recognition, we know, cannot harmonise doxa, ideological stance or politicised overtures as these are characteristic of paradigmatic influences. Paradigms are not neutral, or natural. They organise, operationalise and obligate subservience. It was Thomas Kuhn (1970) who revealed the hidden mechanisms that influence research, its relevance and reception. The generation of alternative paradigms must, therefore, be taken seriously if Africa is to make its foray onto the world's centre stage as a force and a source of future trends.

What we can and have to do is to produce, through our research endeavours in our journals and elsewhere, the creative and productive alternative narratives of Africa. The series of papers this special edition offers is a contribution towards that agenda. The papers reflect the conscious and concerted efforts made by researchers to use the spaces of knowledge transfer, production and reproduction in novel ways that are useful for Africa and beyond. Indigenous knowledge and language development, improving teaching, making learning relevant, the induction of new academics, supervision, improving quality, curriculum restructuring and musings, STEM studies and contextual complexities are some of the issues grappled with in this compendium.

Language is the focus of the first paper. The imperative to reconsider the role of language in the context of both regionalization and internationalization in Africa is gaining currency as a crucial driver for higher education development (Hornberger 2007; Phillipson 1992). Academics are now under obligation to challenge processes and established practices that 'normalize' the use of certain languages while according marginal status others either as lingua franca or as languages of instruction. Terminology development for a scientific discipline is an essential prerequisite for education in the chosen language. In this regard the disciplines of Computer

Science and Information Technology are alleged to be lagging behind especially as they relate to the many non-English languages on the African continent. Disciplinary variations in terminology continue to impact the quality and stability as constructions are determined by who is consulted and how the process unfolds.

As the basis of their article, Keet and Barbour evaluated the veracity of terminology development with a simple hypothesis: *A resultant terminology in an evolving scientific discipline will differ depending on whom you ask, and how*. Through three experiments: an experts-only workshop, two online surveys, and voting on computer literacy terms, they obtained what is arguably the longest existing list consisting of 233 terms for 146 entities. They contend that there are notable differences in preferred terms between experts and computer literate users, and while the passive voting yielded quicker results than the surveys, some entities still have many different isiZulu terms. Keet and Barbour's findings are noteworthy: to ensure rigour and legitimacy of terminology development, the process and product should, of necessity, be broadly participatory and inclusive from the harvesting stage. Yielding multiple contenders for an entity should be a compulsory and explicit before, and possibly also during multidisciplinary terminology development workshops. This democratisation of the terminology development process transcends the insularity and purism which characterises traditional laboratory approaches to development.

Part of shifting from the known, traditional paradigms to alternative ones pertains also to the recognition of African languages as carrying value for the purposes of teaching and generating new knowledge. Nkosi, Ntuli and Ngobo's paper is, therefore, another crucial contribution to this special issue. In their paper, which primarily seeks to highlight the experiences of academics in supervising research in the medium of isiZulu as well as these academics' thoughts about disseminating knowledge in isiZulu, Nkosi *et al.* show the possibilities that isiZulu offers both in the creation of new knowledge, as well as in improving the quality of supervision. The authors found that academics who were supervising research in isiZulu had positive experiences because it forced them to read scholarly method and theory books in order to support their students in their development. These scholars conclude that 'research produced in English is technically not better than research produced in isiZulu because the same materials are used' (8). Apart from these benefits, the interviewed supervisors cited improved writing skills

from students, as they were able to write in their mother tongues, as well as success in student graduation rates as students were doing their work in their home languages. However, while there are all these benefits to supervising in isiZulu, the authors make it clear that exploring alternative, marginal paradigms is not a simple pursuit: the dominance of English in academia makes it difficult for research in African languages to be given serious recognition. The authors show that while there is a willingness and commitment among academics to disseminate knowledge in isiZulu, there exists limited opportunities, be it in the form of conferences or journals, to enable this to happen. The paper concludes by maintaining that academics should insist on publishing their research in isiZulu so as to develop the language while also contributing to new scholarship.

Improving teaching and learning in deep and substantive ways is at the heart of contemporary higher education, more so in Africa where student preparedness for higher education, success and throughput are unsustainably low in relation to comparator nations (see Dhunpath & Vithal 2012). The past decade has witnessed a drastic change in the way universities are structured and financed. Globally, governments are investing less and less in higher education, leading to emerging private sector-funded universities, and an increasing number of privately-funded students in public universities. While this development has widened university education opportunities, it has pedagogical implications. Class sizes have increased, and diverse student populations with varied learning abilities, cultural capitals, social class, and linguistic variations are accessing higher education. Whereas the brightest and most committed students are still admitted as was the case in the past, alongside these are students with neither strong learning abilities nor strong academic backgrounds. There are, consequently, demands on the university teacher to respond innovatively and responsively in terms of teaching approaches. Three papers are instructive in this respect.

The first by Ansurie Pillay, theorises some surprising findings that emerged from a participatory action research study. Working with students for whom English is a second or third language (a common situation across Africa), the study acknowledged the lack of cultural capital for success in higher education. The innovative strategy here was recasting the 'lack' as an opportunity to retrieve from the students their own cultural assets to create a nurturing learning environment. Together students and lecturer chose literary texts, discussed the importance of reading, academic prowess and

empowerment. The turn to an alternative source of cultural capital and to reflexive and responsive pedagogical engagement resulted in effective teaching, engaged learning and competency in academic literacy.

The second by Jayaluxmi Naidoo, relates to the experiences of postgraduate students' use of technology as a tool for mathematics teachers. Teaching mathematics in traditional ways has limitations, the most serious being the marked underperformance as evidenced by performance in benchmarked tests. Technology, it appears may have a critical role to play in reversing the trend of underperformance. Naidoo's study found that teachers valued the use of technology, supported multiple assessment methods and that they also desired platforms outside the bounds of official policy structures like conferences where teaching practices could be shared and the for professional bodies to shift the gaze to academic matters. Though not engaged with in the paper, the hidden discourse one can infer is that there are teachers who realise the lost opportunities to reverse declining mathematics outcomes by those who possess the power to do so.

The third in this thematic trilogy is written by Sarah Bansilal. This study focuses on the study of number patterns, and more importantly, converting the patterns into mathematical symbols, as abstract algebraic equations. The importance of this study against the backdrop of poor mathematics competency as already mentioned previously should not be underestimated. Shifting gears to higher, abstract levels in the training of future teachers is yet another attempt on the part of higher education to contribute to responding to national imperatives. The study revealed different strategies used by the students to no avail. The students were unable to generate terms of the sequences which contained repeating cycles and also struggled to generate a description of the general term of such sequences. Bansilal provides mathematics teachers with vital insights about which aspects of the curriculum teachers-to-be find most challenging.

Taken together the three papers suggest that higher education is obligated to factor - in context, cultural capital, and pre-university education as a responsive pathway for successful teaching and learning in Africa.

Teaching and learning responses are not sufficient in themselves. Serious en-visioning mandates a critical re-evaluation of curricula in higher education. This edition offers two such possibilities: an imagined curriculum and a critical assessment of the implications of proposals to lengthen undergraduate qualifications by an additional year.

The Amin and Campbell article, based on the experiences of health-care workers in rural parts of South Africa, offers an imagined curriculum for palliative care and its impact on patient care. Palliative care is a medical intervention for a patient facing death due to an incurable disease, or poor health prognosis. In Africa, it is often undertaken by volunteers with little or no medical training. The training of the volunteers is a concern as it is influenced by a body of knowledge established in the North which excludes patients' spiritual beliefs and cultural values in respect of healthcare, dying and death. A curriculum, reconceptualised through a post-structural lens, Campbell and Amin argue, will not only respond to the needs of patients and caregivers, it is also a more resilient means to capture the simultaneous, yet different realities within the same context or across multiple contexts. The paper is novel in terms of its interdisciplinary approach, with the work of medical caregivers being bolstered by educational theory and practice. The Amin and Campbell paper is a stark reminder that content knowledge and context knowledge are of importance in equal measure.

By contrast, the Rawatlal and Dhunpath article questions the logic of extending the undergraduate programmes by a year. Furthermore, they critique the notion of an 'irreducible core' in any curriculum. In fact, the powerhouse of the North's hegemony of how, what and why we teach and learn, located within that core, is of great concern, considering the multiplicity and diversity of transnational contexts. An African perspective should destabilise the core as it is epistemologically tainted and the authors take pains to do so. They logically unpack the flawed assumptions and inferences made by the South African Council on Higher Education, making apparent the potential hazards of these flawed assumptions – if they are to inform policy decisions. Deploying a range of scenarios they reveal that a temporal response will perpetuate a pedagogy that fails to transcend remediation motives. Instead, Rawatlal and Dhunpath advance an alternative approach, drawing from the field of Artificial Intelligence and by advocating for smarter rearrangements of curricula and time-tables to optimise learning.

In an era of endless quests for working smarter, the lecture method has to be complemented by new age technologies. Teachers in higher education will need to develop critical and reflexive approaches to teaching and learning underpinned by relevant theory and practice, scholarship and research. Alternative instructional strategies and paradigms will need to be embraced for successful outcomes. For example, Wood and Maistry in their

thesis on higher education accounting pedagogy argue that qualitative studies of accounting pedagogy are rare in South Africa. The larger study from which their paper is drawn explored the pedagogy of Managerial Accounting and Finance lecturers at the University of KwaZulu-Natal (UKZN). One of the significant influences upon the participants' pedagogy was the curriculum and assessment requirements of the South African Institute of Chartered Accountants (SAICA), the regulatory professional association. Using a qualitative case-study research design, conventional and video-stimulated reflection (VSR) interviews as well as lecture and tutorial observations, Wood and Maistry analyse the influence exerted upon pedagogues by SAICA.

Contrary to the learner-centred teaching approach advocated by SAICA, they found that the participants' pedagogy was in practice, teacher-centred. They argue that this slippage may be explained by their restricted pedagogical knowledge arising from inadequate teacher education and deficiencies in continuing professional development. A significant contribution to research curriculum is the video-stimulated reflection (VSR) approach which proved to be a powerful means of prompting critical reflection from the participants and diagnosing inadequacies requiring continuing professional development. Wood and Maistry conclude that SAICA's curriculum and assessment requirements, given the participants' inadequate teacher training and development, were a pervasive constraining influence on their pedagogy. In particular, pedagogues' preoccupation with preparing students for SAICA's examinations was of concern and warrants further research.

The concern with quality promotions and quality assurance is intrinsic to any discussion on curriculum and pedagogy. Improvement' and 'maintenance' of quality in higher education have become buzzwords in the global higher education discourse in both emerging and mature economies as schools and universities make efforts to produce students of international calibre. At the institutional and national level, these attempts include internal and external quality assurance of education programmes and institutions which often leads to institutions and education programmes acquiring or losing their accreditation status. Sosibo argues in her paper that although internal and external review systems have been in place in South Africa for a number of years, not many institutions have reflected on how they impact on the quality of education. In her study, eight academics reflected on these

reviews, with the goal of determining which review had more impact than the other in maintaining quality in education. Because there were a greater number of limitations identified in external reviews than there were in internal reviews, Sosibo infers that academics appear to value and support the latter. Sosibo concludes on the basis evidence she has generated that internal reviews should be strengthened and conducted regularly in order to raise quality in higher education.

The idea of power, struggle and the transformation of structures cannot be excluded from the debates of higher education in Africa. Whitehead and Moosa's paper on the experiences of new academics, especially from previously marginalised groups, in South African higher education spaces narrates such encounters. Recognising that South Africa remains an important site for which to understand how transformation and change are engaged by universities (Soudien 2011), Whitehead and Moosa present a timely review addressing the challenges faced by new academics as well as those who come from marginalised groups. This is an important area of work which is proving to be quite tricky for many institutions across the country, with the University of Cape Town for instance recently facing some of the harshest criticisms on its policies of integration and promotion of Black academics within the institution.

Whitehead and Moosa understand very well that transformation must be accompanied by quality. Therefore, the authors explore the structural factors that prevent new academics from succeeding. Among these are the difficulties in transition from student to staff, as well as the problem of unsupportive institutional and academic cultures and discourses. The paper also highlights the marginalisation that black, women and working class academics experience in HEIs. For Whitehead and Moosa, as part of reinvisioning higher education in South Africa, new academics must be inducted into academic life as this would socialise them to the institutional cultures. Duties that the academics must perform must also be clear. This would in effect, the authors argue, require non-hierarchical mentoring models which would enable new academics to get exposed to existing networks– which are critical for the progress of new academics in HEIs.

It is now a truism that postgraduate supervision is a complex and demanding pedagogic practice, which goes beyond research and disciplinary expertise on the part of the supervisor demanding high levels of disciplinary knowledge and, equally, high levels of psycho-social maturity for both

supervisors and students (Ali & Kohun 2006). This is true of post-graduate supervision in general but perhaps of greater relevance to doctoral supervision where the delicacy of the supervisory relationship predisposes the relationship to conflict and contestation (Spooner *et.al.* 2007). Considering that a limitation of traditional systems of doctoral research training is the master/apprentice supervisory model, Rawlinson and Pillay question whether different genres of research, such as self-study, add to the complexity of a supervision relationship, where the support process between supervisor and student changes the practitioner and her situation.

By adopting a reflexive stance in a self-study supervision relationship, Rawlinson and Pillay engage in the process of self-scrutiny and tenuous knowing of their positions and the shifting nature of these positions as illuminated through particular moments in the self-study doctoral project. Drawing on excerpts from supervisory meeting conversations they co-write their struggles relating to what they describe as 'fixed positionings, dis-positionings, and repositionings' all of which are necessary for reframing the supervision relationship as an ethically and aesthetically caring practice. They conclude that the mutually reflexive process undertaken through writing foregrounds powerful, complex moments that happen as spaces: 'potential, transitional, creative' in a dialogical self-study supervision relationship, which left unattended may have negative consequences for the self-study researcher and the self-study research project as a whole.

The problem of access to higher education has been overshadowed by the realisation that administrative access does not guarantee or enable epistemological access which predisposes students to success or failure. Regrettably, many in the academy continue to relinquish their responsibility for providing epistemological access, playing the perennial blame-game and shifting responsibility to schooling (see Dhunpath & Vithal 2012). Indeed, Higher Education Institutions (HEIs) do require benchmarks for selecting students and the National Senior Certificate results continue to be an important indicator for entry into such institutions. A range of papers dealing with aspects connected to success or failure are offered here.

Stears and James compared first year students' Grade 12 performance with the results obtained in a first-year biology module at a tertiary institution. They used a number of strategies to determine if there was a significant difference in performance between the Grade 12 results and results obtained in the biology module, including the comparison of student

competences with competences stipulated in the Department of Education National Curriculum Statement for Life Sciences. The results showed that the significant difference between Grade 12 results and the performance in the biology module may be explained by the fact that students demonstrate knowledge and skills that are below those stipulated in the policy documents. Furthermore, students' experiences of learning at a tertiary institution are significantly different to their schooling experiences. Students' experiential differences have implications for further study at HEIs and require interventions by such institutions to ensure a smooth transition from school to tertiary education. Similarly, Siyepu and Ralarala's paper offers insights about first-year students learning. They investigated first year chemical engineering students' learning of mathematical concepts. By exploring students' interpretations and misinterpretations in their learning of mathematical differentiation, the authors concluded that early identification of students' misinterpretations of concepts is essential for their success in HEI. In this paper they chose not to focus on prior learning; instead they make the case for a critical re-evaluation of the lecturing modes and the roles of assessment.

The two concluding articles revisit two contentious and politicised issues in Africa: indigenous knowledge systems and sexual and gender diversity issues. Nadaraj Govender's study is tinged with optimism for the insertion of African knowledge systems as an alternative to the established status quo. The study explored the effects of an intervention strategy underpinned by argumentation theories. The findings suggest that argumentation discourses are an effective tool for inspiring students to incorporate local, cultural and indigenous experiences in addressing the science and social justice goals of education. This article must be placed within a larger context of efforts to legitimise African knowledge and to produce evidence of methods and methodologies of approaches that work.

Thabo Msibi's research analyses and theorises students' exam responses in a module concerned with empowering pre-service teachers to address homophobia in schools. Recent events on the continent advocating harsh punitive measures for those who stray from conservative sexuality norms, speak to the need to integrate sexuality politics in all segments of education. Teachers are essential in the fight against homophobia as they have access to and direct influence on those who attend school. Ensuring that the next generation is conscientised, future teachers have to be adequately

prepared to face and neutralise the dangerous discourses that circulate in public and private spaces. To that end, Msibi argues that it is neither sufficient nor acceptable to focus only on the influence over those we teach; instead he instigates a self-reflexive gaze to challenge 'asexual teacher discourse'. Teachers, he argues, are sexualised beings and self-awareness is vital for change to be meaningful.

These papers provide a breathtaking landscape of the efforts being undertaken to confront higher education issues that matter to Africa. They do not pretend to be an exhaustive account, they, nevertheless, add substance to a burgeoning body of emerging alternative scholarship.

The cover: The cover image was painted by Fernando Vicente, a Spanish artist living in Madrid. His oeuvre consists of thematic sets drawn on printed materials combining his passions for topics on anatomy, mechanics, cyber punk culture and the human body with his collections of posters, maps and geographical anatomy texts. His latest exhibition, 'Vanitas', examines the human body, 'without subterfuge, outside and inside, its fragility, is the mirror to look, in that we realise how fragile we are, and what we think. We all have the same viscera, arteries and muscle' (Fernando Vicente 01 Dec 2014).

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Limitations of Regular Terminology Development Practices: The Case of isiZulu Computing Terminology

C. Maria Keet
Graham Barbour

Abstract

Terminology development for a scientific discipline is an essential prerequisite for education in the chosen language. The young disciplines of Computer Science and Information Technology are lagging behind in this respect for many non-English languages. Between the few resources for isiZulu that exist, isiZulu computer literacy terms often differ. This suggests that any resultant terminology in an evolving scientific discipline will differ depending on who is consulted and how, affecting its quality and stability. We evaluated this with three experiments: an experts-only workshop, two online surveys, and voting on computer literacy terms. We obtained the, at present, longest list consisting of 233 terms for 146 entities. There are notable differences in preferred terms between experts and computer literate users, and while the passive voting yielded more results quicker than the surveys, some entities still have many different isiZulu terms. The results indicate that a broadly participative and inclusive collection and proposal stage yielding multiple contenders for an entity should be a compulsory and explicit stage before, and possibly also during, multidisciplinary terminology development workshops.

Keywords: isiZulu, terminology development, computer science, computer literacy, methodology, terminology quality

Introduction

The principal obstacle to teaching and tutoring Computer Science (CS) and Information Technology (IT) in isiZulu is the absence of isiZulu CS & IT terminology and fragmented knowledge of existing isiZulu terms, even among isiZulu speakers. Even more challenging, is the localisation of productivity and software engineering software in African languages, which has been shown to be perceived useful at least for compilers (Neves & EyonoObono 2013). In several other language areas, CS & IT terminology has been developed gradually or pushed by national organisations. For instance, the Académie Française and the Real Academia Española instituted new terms in 2013, including *mot-dièse* for the Twitter 'hashtag' and *whatsappear* for using WhatsApp, and the public has been translating and inventing new terms for CS & IT concepts and devices once they became ubiquitous, such *Datenbank* (Ger.) and *databasis* (Afrikaans) for database. This has occurred only to a very limited extent in isiZulu CS & IT; e.g., *izilungiselelo* ('settings'), *igundane* ('mouse'), and *uhlelokusebenza* ('software'). A major difference between Indo-European languages and isiZulu is that the latter is one of the underresourced languages and faces an uphill struggle to redress injustices of the past, which is even more profound for scientific terminologies. In addition, computer science is a relatively new discipline, and words are being invented in *all* languages. Our initial exploration of different sources for CS & IT isiZulu terms, including the Department of Arts and Culture ICT list (henceforth, DAC 2005), showed that, (1) there are different words for the same entity in the few extant different term resources; (2) these are exclusively at the computer literacy level instead of the scientific level; and (3) there are both Zulufications of foreign terms and new terms. In addition, informal queries to students indicated duplication and lack of coordination of the creative efforts of word formation and usage. At the time of writing, there is no standardised or widely agreed-upon CS & IT isiZulu terminology. It will take many resources to develop terminology the typical way with multidisciplinary workshops, and moreover, it would not be sufficiently inclusive. Typical participants in such workshops are merely a few subject domain experts and more linguists and terminologists. For CS & IT, however, there is a clear distinction between laypeople at the computer literacy level, and experts. The former group includes learners, administrative officers and most non-CS/IT

scientists, whereas the latter includes CS graduates and academics, systems administrators, and programmers.

Concerning inclusiveness, this is meant not just as a value judgement, but especially from a terminology quality point of view, because asking only a few people in a few workshops will result in a lower quality terminology, which hampers its uptake. This claim entails the following, more modest, hypothesis that is yet to be evaluated experimentally: *A resultant terminology in an evolving scientific discipline will differ depending on whom you ask, and how*. If true, then the approach of terminology development via resource-consuming workshops is inadequate, due to the extremely small sample size in general, and the dearth of experts in particular. Further, laypersons, linguists, and terminologists dictating the terminology to experts does not foster its uptake[1], and it is not conducive for CS scientific terminology development that covers many terms that a computer user need not to know, such as the 'computational complexity of an algorithm', 'pass-by-reference', or 'argument' in the programming sense, but which are important concepts for a computing degree.

To evaluate the hypothesis, we collected data using the 'workshop approach' but *with experts only*, asked computer literacy students for their opinion on terms, conducted a survey to compare presenting entities as terms or as pictures, and gathered data from the dictionaries and any extant term lists, and compared the results. The workshop participants agreed on 37 terms, which is the first list of computing terms in isiZulu. There was agreement on some terms among the literacy students, but others received equal votes, and for several entities, the experts preferred another term than the computer literate participants, which was also observed between experts and extant resources. Overall, we now have 233 isiZulu terms for 146 entities. Due to limited participation in the survey, the results are inconclusive as to whether text or pictures would be better. Open, *de novo* creation or recall is the hardest, as exhibited by the short lists elsewhere, the 37 terms from the workshop, and the lack of response to the online survey, whereas the voting typically took no more than 5 minutes for the 19 terms.

[1] For instance, no one at the Computer Science Department at the UKZN Westville campus – academics, students, administrators – was aware of the DAC2005 list, and, as we shall see in the results, there was not much agreement with it once presented to experts.

Given the nature of the setting and outcome, it is expected that these limitations hold also for other underresourced languages that face not only collection of terms in the target language (when the entities are known already), but also a substantial amount of invention of terms. These results provide evidence-motivated suggestions as to how one can devise potentially more efficient and effective methods for terminology development that either avoid the above issues or can somehow quantify the limitations. We will introduce one such option: crowdsourcing.

After addressing related works, we describe the materials and methods for the experiments, the results, discuss them, and conclude.

Related Works

Among the two paths in terminology development – systemic aspects with status planning and corpus development – we focus on methods for the latter, both at the scientific level and the layperson level, and on 'harvesting' terms in the target language in particular.

Terminology development efforts typically take a top-down and selective participation approach (e.g. Kalenderian *et al.* 2011; Engelbrecht *et al.* 2010), relying on workshops in a multidisciplinary setting, which is also advocated by TermNet[2]. Exceptions to this are the so-called 'structured controlled vocabularies' in the sciences that are expert-driven and with relatively broad participation, such as the healthcare terminology SNOMED CT[3], the UN Food and Agriculture Organization's AOS[4], and the Gene Ontology (Gene Ontology Consortium 2000). They may have workshops involving terminologists and ontologists, but this is optional: the experts are the main, or even sole, contributors to scientific terminologies. This raises the question: why is it accepted that experts create a terminology in English when it concerns a scientific discipline, but that any localisation supposedly should be controlled by linguists and terminologists?

Concerning the state of computing terminologies: there is *no official computer science terminology* even in English, although many CS & IT terminologies are available online. With the invention of English terms for

[2] http://www.termnet.org/. (Accessed on 13 January 2014.)
[3] http://www.ihtsdo.org/snomed-ct/.
[4] http://aims.fao.org/.

new entities in computing over the years, no linguist or terminologist was involved, sometimes to the dismay of language purists (Santini 2002). The Department of Arts and Culture of South Africa has developed a first version of an ICT terminology for the 11 official languages of South Africa (DAC2005) by availing of the top-down and multidisciplinary approach: for isiZulu, there were 17 collaborators, 29 participants from diverse disciplinary and professional backgrounds, and 4 members of the technical committee of the natural language board (DAC2005). DAC2005 has 135 terms that are, at most, at the level of computer literacy. Excluding non-computing terms, such as 'postcard' and 'pay TV', only about half of the terms are relevant. Dictionaries contain only computer literacy terms, if any at all; we shall discuss these later in the paper, using mainly the *Shuter & Shooter isiZulu Scholar's Dictionary* and *Collins Pocket Dictionary* for isiZulu. Other African language terminology development efforts exist, notably at Stellenbosch University for isiXhosa[5] – but this does not yet include an isiXhosa CS & IT terminology, and their trilingual dictionaries are available in print for payment only – and at Rhodes University, where Sam developed and investigated the adoption of computer literacy terminology in isiXhosa (Sam 2010). Google's localisation for their website is in flux and contains new terms that do and do not fit with isiZulu – e.g., *izilungiselelo* and *idrayivu*, respectively – and its new translation service has ample room for improvement. Microsoft has an isiZulu, isiXhosa, and Afrikaans localisation for several applications for Windows 8. Large companies apparently do see the benefits of investing in localisation and term development.

There are delicate issues surrounding opinions about African languages development. These range, e.g., from false dichotomies propagated in scientific literature about 'developed' and 'developing languages' (Huyssteen 1999:179)[6] to the idea that '[t]he promotion of African languages in [high-function formal contexts] does not have the support of their speakers, who still seem to believe that their languages are unable to be used in such

[5] http://www0.sun.ac.za/languagecentre/?page_id=47. (Accessed on 29 August 2013.)

[6] No language is static and 'developed'- except for dead languages, they all change. There are languages that have been less extensively researched and for which less material is available, i.e., being proper languages that are *underresourced*.

domains, that is: their minds are still colonised' (Webb 2013:180), which hampers isiZulu terminology development. In addition, one faces the trend in cultural imperialism and globalisation, to the benefit of English as 'indispensable for attaining personal advancement and for being seen as "modern and successful"' (Webb 2013:180), which is even more so in CS & IT. Notwithstanding this, countries in at least continental Europe and Latin America still use mainly their own languages, and terminology *is* being developed in various languages without detriment to their socio-economic or political status. Furthermore, it is possible to invent new computing terms in isiZulu also, just like in other languages, and this has been done. For instance, *ukwakhuhlelo* for 'programming' (n.), which is a contraction of *ukwakha* ('to build') and *uhlelo* ('arrangement' or 'grammar'), *uhlelokusebenza* (software) from *uhlelo* + *uku* (for the verb) + *-sebenza* ('work'), *inhlokosiqoqelalwazi yohleloxhumano* ('server'), and *inhlansi* ('bit'). Some systematic work has been done on the analysis of creating new isiZulu terms by means of 'conceptual blending', which is common practice in several other languages, such as German, and occurs in isiZulu as well (Buthelezi 2008). From experience, we know that term creation does happen among CS & IT students, perhaps as prolific as Mbuyazi's (Steenkamp 2011) efforts. Further, just as isiZulu has contributed to South African English, it can do also in the sciences, including computer science: the world-wide open source software community already knows of the Ubuntu Linux distribution.

It is important to contrast the current situation with that of Afrikaans, which is one of the few languages that evolved in the 20th century from one with no government recognition and existing mainly in spoken form, to one that plays a fundamental role in government, the economy and higher education (Madiba 2001). The development of Afrikaans stems from a linguistically-based ethnicity (de Kadt 2006) and it was developed via a politically motivated top-down approach. This was driven by South African language institutions such as the Government Language Board and the *Suid-Afrikaanse Akademie vir Wetenskap en Kuns* (Webb 1995), together with the Afrikaner universities that simply lectured in Afrikaans while borrowing from Dutch and German, thereby forcing the development of terminology (de Kadt 2006). No such top-down imperative exists for the South African indigenous languages today, despite the constitutional right and demand for the promotion and development of these languages, with non-prioritisation of this task by the modern government (de Kadt 2006). Consequently, these

languages play a very limited role in higher education development. For the situation to change, a democratic bottom-up approach may be needed. The question then is how to do this with maximal efficiency and within a minimum period (Madiba 2001). Magagane (2011:133–143) has a long list of recommendations on how to improve the situation of language development in South Africa, but falls short of presenting a methodology for how best to do this. Likewise, Onyango (2005:222) only states that the 'engineering of terms calls for input from language experts', but does not say how to do this.

Guidelines for terminology development exist, such as from the DIN and ISO, the PEGITOSCA criterion[7] for proper term creation, general instructive notes when developing new terminology (Neundorf 1982:271–273), and guiding principles for a specific terminology (e.g., Donnell 2006:281), but none of them has a method that is shown to be tailored to respecting such guidelines. Also Engelbrecht *et al.* (2010:259–263) describe in the method section only how they did it for their case, using selective participation with only three experts. An IT savvy approach was taken to invent a new Dutch word for the Twitter 'hashtag': (1) Let the public propose terms; (2) The Dutch Language Union (Nederlandse Taalunie) selects a subset of all the terms submitted; (3) Online voting on the subset[8]. To the best of our knowledge, there is no clear-cut, proven, agreed-upon *method* for scientific terminology development when the scope is localisation of the terminology, such that it will be by the people and for the people. We will suggest that crowdsourcing may be key.

Materials and Methods

We describe the materials and methods of the three experiments, namely the workshop, the computer literacy term survey, and the computer literacy term voting.

[7] Precision, Economy, Generativity, Internationality, Transparency, anti-Obscenity, Systemicity, Consistency, and language-relative Acceptability (attributed to Kiingi).

[8] Explained in the sound file at http://www.vrt.be/taal/joos-zoekt-nederlands-woord-voor-hashtag. (Accessed: 17-1-2014.)

Workshop Experiment

The purpose of this experiment is to use the *typical workshop setting* and observe its effectiveness in terminology development when *only experts* participate, which should give an idea of what terminology the experts use (regardless of whether that is linguistically the best term).

Setup. The setup of the experiment is as follows:

- Participants: 10 senior CS & IT students with isiZulu as first (home) language.
- Venue: Computer science seminar room, where the tables and chairs are ordered in a circle.
- Duration: 2 hours.
- Incentives: the honour of being at the forefront of this endeavour, and pizza and softdrinks afterward.
- Instructions: (1) Go through the prepared list of entities, (2) for each one, note whether there is consensus about that isiZulu term, (3) note whether there are synonyms, (4) you must do this together, not in smaller groups.

Analysis. Count of the entities for which isiZulu terms are proposed, count of multiple entries, count of synonyms, count of consensus. Compare the results with those of the other experiments.

Computer Literacy Terms: Survey

We conducted two exploratory polls to obtain insight into how to ask for terms, whether there is a difference in term usage, and to gain some indication about current computer literacy terms and their use. The first survey considers the question of how entities should be presented – text or picture. It is aimed at examining two aspects in particular:

- What is the current body of knowledge on basic IT isiZulu computer literacy terms, given a fixed set of entities? What is the proportion of entities that have multiple words for one entity in everyday usage?

– Test the hypothesis that the entity set with pictures results in a significantly greater amount of term proposals compared to the entity set presented with only English terms.

The hypothesis in the second item is motivated by cognitive science and multilingualism. Consider Ogden and Richard's semiotic triangle depicted in Figure 1, which was influenced by Peirce, Saussure and Frege. The sign or symbol invokes a concept an individual is thinking of, which identifies the object; e.g., the term 'keyboard' or its picture invokes a thought about what a keyboard is, which is such that, when given a set of things, one can pick out the object that is the keyboard.

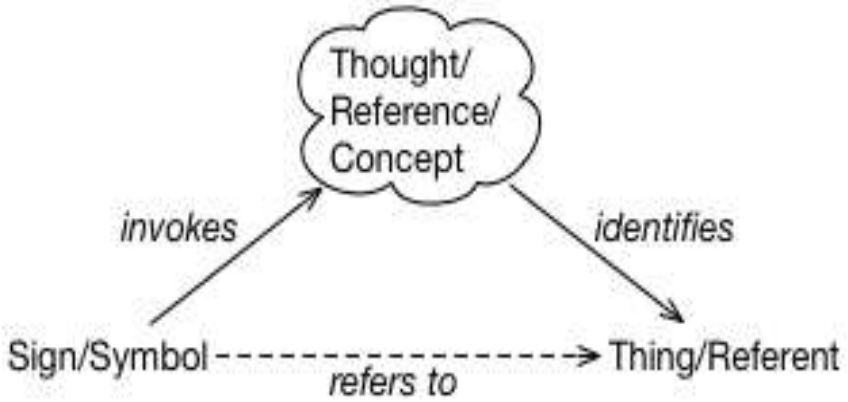

Figure 1: Ogden and Richard's Semiotic Triangle (after Guarino *et al.* 2009:15).

Regarding multilingualism, while there may still be a debate about whether a person thinks in a certain natural language or that the Thought/ Reference/ Concept is more abstract, in particular among monolingual people, this is not the case for multilingual people, as – besides the support of the semiotic triangle – such an approach becomes increasingly cognitively unmanageable the more languages one masters. *In casu*, most isiZulu speakers speak at least

two languages. It may be that observing the Sign/Symbol as a term in one language may *impede* matching the Thought/ Reference/ Concept it invokes back to a Sign/ Symbol in another language. If this is the case, it will negatively affect the outcome when entities are presented to participants as English terms compared to a natural language-independent symbol, i.e., a picture or a diagram, that may be closer to the concept one thinks and thereby make it easier to propose an isiZulu term. Moreover, it may induce a semantic translation rather than zulufication of the English term, such as *uhlelokusebenza* for 'software' is, and andopting for *iposisiqoqelalwazi* instead of *i-imeyili* ('e-mail').

Setup. The setup of the experiment is as follows:

- Participants: 2nd and 3rd-year isiZulu-speaking students in CS or CS & IT, who are contacted by email to participate, with the email written in isiZulu. Half will receive the link to the term survey, half will receive a link to the picture survey. The email list is divided by means of the www.random.org randomiser.
- Entity set: 50 entities, at the level of computer literacy (see results for the list).
- Mode: Through the open source LimeSurvey software [www.limesurvey.org], localised in isiZulu.
- Time the survey will be open: 2 weeks.
- Incentive: none.
- Instructions: (1) invite the students by email, where the email is written in isiZulu to filter out basic language proficiency, (2) ask them to fill in the isiZulu term(s) if known with multiple terms separated by a semicolon, or left empty if not known.

Analysis. For both sets, separately: calculate number and percentage of entities that have at least one isiZulu term, list and number and percentage of entities that have no isiZulu term, list and number and percentage of entities that have more than one isiZulu term (whether proposed by a single participant or aggregated for all participants). Comparison of the two sets using basic statistical analysis.

Computer Literacy Terms: Voting

The second poll is aimed at examining three aspects:

- What is the current body of knowledge on isiZulu computer literacy terms among computer literacy students, given a fixed set of entities? What is the proportion of entities that have multiple words for one entity in English in everyday usage?
- Voting will reveal both synonyms and preferred terms.
- Voting is quicker and will result in more answers than asking *de novo* in the survey.

Setup. The setup of the experiment is as follows:

- Participants: 1st-year students in the computer literacy module 'computing for natural scientists' (COMP106 WVL 2013) who speak isiZulu.
- Entity set: those entities at a computer literacy level for which different sources list different terms. Sources used: the DAC2005 list, results of the workshop, *Shuter & Shooter isiZulu Scholar's Dictionary*, *Collins Pocket Dictionary for isiZulu*, and two terms from ii translation (http://iitranslation.com/resources/English-isiZulu.html).
- Time: during the last week of lectures, in the lecture break and afterwards.
- Incentive: none.
- Instructions: select the preferred/best option for each entity, or *angazi* ('don't know') if you do not know, and return the sheet to the lecturer.

Analysis. For each entity, calculate the percentage of overall votes for each answer option. Cross-check and compare them with the outcome of the workshop. Note clear preferences and potential synonyms, and whether the terms from one source typically receives more votes.

Results

The results of the three experiments are described and then compared to each other and to other sources.

Workshop Experiment

The setup was as depicted in Figure 2, where the research assistants had a desk on the side to place their laptop on.

Characterisation of the Participants. Fifteen students participated in the workshop session instead of the envisaged 10, thanks to students' interest. Nine students were CS or information systems honours students, and 6 were in their final year BSc CS or CS & IT. The gender distribution was slightly higher than the institutional average, being 5 females and 10 males. All participants have isiZulu as home language, as self-registered in the student database upon enrollment at UKZN. The four moderators were CS honours students (two with isiZulu as home language, and the other two fluent in isiZulu), one of whom fulfilled the role of chair/moderator, and the other three managed the note-taking, proposed entities to discuss, and looked up definitions. The participants were not aware of the DAC2005 nor its contents, nor of the private collection of terms of one of the authors, and this was not used during the session.

The Session and Resultant Terminology. At the start of the session, the principal investigator (author [CMK]) commenced with the dictionary entry *uhlelokusebenza* ('software'), and asked whether they agreed with that. This generated immediate response, and the conversation started (in isiZulu). Initially, the female participants dominated the conversation, but in about 5 minutes, everyone participated, and from about 20–30 minutes into the session it was lively, oscillating from thinking, to discussion of the meaning of the entity and possible alternative terms, to laughter and applause. When the time was up, there was a general murmur that they were not finished yet. Finding isiZulu words occurred in various ways. In some cases, when an entity's English term was mentioned by a moderator, many or all of the participants instantly mentioned the isiZulu term. In a majority of cases, the

meaning of the term was discussed before reaching an agreement on possible alternatives. This, at times, was augmented by a request to the moderator to read aloud a definition of the entity to reconsider the meaning, and at times which of the options was better or whether they were sufficiently similar to count as synonymous.

Table 1 presents the list for which there is at least one isiZulu term for the entities about programming and Table 2 presents those for networking, which is a total of 37 entities that clearly include entities also well beyond the level of computer literacy.

Figure 2: Photo taken during the session, with the participants in discussion and the moderators on the left.

Exception, garbage and method have consensually agreed synonyms in isiZulu. *Indlela yokwenza* may be a homonym, because it is used for both algorithm and method. The following entities were discussed – still in the

context of programming and networking – but no isiZulu term was provided: instance variable, object oriented design, class, subclass, ad-hoc, bandwidth, beacon interval, broadband, buffer, datagram, domain. In addition, one can observe that there is no Zulufication of foreign terms in Tables 1 and 2, other than the *ithuluzi*-part (from 'tool') of *ithuluzi lokucinga*; thus, all proposed terms denote the meaning of the entity, not a string of text that is devoid of semantics in isiZulu. Even algorithm is unrecognisable from its origin: the etymology of 'algorithm' is not to be found in the English language, but the entity was named after the Persian mathematician Al Khwarizmi.

Informal feedback after the session during the pizza dinner revealed that participants found it a difficult task to carry out. A suggestion was made to distribute the entities beforehand, if the experiment were to be conducted again.

Table 1: Entities within the context of programming with their English term and isiZulu term(s).

Entity (programming)	
English	***isiZulu***
algorithm	indlela yokwenza
object	into
argument	ilungu lohlelo
method	uhlelo, indlela yokwenza
comment	isiphawulo
encapsulation	ukucatshisa
exception	isivimbelo, inkinga, isqaphelo, isixwayiso
field	ilunga
formal parameter list	amalungu ohlelo ahlelekile
garbage	doti, izibi
graphical user interface	inkundla

inheritance	ufuzo
initialize	ukuqaliso
member	ilunga
overloading	ukugqilaza
overriding	ukushintsha ufuzo
pass-by-reference	ukudlulisa ikheli
pass-by-value	ukunikeza uqobo lwento
polymorphism	ubululwane
runtime-error	iphutha elivela uma usubheka ukusebenza kohle
reference	umsuka
scope	indima
array	amagumbi
sub-array	amagumbi phakathi kwegumbi

Table 2: Entities within the context of networking with their English term and isiZulu term.

Entity (networking)	
English	***isiZulu***
access-point	indawo yokungena
adapter	isengezo sokuxhumana
amplifier	umlekeleli
backbone	umgogodla
bit	inhlansi
boot	ukuhloma
bridge	ibloho
browser	ithuluzi lokucinga
Internet	inkanji yolwazi

byte	izinhlansi ezili shagalo-mbili
client	incelebane
cryptography	ubhalo mfihlo
database	inqolobane

Computer Literacy Survey Results

Emails were taken from the student management system for the core 2nd-year and core 3rd-year modules (COMP201 and COMP314), amounting to 178 emails, which included the deregistered students. The email addresses were randomised, and split into two groups based on order in the list, and the first group received an email invitation with the link to the text-based survey and the second one to the picture-based survey. By rough estimate, only about half have isiZulu as home language, so one could have about 80 responses in total for the two surveys as the maximum response rate. The invitation was sent at the end of the lectures in the semester, a reminder in the following week, and results were collected 6 weeks later later.

There were two challenges that affected the realisation of the survey. The major obstacle to realising the survey was that no survey software has an isiZulu localisation, which meant that it had to be developed and compiled into LimeSurvey. Autotext needed for that particular survey has been translated, so that not only the questions, but also the standard features and the introduction and closing messages of the surveys were in isiZulu only[9]. Now there are, e.g., buttons labelled *Hambisa* for 'Submit' and autotext *Khetha kulezi ezilandelayo* for 'Check any that apply', and error messages in isiZulu; some examples are shown in Figures 3 and 4. The surveys are available online at http://limesurvey.cs.ukzn.ac.za/index.php?sid=18396 (terms) and http://limesurvey.cs.ukzn.ac.za/ index.php?sid=75575 (pictures). Second, it was difficult to find or create an unambiguous picture for some of the entities without using any text, such as megabyte, spyware, softcopy, and internet protocol suite. For 20 of the 50 entities, the term was also added below the figure to clarify it, and anecdotal feedback suggests more pictures should have been annotated for disambiguation.

[9] Anyone can contribute to the localisation at http://www.limesurvey.org/en/contribute/translations-status.

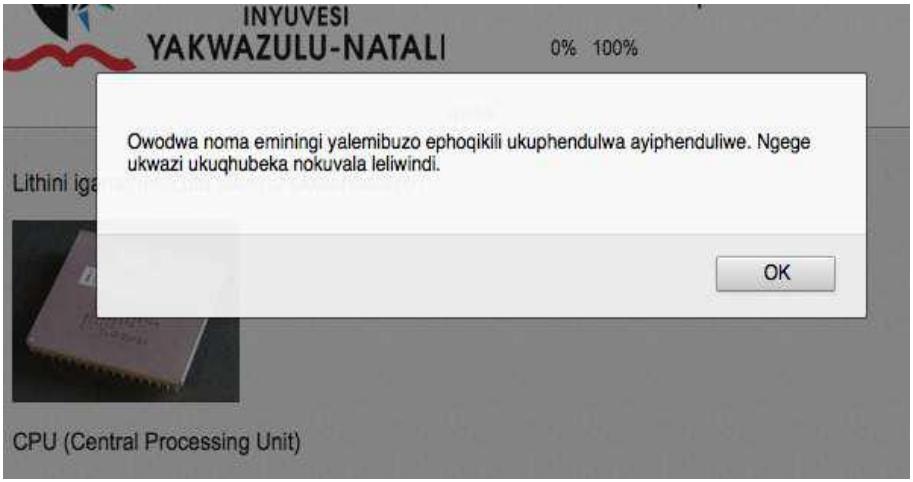

Figure 3: Message after submitting a survey where one or more questions that are mandatory have not been answered.

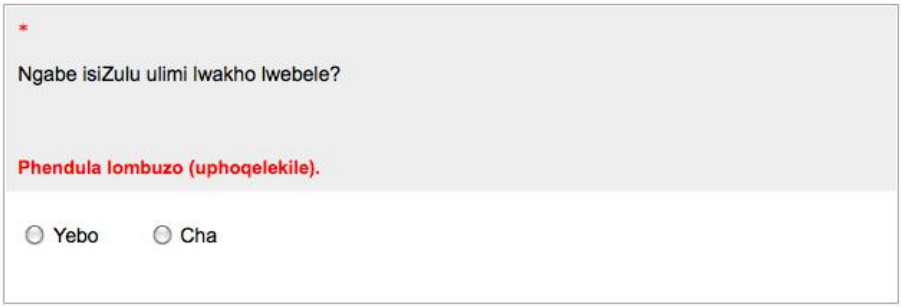

Figure 4: The question that was mandatory, now with explanatory text in addition to the red asterisk.

The response rate was very low for both surveys: 12 IDs were generated in the term survey, of which one was incomplete but with some responses and one successfully completed, and 16 IDs were generated for the picture survey, of which one was incomplete and only one term, and two

completed. Forty-four terms have one or more isiZulu term proposed for them – 21 times for the term survey and 37 times for the picture survey – of which 15 more than one; this set is included in Table 4 in the Appendix. The entities for which no term was proposed are: network interface card, bit, cloud computing, terabyte, softcopy, and hacker. Given the low response rates, there is insufficient data to falsify or validate the experiment's hypothesis.

The responses do give some useful indications for the questions in the first item of the experiment design, notably that no terms were proposed for basic entities, such as network interface card and bit. There are only two terms exactly the same at least twice (*igundane* ('mouse') and *igciwane* ('virus'), and one could count as essentially the same 'logout' and 'shutdown': *phuma* and the infinitive *ukuphuma*, and *cisha* and the phrase *izindlela zokucisha ikhomp*, respectively. The (un-)clarity of the pictures most likely affected email and operating system, and certainly computer program, whose picture indicated some code with both class and method but only a term for class was provided (*iklasi*). The picture for algorithm was alike a flowchart, which explains the proposed term for it (*umdwebomfanekiso*), and the pictures distinguishing bit and byte may have been ambiguous (*ibhay* for 'byte' that is probably meant for 'bit', given that *amabhay'thi* was used by the same respondent for [mega]byte). There are only a few Zulufications of foreign terms, such as *imemoly*, *iprintha*, and *idesithophu*: 9 out of 79 phrases, excluding the repetition of bytein the KB, MB and GB (see also the discussion in Section 5).

Computer Literacy Voting Results

The 2-page list of 19 entities had the instruction on paper written in isiZulu and some context was provided to the students in English by the lecturer. Fourteen answer sheets were returned during the lecture and 4 afterwards. The demographics of the students were not recorded, nor whether their home language was isiZulu. Going by the class average, the respondents were predominantly first-year students, a large majority of whom are enrolled on a degree in geology, and some life science, applied chemistry, and marine biology. The terms, their source and the percentages the terms received are shown in Table 5 in the Appendix.

Of the 19 entities, 6 did not have one isiZulu term option that received more than 50% of the votes, being bit, byte, database, email (n.), mouse, and directory, although when one aggregates the three *igundane* versions for mouse, it has a majority. Only four terms received a large majority (≥75%) of votes, being those for laptop, logic, data and server. Byte, bandwidth and open source software stand out by their comparative high percentage of *angazi* responses. The latter is noteworthy, given that the PCs in the labs have Fedora Linux installed, the office suite used was OpenOffice, and additional software was also open source. Other noteworthy results are the near tie between *isiqoqelalwazi* and *ikhompuyutha* (computer), between *-xhuma* and *-faka* ('installing' [software]), between *isikhiphambhalo sesiqoqelalwazi* and *iphrinta* (printer), and the four options for 'email'. A linguist may find it of interest to investigate why a Zulufication such as *iphrinta* receives a near-tie, but that the Zulufications for server (*iseva*) and satellite dish (*indishi yesathelathi*) received hardly any votes. Another discrepancy can be observed between data and database, which have specific and closely related meanings in computing, but apparently less so from a pure terminological viewpoint: data has a clearly preferred *ulwazi olungahluziwe* over the *imininingo*, but *imininingo egciniwe* received most votes for database over either of the two *ulwazi* variants.

There was no overall winner among the sources, but one could say that the terms from the workshop were less favoured overall by the computer literacy students compared to the DAC2005 and dictionaries: pitting workshop vs. DAC2005 results in a 1:4 score, workshop vs. S&S a 0:2 score, and DAC2005 vs. S&S a 1:1 score.

Comparisons

There is *no* overlap between the DAC2005 and the programming terms, and a partial overlap with the networking entities, which are included in Table 3. From this comparison, it can be observed that (1) there are 32 new terms recorded in our experiment, (2) the five common entities have an empty intersection between the terms from the experiment and the terms from the DAC2005, (3) there is a higher incidence of Zulufying the English term (*intanethi*, *ibhithi*) in the DAC2005, and two of the terms proposed for database are definitely wrong from a computing viewpoint, because *ulwazi*

means knowledge, not data, and a knowledge base is different from a database. Conversely, of the terms that were discussed but for which no isiZulu term was provided during the workshop, two were proposed elsewhere: bandwidth has an entry in the DAC list, where *umkhawulokudonsa* has a slight preference over *umkhawulokwamukela* in the voting survey (see Table 5), although most computer literacy students did not know a term for it either, and class in object-oriented programming has a proposed *iklasi* in the picture-based survey. Further, the term-based survey has *isisu* for hard drive compared to Google's *idrayivu*.

Table 3: Comparison of isiZulu terms between our workshop results, the DAC2005 list, and the Shuter & Shooter Scholar's Dictionary.

Entity (networking)			
English term	***isiZulu term***		
	Workshop experiment	*DAC 2005*	*S&S Dictionary*
bit	inhlansi	isimumathalwazi esincu, ibhithi	N/A
browser	ithuluzi lokucinga	isiphequluli	N/A
byte	izinhlansi ezili shagalo-mbili	isimumathalwazi	isimumathikazi
database	inqolobane	ulwazi olugciniwe, ulwazi olulondoloziwe, imininingo egciniwe	inqolobane yolwazi/ isilondalwazi
internet	inkanji yolwazi	uhleloxhumano lomhlaba, intanethi	uhleloxhumano lomhlaba

There are some differences between the isiZulu terms used by the computer science students and the computer literacy students. In the workshop, there was agreement about database as *inqolobane*, yet this term received only 6% of the votes from the literacy students, who slightly

preferred *imininingo egciniwe* (47%) from the DAC2005, and likewise for the workshop's agreement about bit (*inhlansi*) versus *isimumathalwazi esincu* (44%) from the DAC2005, and the workshop agreement on byte (*izinhlansi ezili shagalo-mbili*) versus the literacy students' divided vote across all four options and 33% for *angazi*. A clear difference can be observed regarding Internet, where the workshop's term, *inkanji yolwazi* received only 11% versus 56% for *uhleloxhumano lomhlaba* from the DAC2005 and S&S. On the other hand, the workshop's browser (*ithuluzi lokucinga*) received a clear majority with 66% over DAC2005's *isiphequluli*. However, if we put the results of the voting survey together with the workshop's preferences for terms and recalculate the votes with the experts included, then *inqolobane* would have come out highest with 50% and the difference between the two sets of respondents would have been missed, and likewise for *inkanji yolwazi* (Internet), *inhlansi* (bit), and *izinhlansi ezili shagalo-mbili* (byte).

Discussion

The results of the experiments are reflected upon, and a potential solution is proposed for the observed issues, namely crowdsourcing.

Reflection on the Experiments

One might deem the workshop experiment setup limited, for, in theory at least, one could design the experiment with a second workshop running parallel using the same set of words, in order to examine whether those lists would differ. The limiting factor preventing this option is the demographics of the students. Even for this workshop, information systems honours students (who completed a BSc in CS or in CS & IT) and 3rd-year computer science students had to be invited to make up the numbers, and there was no isiZulu-speaking full-time postgraduate student.

Concerning the workshop's list of entities, it may be that providing one upfront is beneficial, but from ontology development practices, it is known that discussions about the definition and meaning are helpful in teasing out the semantics of the entity, which aids in capturing it better. That is, such an analysis phase is not a negative aspect, but an integral part of the process and it occurs also in terminology development in other languages. In addition, there is also oftentimes not a literal translation; e.g., operating

system is *Betriebssystem* (Ger.), which means the 'managing' system, not 'operating' system. Moreover, some English IT terms are misnomers (Santini 2002) and are better not translated one-to-one, such as 'wifi' and 'email'. The case of email is interesting for isiZulu, as Santini's lamentations are not applicable. He notes that '*e-mail* refers to messages transferred through computer networks ... not that it works by moving electrons around' (Santini 2002:114). While in several other languages it remains 'email' or 'e-mail' or as a literal translation, e.g., *correo electronico* (Sp.), and *e-pos* or *elektroniese pos* (Afrikaans), in isiZulu the e-somethings are a variant of *uhleloxhumano* ('network') with the relevant designator; e.g., instead of 'e-learning', we have *ukufunda ngohleloxhumano*, i.e., to learn with/by the network; other examples are included in Table 6 in the Appendix. Further, claims and lamentations about 'Zulufications of English' to construct a computing terminology are tricky to assess for the following two main reasons. First, about 75% of English lexicography originates from French or Latin (Elms 2008); e.g. 'printer' has its origin from the French *preinte* and 'data' and 'compute' are based on Latin. Likewise, *programmare* (It.) and *programmieren* (Ger.) and *programmeren* (Ned.) may all seem Anglicisms for 'to program', but etymologically, the root comes from Latin. Second, there are also origins not based on language: e.g., while 'bit' is a contraction of 'binary digit', 'byte' is a language joke on 'bite' being larger than nibbling a bit of food, 'software' was a wordplay from 'hardware', 'worm' was inspired by the science fiction novel *The Shockwave Rider* by John Brunner, and we have mentioned 'algorithm' before. Perhaps the etymology of computing terms should be taken into account when devising isiZulu terms; either way, if there is some decipherable Indo-European in the coined isiZulu term, this is not necessarily a bad thing, as it may reflect a carrying over of the insider joke or respect for its inventor.

The survey experiment was not successful in terms of finding out which way – picture or text – is better to present the entities and obtain data, other than that one may speculate that asking people to provide terms from scratch is tougher than it may seem. Nevertheless, the experiment was useful in two aspects. First, with respect to how realistic presenting *all* entities with pictures and diagrams is: it is not. Even the picture survey had some entities with text only, such as 'megabyte', and roughly half had, or should have had, some explanatory text, demonstrating that a self-standing picture is not enough. This problem is exacerbated for the more abstract entities in the CS

discipline. Second, considering the proposed terms, also here there is agreement on a few terms (browser, mouse), but more new terms have been proposed in addition to those in the other sources and the workshop, notably for Internet, email, computer, printer and server. The new one for computer (*umshini*) is slang for computer, just like 'machine' is in English. Overall, though, these additional terms could, on the one hand, be potential synonyms to those proposed in the workshop, dictionaries and DAC2005, but, on the other hand, be part of the normal 'term proposal stage' in terminology development, like the Dutch term for the Twitter 'hashtag' mentioned in Section 2. Either way, also elsewhere, there is a stage where multiple terms are proposed, played with and mulled over, and eventually one or more preferred terms will be settled on.

The comparison of output from experts vs. laypersons voting and DAC2005 demonstrates that care has to be taken and documented on who proposes what. This also can involve some weighting of contributions by experts vs. laypersons, and to compute its effect on the draft terminology. If the number of respondents in the voting poll had been much larger than the number of experts, then the experts' preferred term would have been outvoted and thereby lost in the process. While this may be of little interest to people outside an educational setting, when isiZulu is used as a medium of instruction, it is important to establish which terms the learners and students are introduced to, and which ones would be the preferred terms from a scientific discipline viewpoint. If there are irreconcilable differences, one could consider creating a 'two-track' terminology for scientific and for layperson use, as already exists in several other languages.

Finally, these observations and considerations demonstrate that availing of the typical selective workshop approach or dictionary authority may actually not be such a good idea, because it only captures the prevailing term(s) of that small group, which may neither be the preferred term in everyday use nor from a specialist stance. Put differently, it demonstrates the need for broadening the pool of contributors and increasing its size, and having the facility to obtain and analyse data both aggregated and disaggregated by type of contributor. While terminology developers and society may wish to push ahead fast, when considering the data obtained in these experiments, one can infer that the current stage of isiZulu CS terminology development is at the proposal and collection stage for most terms. This, then, should be facilitated.

Involving the Masses

As a means of broadening the pool of contributors and at the same time collecting more data about the terms for better analysis, we propose an alternative to the aforementioned techniques for terminology development, namely crowdsourcing. Crowdsourcing, in short, is the process of soliciting information from, or offloading tasks to, a large group of people typically via the Web and making use of games (Estellés-Arolas & González-Ladrón-de-Guevara 2012). Crowdsourcing has been used to annotate pictures, solve scientific problems, and more. It should be feasible to use the same principle for collecting isiZulu computing terminology via such online games, although it has not yet been used for this purpose. Using crowdsourcing design principles described in Doan *et al.* (2011:93–96), we are developing such a game, which is being implemented at present. In short, members of the community join and play the games by browsing to the website, and they begin scoring points by playing the games either against others, the computer, or on their own. The games are designed to solicit isiZulu terms and to solicit opinion about them. One can earn points for proposing terms and for voting for a term, where consensus has a higher payoff. The reward of earning points is expected to encourage participation for at least two reasons: the competitive aspect, which has been shown as the best incentive in a Facebook-based South African cultural heritage game (Havenga *et al.* 2012), and that one gets rewarded and valued for knowing what one knows without any punishment for not knowing.

To illustrate the idea, a walkthrough of the game is briefly described. A player is presented with a sequence of five entities sequentially in one game. For each entity, the player is presented with an English term, which is shown in Figure 5 with the English term 'CPU' (central processing unit). The player has the option to propose a corresponding isiZulu term, e.g., *umqondo womshini*, to skip it, or to vote for existing terms instead. Proposing a term scores the most points, and even more when a co-player proposes the same term. When the player chooses to vote instead, the player can vote for terms proposed by others, or selects 'neither' to indicate dissatisfaction with both existing proposals (see Figure 6). Voting too earns points, but less than proposing a term.

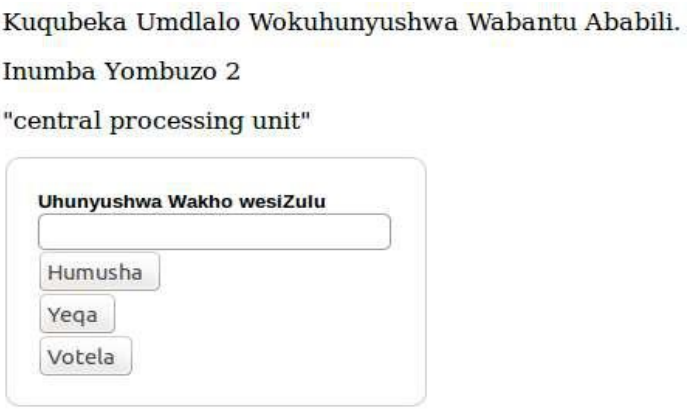

Figure 5: Crowdsourcing: Propose a translation for 'central processing unit', Skip, or Vote, respectively (screenshot of the beta version of the tool).

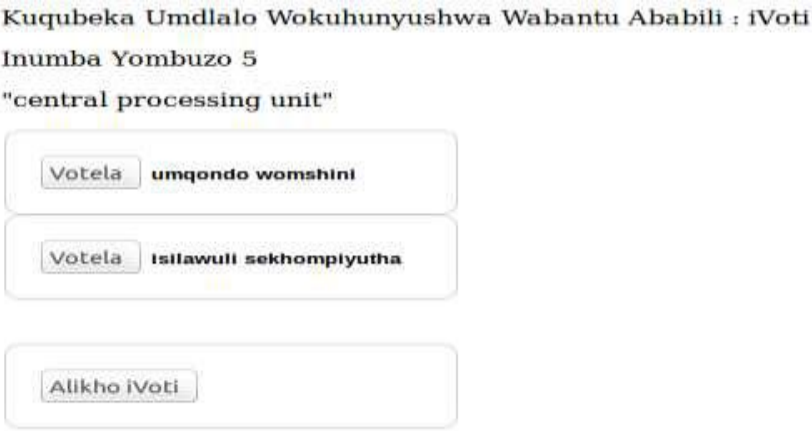

Figure 6: Crowdsourcing: Voting (*Votela*) for an isiZulu term for 'central processing unit' or vote for neither of them (button with Alikho iVoti). (screenshot of the beta version of the tool)

The approach of crowdsourcing a terminology in such a manner engages the users of the terminology directly and as broadly as possible. Since the games can be played at anytime and anywhere, the problem of finding time and

members to sit in a workshop is alleviated. Participation is expected to be far broader than the workshop approach. By recording all actions, it is possible to track convergence and divergence of proposed terms. Upon registration, players are (self) categorised into levels (layperson and expert), and so the method can track divergence based upon expertise and common usage. A terminology thus crowdsourced is expected to serve as a comprehensive input to further processes in the terminology standardisation processes.

Conclusions

The experiments conducted demonstrate a marked divergence between the terms obtained by the Department of Arts & Culture ICT list and those sourced from both isiZulu-speaking computing experts and computer literacy students. In addition, the experiments indicate some difference in terms proposed by experts and those proposed by laypeople. Consequently, proposed terms must include a wide range of stakeholders and record the level of expertise of proposers, and this level must form part of the post analysis. Further, terminology sourced in this manner yields less Zulufied English terms. Hence a clear need is demonstrated for the requirement to broaden the pool of terminology proposers, both in scope (domain experts, laypersons, etc.) and in number. The results also indicate that some form of voting for terms is a necessary component of the terminology development process to obtain preferred terms among synonyms. The results obtained with the computer literacy survey were insufficient to validate or falsify the hypothesis that pictures would result in more and better term proposals compared to English terms only.

Crowdsourcing was proposed as an alternative method for the proposal and collection stage. It can be deployed democratically and bottom-up, is low-cost compared to resource-intensive workshops, and such a tool can capture new proposals, measure consensus, and store various statistics about the crowdsourced terminology, which can then constitute an informed input for any further stages in standardisation. We are preparing for the first experiments of this approach.

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Appendix

Table 4: Results of the term versus picture survey. Note: this is uncurated data, and some proposed terms contain misspellings made by the participants.

Entity (English term)	CompLitTerm	CompLitPicture
CPU	Umqondo womshini, Inhlizoyo yekhompuyutha	isilawuli sekhompiyutha
RAM	--	umthamo wongeno
mouse	Igundane, igundane / igundwane	igundane lekhompyutha, inkomba, igundane
keyboard	Uqwembe lwezinkinobho	ikhibhodi, Isithebe sezinkinobho
microphone	umbhobho	umlekileli woculo, umbhobho wokukhuluma
monitor	Umtshengisi 'zithombe	imonitha
printer	Umgayi 'maphepha	Iphrinta
speaker	Umkhiphi 'msindo	izakha msindo
modem	--	imodemu
wireless	Akukho 'zintambo	umxhumana womoya
virus	Igciwane, igciwane	--
worm	Umnyundu, igciwane	--
spyware	impipi	ithola minininingwane, Ixoki
harddrive	isisu	--
USB	--	umgcina minininingwane

system software	--	uhlelo lesof
operating system	--	iwindi
server	Umsizi	--
computer	Umshini	ides
algorithm	--	umdwebomfanekiso
internet	Umxhumanisi womoya	--
HTML	--	i-html
browser	--	isiphequluli, inkanji/inkambu yolwazi
proxy	--	umngenisi weWephu
booting	Ukuvula	--
IP suite	--	uHlelo Lwe-Ithanethi
internet layer	--	ugqinsi Lwe-Ithanethi
memory	--	imemoli
PC	--	idesithophu
ROM	--	umthamo ofundwa kuphela
website	Indawo emoyeni	--
byte	--	ibhay
gigabyte	--	izingidi eziyizikhulugwane zamabhay'thi
megabyte	--	okubile okuzipende ngashumi amabili amabhay'thi
kilobyte	--	inkulungwane namashumi amabili nakune amabhay'thi
internet protocol	--	ikheli lekhompyutha

email	--	mthumela ncwadi
programming language	Ulimi lomshini	ulimi lokwakha isof[10]
login	Ngena	ikungena ngaphakathi
logout	Phuma	ukuphuma
shutdown	Cisha	izindlela zokucisha ikhomp
bus	--	isixhumanisi
computer program	--	iklasi
driver	--	abashayeli bekhompyutha

Table 5: Computer literacy entities with isiZulu term options, their source(s) and voting results. A term in italics received ≥50% of the votes. DAC: (DAC2005); WS: the workshop experiment; S&S: Shuter & Shooter isiZulu Scholar's Dictionary; Collins: Collins Pocket isiZulu; ii translation: http://iitranslation.com/resources/English-isiZulu.html.

Entity		Source	Vote (%)
English	***isiZulu***		
bit	inhlansi	Workshop	17
	isimumathalwazi esincu	DAC2005	44
	ibhithi	DAC2005	28
	angazi		11

[10] Several proposed terms such as *isof* are used and can be traced etymologically from 'software' to *isoftware* to the shorthand *isof*, and similarly for *ides* [from *idesktop*, 'desktop computer'] and *ikhomp* [from *ikhompuyutha*, 'computer'].

browser	*ithuluzi lokucinga*	Workshop	61
	isiphequluli	DAC2005	33
	angazi		6
byte	izinhlansi ezili shagalo-mbili	Workshop	11
	isimumathalwazi	DAC2005	28
	isimumathikazi	S&S	28
	angazi		33
database	inqolobane	Workshop	6
	ulwazi olugciniwe	DAC2005	29
	ulwazi olulondoloziwe	DAC2005	12
	imininingo egciniwe	DAC2005	47
	inqolobane yolwazi/isilondalwazi	S&S	6
	angazi		0
internet	inkanji yolwazi	Workshop	11
	uhleloxhumano lomhlaba	DAC2005, S&S	56
	intanethi	DAC2005	28
	angazi		6
email (ibizo)	umbikombani	S&S, DAC2005	18
	isiqoqelalwazimbiko	S&S, DAC2005	24
	iposisiqoqelalwazi	S&S, DAC2005	18
	i-imeyili	S&S, DAC2005	29
	angazi		12
computer	*isiqoqelalwazi*	DAC2005, ii	53

		translation	
	ikhompuyutha	DAC2005, Collins, ii translation	47
	angazi		0
laptop	umathangeni	ii translation	11
	isiqoqelalwazi esipathekayo	DAC2005, ii translation	78
	angazi		11
bandwidth	umkhawulokwamukela	DAC2005	12
	umkhawulokudonsa	DAC2005	29
	angazi		59
mouse	igundane lesiqoqelalwazi	S&S	12
	Igundane lekhompyutha	S&S	35
	imawusi	S&S	18
	igundane	Charmaine M.	6
	isilawuli	DAC2005, ii translation	29
	angazi		0
logic	ilojiki	S&S	12
	ukwazi ukuqonda nokuhlazulula ngohlelo izindaba	S&S	6
	ukuhlela ngokulandelanisa	S&S	82
	angazi		0
data	*ulwazi olungahluziwe*	DAC2005	88

	imiininingo	DAC2005	12
	angazi		0
directory	inkomba ekusiqoqelalwazi	DAC2005	35
	inkomba ekukhompuyutha	DAC2005	12
	inkombamininingwane	DAC2005	47
	angazi		6
install	-xhuma	DAC2005	41
	-faka	DAC2005	53
	angazi		6
open source software	uhlelokusebenza oluguqukayo [lwesiqoqelilwazi]	DAC2005	12
	uhlelo oluvulelekile [lwesiqoqelilwazi]	DAC2005	53
	angazi		35
printer	*isikhiphambhalo sesiqoqelalwazi*	DAC2005	59
	iphrinta	DAC2005	41
	angazi		0
satellite dish	*indishi yesiphakalwazimkhathi*	DAC2005	71
	indishi yesathelathi	DAC2005	18
	angazi		12
server	*inhlokosiqoqelalwazi yohleloxhumano*	DAC2005	76

	iseva	DAC2005	18
	angazi		6
wide area network	*uhleloxhumano olusabalele*	DAC2005	71
	uhleloxhumano olumgamubanzi	DAC2005	24
	angazi		6

Table 6: Entities of the 'e-something' variety and their isiZulu counterpart.

English's e-term treatment in isiZulu		**Rough translation into English**
English term DAC2005	***isiZulu term(s) from DAC2005***	
e-commerce	uhwebo ngohleloxhumano	
e-government services	ukuthola usizo lukahulumeni ngohleloxhumano	
e-learning	ukufunda ngohleloxhumano	'to learn with/by the network'
e-literacy	ulwazi ngesiqoqelalwazi, ulwazi ngekhompuyutha	'knowledge with the computer'
electronic advertising	ukukhangisa ngohleloxhumano	
electronic media	ezokuxhumana ngobuchwepheshe bomoya	
electronic transaction	ukuthengiselana ngohleloxhumano	

email (n)	umbikombani, isiqoqelalwazimbiko, iposisiqoqelalwazi, i-imeyili	Iposisiqoqelalwazi ≈ 'computer mail'
e-readiness	ukulungela ukusebenza ngesiqoqelalwazi, ukulungela ukusebenza ngekhompuyutha	'get ready to learn with the computer'

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Lecturers' Experiences in Supervising Research in the Medium of isiZulu and their Language Preferences in Disseminating Research

Zinhle Nkosi
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Abstract

This research paper reports on lecturers' experiences when using isiZulu to supervise postgraduate studies and their language preferences when disseminating research. Qualitative research methods were used for data collection and interpretation. The sample consists of ten UKZN lecturers, who supervise research in isiZulu. All the lecturers are isiZulu speaking. The study employs Gramsci's hegemony theory and the expression 'swimming against the tide' as a theoretical framework. The study reveals that lecturers feel fulfilled to supervise students in isiZulu. The study also reveals that although the University encourages the use of isiZulu in research, isiZulu speaking lecturers find it hard to use isiZulu for research activities because of challenges they encounter when presenting at conferences and publishing in African languages. However, some are motivated to contribute to the development of African scholarship, more particularly, isiZulu, and are willing to 'swim against the tide', until isiZulu is recognised, not only on paper, but through implementation. In conclusion, we say that it is possible for isiZulu to grow as the language of research at UKZN if lecturers who are proficient in isiZulu can disseminate their research findings in isiZulu and can encourage African (isiZulu) students to conduct their research studies in isiZulu.

Keywords: university, benefits, isiZulu concepts, African languages, language policy, medium of instruction

Introduction

Using African indigenous languages in research studies is not prevalent in most institutions of higher learning in South Africa and across the globe (Ali-Dinar 2000; UNESCO 2010). For example, at the University of KwaZulu-Natal (UKZN), not many studies have been produced through the medium of isiZulu. This lack of research in indigenous African languages is evident in all the UKZN libraries. Not only is the problem evident in the libraries of the UKZN, but also at the conferences organized by the University. For example, at the annual University Teaching and Learning Office (UTLO) conferences, a large quantity of papers is presented in the medium of English. It is important to clarify that the reason may be that isiZulu has not been a medium of instruction during the apartheid regime, and even today its use is still limited. This happens even though there are policies and other strategies in place that promote its use in teaching, learning and research (The University of KwaZulu-Natal Language Policy 2006; The University of KwaZulu-Natal 2012a; 2012b). This lack of research in African languages negatively impacts on the production of publications, which include journal articles and books. Liddicoat (2005) has remarked that very few publications are available in the medium of African indigenous languages compared with those produced in English. Researchers like Liddicoat (2005) and Finlayson and Madiba (2002) have argued that if African indigenous languages can be used to produce and disseminate research, this can improve the development of these languages. This concurs with the Asmara Declaration on African Languages and Literatures (2000) which asserted that Africa must encourage the use of African languages in research for their development and that the documentation should be best served by using them (Al-Dinar 2000). Therefore in this paper we argue that isiZulu has the potential to be used in research. Firstly, we give a brief background to the study where we highlight the extent to which isiZulu is used by lecturers at the University. Secondly, we discuss policies that impact on isiZulu as the language of research at UKZN. Thirdly, we discuss the state of postgraduate productivity in South Africa. Fourthly, we discuss the theoretical framework. Fifthly, we present

the methodology employed in this research. Lastly, we present the results and discussion of the findings, followed by recommendations and conclusion.

Background

The Constitution of the Republic of South Africa (1996) and the Language Policy for Higher Education (2002), as well as the Language Policy of the University of KwaZulu-Natal encourage the promotion and development of African languages in research and teaching (isiZulu at UKZN). However, research indicates that African languages, although regarded as official by the constitution of the country, are not fully recognised as such in South African universities. Nkosi (2013a; 2013b; 2014) has observed that 'on paper, South Africa has very good language policies, but the problem emerges when it comes to implementation'. Similarly, Kamwendo (2008; 2010) has commented that African languages are generally undermined and not taken seriously, especially by their speakers. This is a result of the legacy of apartheid, which did not recognise indigenous African languages as languages of research and higher learning. For this reason, many lecturers at UKZN, including native isiZulu speakers, still find it hard to use isiZulu for research purposes.

Many lecturers who are native African language speakers prefer to write their research papers in English due to journal requirements and lack of opportunities to publish papers written in African languages. As a result, very few research papers are presented in isiZulu at conferences and seminars in the University, despite the fact that the University promotes the use of isiZulu in research and teaching. It is worth noting that at the University of KwaZulu-Natal Annual Teaching and Learning Office (UTLO) conference, the University encourages presentation of papers in both English and isiZulu. At the 2013 University Teaching and Learning Conference, there were many UKZN lecturers amongst the presenters who were proficient in isiZulu. However, only four papers were presented in the medium of isiZulu. This appears contradictory especially in an institution whose motto emphasises its role as the 'premier University of African scholarship'. One would have expected that a good proportion of research papers, especially presented by isiZulu speaking scholars would have been in the medium of isiZulu at this conference. However, we take into consideration that among reasons for the inability of many lecturers to present their papers in the medium of isiZulu,

some are not proficient in isiZulu, and thus are constrained to presenting their work in the medium of English.

With regard to supervision, it is observed that many research studies are supervised in the medium of English in many South African universities, and this also applies at UKZN. To this end, very few lecturers at the University of KwaZulu-Natal supervise students' research projects in the medium of isiZulu. Against this background, the aims of this study are two-fold: First, it aims to explore lecturers' experiences on the use of isiZulu in supervising postgraduate studies. Second, it aims to explore lecturers' language preferences when disseminating their research findings. The following are the two research questions that this study aimed to address:

1. What are the experiences of lecturers in supervising research studies in isiZulu at UKZN?

2. What are the language preferences of lecturers towards dissemination of research in isiZulu at UKZN?

Policies that Impact on IsiZulu as the Language of Research at UKZN

While there is the problem of a lack of research produced or published in African languages, particularly in isiZulu, the South African Language Policy for Higher Education (2002) clearly states that African languages should be developed and promoted as languages of learning, teaching and research. Most importantly, the UKZN Strategic Plan 2007-2016 (UKZN 2012b), the Language Policy of the University of KwaZulu-Natal (2006) and the University of KwaZulu-Natal Teaching and Learning Policy (principle 1), all state that the University is committed to becoming the premier university which promotes African scholarship, more particularly isiZulu. Obviously, isiZulu is a dominant language in the province of KwaZulu-Natal and it is where the University of KwaZulu-Natal is positioned.

Based on the above discussion, it must be noted that the University of KwaZulu-Natal's (UKZN) Language Policy promotes isiZulu as an official South African indigenous language, whose 'use and status' have been 'historically diminished' (Language Policy of the University of KwaZulu-Natal 2006: 2). This policy is in agreement with the University of KwaZulu-

Natal's Transformation Charter (2012a) which also recognises that 'African languages will be promoted as academic languages' (p. 2), in the same way as policies cited above.

Given the above discussion, one notes that the University of KwaZulu-Natal's language policy and strategic plan promote African scholarship (Ndimande-Hlongwa, 2008). What is required is the commitment of everyone in the university, for the policy to be successfully implemented. This requires that African academics, take a leading role in using isiZulu in research, particularly those in the isiZulu departments across the University. For example, research produced in an African language can be motivating to university students if done by their own lecturers. It must be emphasised that the UKZN Language Policy does not only apply to students, but lecturers are also part of the institution and therefore are expected to demonstrate commitment to implementing policies that impact on them.

The State of Postgraduate Productivity in South Africa

Available statistics indicate low production of postgraduate studies in South Africa and globally (Mouton 2011; Academy of Science of South Africa (ASSAF) 2010), Council on Higher Education (CHE) 2009; UNESCO 2010). Data emanating from all 23 South African universities for the years 2000 to 2007 show that South Africa is near the bottom of PhD producing countries worldwide (ASSAF 2010; Mouton 2011). The country currently graduates an annual 27 PhDs per million of the population compared to Brazil's 42, South Korea's 172, Australia's 240 and the United Kingdom's 259 (McKune 2009). Attempting to address the problem in South Africa, the Academy of Science of South Africa (ASSAF) (2010) notes that a bold intervention will be crucial in order to escalate and grow the number of PhD graduates in the country. It is of particular interest that in South Africa, the average annual growth in the number of PhD graduates is only 6%. Studies also show that while approximately 45% of doctoral students who enrol never complete their studies, about 29% drop out within the first two years (Council on Higher Education 2009).

Among reports about low Masters and PhD production in South Africa, language could be one of the contributory factors to the problem of low production of postgraduate studies (Huang 2011; Mushtaq & Khan

2012). We say this because we understand that language is a very important tool upon which all learning depends (Fillmore & Snow 2000). For example, if students do not understand research concepts in English, this may negatively affect their learning. Moji (1998) cautions us of the need to develop concepts for African students, and asserts that African students at tertiary level memorise concepts without understanding them. Thus, the issue of language in research plays a major role in the success of postgraduate students.

Theoretical Framework

The study uses Gramsci's (1971) hegemony theory and the English Expression, 'Swimming against the tide' as a theoretical framework.

Hegemony Theory (Gramsci 1971)

The term hegemony was originally associated with the Italian political writer, Antonio Gramsci (197I) who argued that civil or lay society is directed by both 'domination' and 'intellectual and moral leadership' (p. 57). In other words, Gramsci (1971) used the term hegemony to denote the dominance of one social class over others (for example, English hegemony over African indigenous languages). This does not only represent the political and economic control, but also the ability of the dominant class to project its own way of seeing the world so that those who are subordinated by it should accept it as 'common sense' and 'natural'. Brookfield (2005) believes that hegemony is the process by which we learn to embrace enthusiastically a system of beliefs and practices that end up harming us and working to support the interests of others who have power over us ... the way we learn to love our servitude (Brookfield 2005: 93). Hegemony manifests itself in many forms, example, racial, political, cultural, and linguistic forms (Gramsci 1971). The linguistic hegemony thus derives from the political hegemony, which entails political leadership based on the consent of the led, a consent which is based on the popularisation of the views entertained by the rulers or the ruling class (Gramsci 1971; Bates 1975). Thus, the working definition of linguistic hegemony for this article is; wherever there is more than one language that exists together, their status in relation to each other is often

asymmetric. In most cases, one is perceived as superior, desirable and necessary, whereas the other will be seen as inferior and undesirable (Gramsci 1971; Shannon 1995).

Swimming against the Tide

Literally, this English idiom means to swim in a direction opposite to the flow of the water. Figuratively, it means to do something that is contrary to what most others are doing. In other words, you try to do something that is very difficult because there is a lot of opposition against you. We have chosen this expression because, we observe the participating lecturers who are using isiZulu to be among a few academics in the University to recognise and use isiZulu as an academic language. It must be mentioned that the majority of African scholars, particularly those who are native speakers of isiZulu, do not seem to bother about using isiZulu in their research activities and supervision of students. Pitawanakwat (2007) argues that the development of an indigenous language requires the active participation of native and non-native scholars, community members and elders. We therefore find this expression relevant to what the participating lecturers are doing, against all odds.

Research Design and Methodology

This study employed qualitative case study methods. It operated under the interpretivist paradigm. Cohen, Manion and Morrison (2007) have stated that the interpretivist paradigm developed as a critique of positivism in the social sciences. In general, interpretivists share the following beliefs about the nature of knowing and reality:

- relativist ontology - assumes that reality is constructed inter-subjectively through the meanings and understandings developed socially and experientially.

- transactional or subjectivist epistemology - assumes that we cannot separate ourselves from what we know. The investigator and the object of investigation are linked such that who we are and how we

> understand the world is a central part of how we understand ourselves, others and the world. Therefore, by positing a reality that cannot be separated from our knowledge of it, the interpretivist paradigm posits that researchers' values are inherent in all phases of the research process. Therefore, truth in the interpretivist paradigm is negotiated through dialogue (Cohen, Manion & Morrison 2007).

The sample consisted of ten UKZN lecturers who have produced their own research, disseminated (published or presented papers) or supervised research in the medium of isiZulu. These lecturers were employed in the School of Education and the School of Arts, both schools located in the College of Humanities. Five of these participants were females and five were males, and all were South Africans. Participants were selected through convenience sampling. The data was collected over a period of two weeks. Semi-structured interviews were used, and a semi-structured interview schedule with open-ended questions was developed as a data collection instrument. Questions were written in both English and isiZulu, and lecturers were allowed to answer in any of the two languages and they were allowed to code-switch. Interviews took about one hour per participant. A voice recorder was used during the interview process.

Telephone conversations were used with two of the participants who were not physically available during the time of the research, and three of the participants responded by email. Ethical procedures were observed throughout the research. This included obtaining informed consent from each participant, along with an assurance that all data would remain anonymous and confidential and would only be used for research purposes. It also included observing participant's rights to contribute or not to contribute to the study without negative consequences. Participants were informed of the purpose of the study, and their rights to withdraw from the study at any given time should they wish to do so, without negative consequences. The reliability of research tools was tested through using a pilot study before conducting the actual study. This was done with three lecturers who were not part of the study.

For the purposes of analysis, qualitative data analysis methods were used. The semi-structured interviews, telephone conversations, as well as the interview responses sent via email were transcribed, and the transcriptions were analysed using thematic analysis. During the analysis, categories and

broad themes that emerged from the data were developed. The results and conclusions were sent to the participating lecturers to ensure that the interpretation of the results was consistent with their original opinions. All material from the interviews and the following discussions served as the basis for the final interpretative work.

Results and Discussion

It is important to explain from the outset that some of the interview responses are only in English (without isiZulu translations), while some are both in English and isiZulu. The reason for this is that participants were allowed to respond in either English or isiZulu. Therefore, all the statements which appear in English without isiZulu translations, are direct quotations which were expressed in English, while those which appear in both isiZulu and English, were expressed in isiZulu. As a result, there was a need to translate them into English, for the purposes of this paper.

The Benefits of Using isiZulu in Supervising Postgraduate Studies

The following is a discussion based on the theme that emerged from the findings in addressing the first research question: What are the experiences of lecturers in supervising research studies in isiZulu at UKZN? The issues that emerged relate to: aspects relating to isiZulu research concepts; research supervisory skills; aspects relating to research methodologies; aspects relating to exposure to theories; aspects relating to language and students' success; as well as aspects relating to students' academic writing skills. Below is a discussion of each of these aspects.

Aspects Relating to isiZulu Research Concepts

Some lecturers indicated that using isiZulu in supervising research is not as stressful as many people may think. They stated that it is not that research concepts are not available in isiZulu, but researchers need to indulge in conducting research in isiZulu so that isiZulu research concepts can be widespread. The lecturers stated that researchers need to use isiZulu when

conducting research so that those concepts are utilized. Below are some of the quotations that indicate that lecturers are confident that using isiZulu in supervising research is possible and is a way of developing the language.

> *You see, people think that isiZulu has no research concepts. This is not true. Concepts are there, you only need to play with words. IsiZulu is very rich, words are there, but you only need to choose the one that best describes the concept.*
>
> *It is not correct to say isiZulu lacks research concepts because concepts are available, people need to change their attitudes and use the concepts because you never get stuck when you write, you find a word with ease…for example, research methodology in isiZulu is izindlela zocwaningo; research is ucwaningo; chapter one is isahluko sokuqala; summary is iqoqa; pilot study is isivivinyo socwaningo; and so on.*
>
> *I encourage my students to use isiZulu concepts as much as they can, and discourage them from using English derivations. You will be surprised, they will come up with words, sometimes I never even thought about, and those words are exactly the English equivalents. In this way, the meaning becomes the same. Examples could be: list of figures (uhlu lweziboniso); key questions (imibuzo-ngqangi/imibuzo ewumgogodla); literature review (ukubuyekezwa kwemibhalo); analysis (ukuhlaziya); results (imiphumela); theory (injulalwazi); theoretical framework (uhlaka lwenjulalwazi); ethical procedures (inkambiso elungileyo); mixed methods (izindlela ezixubile) ….*

From the above quotations, we found that supervisors believe that isiZulu has the potential to be used for research purposes, and this refutes what others believe, that is, isiZulu and other African languages cannot the used in research due to the unavailability of concepts (UNESCO 2010).

Experiences of Lecturers in Supervising Research

Research supervision can be immensely rewarding for both supervisor and

student, but it can equally be frustrating and disheartening. The following discussion is based on the two themes that emerged from the findings in addressing the first research question: What are the experiences of lecturers in supervising research studies in isiZulu at UKZN? The issues that emerged relate to: aspects relating to isiZulu research concepts; research supervisory skills; aspects relating to research methodologies; aspects relating to exposure to theories; aspects relating to language and students' success; as well as aspects relating to students' academic writing skills. Below is a discussion of each of these aspects.

Aspects Relating to the Research Supervisory Skills

Below are some of the interview statements by some supervisors:

> *I am happy that my supervision skills are developing in isiZulu and I will continue to supervise my students in isiZulu.*
>
> *It is pleasing to see your student completing on record time. It really makes me feel my supervision skills are improving and that means I am growing as an emerging researcher and a supervisor that a student can trust, particularly as it is only a few of us who supervise students in isiZulu. I am really satisfied with the results.*
>
> *Well…when you supervise in isiZulu for the first time, you become intimidated because you have not done it before, you feel you are not doing it, but as you continue, you improve more and more.*
>
> *I have developed my supervision skills in isiZulu. Previously, it was very difficult but now I am confident with how I supervise my students in isiZulu. I also have students whom I supervise in English. Those are the ones who have chosen to do their research in English. But I can tell you that I have some African students that I supervise in English, and they are really struggling when compared with those I supervise in isiZulu.*

From the above statements, it is interesting to see that supervisors appreciate the importance of using isiZulu for supervision purposes. It is also remarkable

that supervisors feel that the students who do research and are supervised in isiZulu demonstrate a positive performance, especially when compared to the other African students whom they supervise in English.

Aspects Relating to Research Methodologies

Other responses indicate that supervisors find it fruitful to supervise postgraduate research in isiZulu because they are exposed to various research methodologies, which they need in order to be able to supervise students:

> *I have learnt a lot about various research methodologies in the language of my own. It [being a supervisor] forces you to learn about research methodologies. Your students employ different research methodologies, and therefore you also should know about them, to be able to supervise effectively, no matter most of the materials are in English, I use the same stuff and explain to my students in isiZulu. This assists me a lot, and a few materials I get in isiZulu, makes things easier for me.*
>
> *If you need your student to trust you, you must demonstrate adequate knowledge of the methodology which the student wants to use… I use isiZulu to advise them, but mostly, we use the English research concepts, if there is no isiZulu equivalent.*
>
> *I have been exposed to a lot of literature to equip myself with knowledge on various research methods, and this helps me to give proper guidance to the students I supervise. It doesn't matter if most of the materials are in English because when I supervise my students, I do that in isiZulu, by making translations of the English materials.*
>
> *I have come across some theses written in isiZulu, and I focus on the methodology sections, to see how they use the research concepts in isiZulu. This helps me a lot. It makes work very easy for me because my students understand better when the concepts are available in isiZulu.*

Based on the above responses, we find it interesting that supervisors are able

to use materials which are available in English, to supervise research in isiZulu. This means that research produced in English is technically not any better than research produced in isiZulu because the same materials are used, it is only the language that is used to explain research concepts that differs. It is therefore interesting to see that the supervisors understand that a supervisor should have adequate knowledge of research methodologies to be able to supervise students, which is what these lecturers do.

Aspects Relating to Exposure to Theories

Some of the aspects included lecturers' contribution towards developing students' ability to engage with theory during data analysis. Some lecturers also emphasised the importance of attending conferences and seminar presentations as they feel that they learn more or gain exposure to various theories through other people's presentations. Below are some of the interview examples:

> *I feel good that I now understand how different theories in my field of study operate. I have known few of them, but now I can use or explain to another person how a particular theory works. This gives me the opportunity to guide them appropriately with regard to the theory to be chosen for a particular study.*
>
> *I normally attend conferences and seminars and get to know about different theories.*
>
> *I become very happy to see my student able to engage with theory chosen for the study, which tells me I am the good supervisor.*
>
> *Many students find it challenging to engage with theory when analyzing data, but I explain to them how to use a particular theory, then they do it. Usually, I am satisfied with my students.*

Aspects Relating to Language and Students' Success

Many supervisors mentioned aspects relating to language and students' aca-

demic success in research. The following are some of the supervisors' statements based on this aspect:

> *Although I have not much experience in supervising in isiZulu, I have graduated three students at Masters level. They write very well when they write in isiZulu. It is quite essential to encourage students to write in isiZulu … this has worked for me.*
>
> *Using isiZulu to supervise my students' project is best for me because there is no communication breakdown between me and my students as it happens when I supervise in English, so if they do not follow instructions it is not that they did not understand me. Language plays a vital role in their success in research.*
>
> *I supervise in isiZulu because I was also supervised in isiZulu when I was a student at the former University of Natal. I learned supervision skills from my own supervisor, and now I am doing the same to my students to ensure their success.*

The above quotations indicate that using isiZulu to supervise research is possible and it plays an important role, particularly when supervising a student who is a native speaker of isiZulu. In this way, the mother tongue plays an important role in ensuring academic success in research. This is seen in students who have graduated in isiZulu, as some of the supervisors have mentioned above. The importance of mother tongue is one of the issues emphasised by the Millennium Development Goals (MDGs), as it is a key factor for education and the success of other development efforts (Boonroj 2010). Evidence in Africa and across the globe shows that the mother tongue is essential for effective learning to occur because it makes learning interesting and accessible, while it is improving the quality of education and preserving the language (Iyamu & Ogiegbaen 2007). For this reason, it may be concluded that students are likely to succeed in their research studies if mother tongue instruction is in place.

Aspects Relating to Students' Academic Writing Skills

The other aspects that emerged from the findings relate to students and

academic writing skills. This was thus reflected in the following statements:

> *Abafundi babhala kahle kakhulu lapho bebhala umbiko wocwaningo lwabo ngesiZulu, akufani noma bekwenza ngesiNgisi.*
>
> *Students write very well when they write their research reports in isiZulu, it is far better than when they do it in English.*
>
> *Amakhono okubhala kubafundi [ngesiZulu] angcono kakhulu kunalapho uma bebhala ngolimi lwesiNgisi. Phela i-academic language is nobody's home language. Nakhona esiZulwini, njengasesiNgisini, abafundi badinga ukufundiswa indlela yokubhala i-academic writing, okuyinto vele engiyenzayo ukubalekelela.*
>
> *Their writing skills [in isiZulu] are much better than when they write in English. Academic writing is nobody's home language. Even here in isiZulu, students need to be taught academic writing skills, which is what I do to assist them.*
>
> *Ama academic writing skills abo angcono kakhulu kunalapho bebhala ngesiNgisi. Kukhona nje omunye umfundi wami obebhala ngesiNgisi, sengize ngameluleka ukuthi abhale ngesiZulu. Ungamangala ukuthi usebhala into enomqondo kanjani. Nendlela abhala ngayo sekuyabonakala ukuthi yinto ayibhala eyicabanga ngolimi lwakhe, useyashibilika nje impela. Uyabona nje, ngisho isivinini sakhe sokubhala, kuqala bengithi uma ngimnika umsebenzi, avele alethe amakhasi ama-4, kodwa manje useletha ayi-14. Kusho khona ukuthi usebhala ngolimi lwakhe.*
>
> *Their academic writing skills in isiZulu are much better than their academic writing skills in English. I have a student who has been writing in English, I have now decided that he writes in isiZulu. You will be surprised how well he can write now. The way he writes now shows that he is using the mother tongue, the language he thinks with, he is now cruising. Even his writing speed has now improved.*

> *Before, he used to submit 4 pages of work whenever I gave him a task, but now he can submit 14 pages. It shows he is now using his mother tongue.*
>
> *Ngibeluleka ngaso isiZulu ngoba kwabona ucwaningo lwabo balwenza ngesiZulu futhi ngijabula kakhulu ngoba babhala into enomqondo nami angiphathwa yikhanda kangako, kunalabo engike ngabeluleka ngesiNgisi.*
>
> *I supervise them in isiZulu because it is the language they use in conducting their research and I am so happy because they write meaningfully. They don't give me any headache, unlike those whom I have supervised in English.*
>
> *…Uma bebhala ngesiZulu benza kangcono kakhulu nami ngiyayibona into engiyenzayo.*
>
> *They write much better when they write in isiZulu and I can see where I am going.*

As already stated above, the issue of mother tongue instruction comes into play. Studies indicate that mother tongue instruction makes learning easier (Kamwendo 2010; UNESCO 2010; Wa Thiongo 1986). It must be stated that some supervisors had the above statements to say about their students, and it is interesting to note that they were happy with most of the students they supervised in isiZulu in relation to academic writing skills. It is important to note that these participating lecturers appreciate the use of isiZulu as a medium of instruction in supervising research, no matter what the challenges were.

The Language Preferences of Lecturers towards Dissemination of Research in isiZulu at UKZN

The following discussion is based on the two themes that emerged from the findings in addressing the second research question: What are the language preferences of lecturers towards dissemination of research in isiZulu at

UKZN? The issues that emerged from the data relate to (1) Conference, colloquium and seminar papers; and (2) Publications.

Conference, Colloquium and Seminar Papers

Presenting in isiZulu

Some of the lecturers stated that they prefer to present their papers in isiZulu, especially at UKZN conferences and some other conferences outside the university, where isiZulu is recognised:

> *Ngivame ukusebenzisa lona ulimi lwesiZulu ngenhloso yokukhombisa yinoma ubani ukuthi kuyenzeka lokhu ngesiZulu. Ngike ngawethula amaphepha ami ngesiZulu engqungqutheleni ye-UTLO neye-ALASA.*
>
> *Usually, I use isiZulu to showcase that it is possible to present research in isiZulu. I have papers that I have presented in isiZulu at the UTLO and ALASA conferences.*
>
> *Ngike ngiwethula amaphepha ezingqungqutheleni ze-ALASA ne-ALTA yaseMelika ngesiZulu, kanti nangonyaka ozayo (2014) ngizolethula ngesiZulu eMelika ku-ALTA ngoba amaphepha ethulwa ngezilimi zesintu. Awamaningi wona amathuba okwethula amaphepha ngolimi lwesiZulu.*
>
> *I have presented a paper in isiZulu in the ALASA conference, and next year I will present my paper in isiZulu at the annual ALTA conference which is usually held in the United States of America.*
>
> *Ngiyawethula ngesiZulu amaphepha ami ngoba iNyuvesi iyakukhuthaza, njengasengqungqutheleni nje ye UTLO, kanti ngike ngalethula nangecolloqium leya eyayimayelana nezilimi zesintu eyayiseHoward College campus.*
>
> *I use to present my papers in isiZulu because the University promotes presentations in isiZulu at the UTLO conference, and I did present my paper in isiZulu during the African languages colloquium which was held at Howard College campus.*

> *Sengake ngalethula iphepha ngesiZulu ku-UTLO conference nakulo nyaka ngizolethula futhi, kodwa inkinga ukuthi kuvele abakulalele babe mbalwa. Ngibona sengathi akukangeni ezingqondweni zabantu abaningi ukuthi isiZulu ulimi olukwaziyo ukusebenza nasezintweni ezinjengalezi. Nabo Kanye laba abathi bayalugqugquzela lolu limi ababonakali bethula ngisho elilodwa iphepha ngolimi lwesiZulu.*
>
> *I have presented a paper in isiZulu at the UTLO conference and I will do the same this year. However, the problem is that when you present in isiZulu, you have a very small audience. I think for many people, isiZulu is still not recognised as a language that can be used in things like this [conferences]. It is disappointing to find that even those who encourage the use of isiZulu [in research], do not do what they preach.*

From the above responses, we deduce that lecturers are inspired to present papers in isiZulu. The only problem is the lack of space to present papers in isiZulu. Only three conferences were mentioned by supervisors as enabling them to present papers in isiZulu. These were the University Teaching and Learning Office (UTLO) conference of the University of KwaZulu-Natal, the African Languages Association of South Africa (ALASA) conference, as well as the African Languages Teachers Association (ALTA) conference usually held in the United States (US). In addition, some of the supervisors appreciated the opportunity to present their research papers in isiZulu in the African languages colloquium which was held at the University in 2013. Supervisors who said they had presented papers in the ALTA conference in the US, all stated that they have presented in isiZulu. Most interestingly, is the fact that African languages (like isiZulu) are used in conference presentations overseas, while they are minimally used in the country where they are spoken.

Besides challenging situations that do not favour the use of isiZulu in terms of research dissemination, the participating lecturers are not discouraged, but instead they want to see isiZulu developing as a language of research, thus contributing to the development of African scholarship. To us, this is 'swimming against the tide'. Nkosi (2013b) in her presentation entitled '*Le Mpi Akuyona Eyamagwala: Ukufundisa, ukweluleka ucwaningo, nokucwaninga ngesiZulu e-UKZN*' (This Battle is not for Cowards: Teaching,

Supervising and Disseminating Research in the Medium of IsiZulu) has demonstrated that it is indeed possible to use African languages as languages of learning and research to develop African scholarship, no matter what the challenges are. Therefore, it will be said that it is up to the lecturers to ensure that isiZulu is put on the map in research and to ensure that they 'swim against the tide'.

Presenting in English

Four of the lecturers mentioned that they prefer to present their research papers in English:

> *Njengamanje ngi-presenter ngesiNgisi, uma kunama-seminar noma ama-conference ngoba uma i-audience ingasazi isiZulu ayikho into engisuke ngingayenza, ngisho noma ngikhona lapha eSouth Africa.*
>
> *For the time being I do my presentations in English at seminars and conferences as this is dictated by my audience, even if I am in South Africa.*
>
> *Ngiye ngi-presente ngesiNgisi ngiphakathi nangaphandle kwaseSouth Africa. Akusikho ukuthi angithandi uku-presenter iphepha ngolimi lwesiZulu, inkinga ukuthi ngiye ngizame ukuthi abantu abaningi bezwe okuqukethwe yiphepha lami.*
>
> *I usually do my presentations in English locally and internationally. Not because I detest presenting in isiZulu, but there is very little you can do when trying to reach out to a wider audience.*

The above two statements indicate the problem that the two participants have had to sustain in presenting their research papers when the audience was non-isiZulu speaking. It is understood that not everybody is proficient in isiZulu but there are translation facilities that could be used to overcome the problem, if African languages were to be taken seriously. However, because of the hegemony of English, it seems the availability of such facilities is not provided by institutions where conferences are held. It is unexpected of a country like South Africa, to have institutions that cannot cater for African

languages during conferences. For this reason, presenters are unable to use languages of their choice. In other words, if we have a country or universities whose language policies promote African languages; this problem can be minimized. It is therefore evident that many institutions do not recognise African languages as languages that can be used in research. Kwesi Prah (2003) tells of the 'collective amnesia' that is occurring as a result of not using African languages as languages of education. When African languages are devalued in this way, much of the indigenous knowledge contained in those languages becomes devalued (Roy-Campbell 2006).

Presenting in both isiZulu and English

The following are examples of interview quotations by some of the lecturers:

> *Ngiwethula ngazo zombili izilimi (isiZulu nesiNgisi), kodwa imvama kuba yisiNgisi. Ngiye ngibheke ukuthi izethameli zengqungquthela zisebenzisa luphi ulimi, uma kungamaNgisi ngisebenzise isiNgisi, uma kungamaNguni [amaXhosa, amaNdebele, amaSwazi namaZulu) ngisebenzisa ulimi lwesiZulu.*
>
> *I use both languages (isiZulu and English), but usually I use English. Language preference is usually dictated to by the audience. For a seemingly English speaking audience, I use English and for a Nguni speaking audience I prefer isiZulu.*
>
> *Iningi lamaphepha ami ethulwa ngesiNgisi ngoba isikhathi esiningi ingqungquthela isuke imayelana nolimi lwesiNgisi, kodwa-ke nangesiZulu ngiyawethula uma ingqungquthela iphathele nezilimi zesintu ....*
>
> *Most of my papers are usually presented in English because conferences are usually conducted in the medium of English, but I also use isiZulu if the conference is about African languages ....*
>
> *Isikhathi esiningi abethuli bamaphepha ezingqungquthela kuba amaNgisi, kodwa uma ngithola ithuba lokwethula iphepha ngesiZulu, ngiyalisebenzisa lelo thuba. Zimbalwa izingqungquthela ezivumela*

> *ukusetshenziswa kwezilimi zase-Afrika ….*
>
> *In most cases the conference presenters are English speaking, but if there is a chance to present in isiZulu, I use that opportunity. Very few conferences allow the use of African languages ….*

From the above quotations, we learn that what informs the choice of a language when lecturers present their conference papers is the nature of the audience. Lecturers are compelled to present most of their papers in English because the audience is non-African, while a few of their works are presented in isiZulu. Besides, African presenters find it difficult to use their African languages as they want to share their research works with academics who are non-Africans. For the African lecturers, avoiding the use of English in conferences, may limit chances of getting feedback from the audience, as some of the conference attendees are not proficient in isiZulu. However, the lecturers mentioned that they use isiZulu if the audience is predominantly isiZulu speaking. This means that lecturers should not be blamed for having negative attitudes towards their own languages as many would think, if they use English in conferences, since they are able to use them when opportunities are available. From the lecturers' statements, it is obvious that African isiZulu presenters are not likely to be a majority in many research conferences, which is the reason for the dominant use of English. This is because Africans are underrepresented in education and research (Assaf 2005-2006; 2010). Therefore, this calls for African academics to put more effort in attending and presenting their work at conferences to maximize the need for using language translation facilities in conferences, so that different languages are taken seriously, more particularly, African languages which are underrepresented in such activities.

Publications

Under this theme, two sub-themes emerged. These were publishing in isiZulu, and publishing in English:

Publishing in isiZulu

Of the ten lecturers who participated in the study, **four** mentioned that they

prefer to publish their research in isiZulu. The following are some of the interview examples of lecturers' statements:

> *Nakuba ngiseyingane ekubhaleni, leyo mbijana yemisebenzi yami ngiye ngikhethe ukuyibhala ngesiZulu. Ngikubona kuwumthwalo wami ukubamba iqhaza ekuthuthukiseni ulimi lwesiZulu ngayo yonke indlela engingase ngenze ngayo.*
>
> *Although I am still young in research, I write most of my work in isiZulu. I regard it as my responsibility to make a contribution towards the development of isiZulu as a language.*
>
> *Yikho ukuthi sibophe izifociya silusebenzise ocwaningweni ulimi lwesiZulu ukuze luthuthuke...Sikhumbule ukuthi ayikho ingane ethi izalwa ibe isigijima. Nolimi lwesiZulu luseyingane, lusafuna ukukhuliswa.*
>
> *We need to soldier on and use isiZulu in research so that it can develop; bearing in mind that everything must have a start. IsiZulu likewise is still in its infancy and must be developed.*
>
> *Iningi lozakwethu libhala ngesiZulu, kodwa ke mina ngiye ngibhale ngesiZulu ikakhulu, nakuba kusekuncane esengike ngakubhala, nami ngisemusha eNyuvesi futhi ngisakhula ekucwaningeni.*
>
> *I usually write in isiZulu, although there is still very little that I have written so far, as I am still new at the university level of education and am still growing in research.*

From the responses of the lecturers quoted above, it is clear that their willingness to publish in isiZulu is congruent with their intention to reinforce the development of isiZulu in research. They understand that it is their responsibility to ensure that isiZulu develops in research, as presently there is a lack of research available in the medium of isiZulu, as stated earlier in this paper. We find these lecturers carrying a burden of being at the forefront of the battle, in fighting against circumstances which do not favour the use of African languages in research publications, as most journals require only

papers produced in English. For this reason, the lecturers who are 'swimming against the tide' need to be supported. This may, for instance, be done by encouraging more African lecturers to publish in isiZulu. However, people do not have the same preferences. This is seen in the following discussion about publishing in English.

Publishing in English

While some lecturers have mentioned that they mostly publish in isiZulu as demonstrated above, others stated that their publications are in English, for publication opportunities. The following are examples of interview excerpts:

> *Into eyinkinga ukuthi uma ubhala iphepha lakho ngesiZulu, lizophabhlishwaphi (publish) [lizoshicilelwaphi]? Ambalwa amajenali avuma amaphepha abhalwe ngesiZulu nezinye nje ke izilimi zesintu.*
>
> *A major challenge is that it is difficult to publish a paper written in isiZulu. Very few journals accept papers written in isiZulu.*
>
> *Ngiye ngibhale ngesiNgisi. Kubalulekile ukuba umlayezo wakho uzwakale kwi-audience, nami ngizama lokho.*
>
> *I write in English. It is very important for your contribution to be understood by a wider audience and that is what I am trying to do.*

The above statements aptly concur with Gramsci's (1971) theory of linguistic hegemony. In a democratic country like South Africa, where there are eleven languages mentioned in the constitution as official languages, it is disturbing to observe that lecturers are still complaining about the scarcity of journals to publish their research. It is difficult to understand why there are few journals and other sources that publish papers written in isiZulu, while the country is dominated by Africans, and particularly isiZulu, which has the highest number of speakers when compared with other languages (Statistics South Africa 2011). We see this as the linguistic hegemony of English, which enjoys prestigious status as the most recognised language in research, while

little is being done to uplift the status of African languages. One could ask what are isiZulu lecturers doing in order to uplift its promotion in research? The possible answer to this question, as already highlighted before, could be that African isiZulu lecturers are the victims of the system which favours the use of English in publications. For instance, many journals only accept papers authored in English, and therefore chances are limited for papers written in African languages (UNESCO 2010). When one writes a paper, the aim is to get it published. For this reason, chances of publishing in isiZulu become limited. In other words, understanding the difficulties that African lecturers are faced with in terms of language preferences of their publications may help in reducing false accusations, for example, that African writers have colonised minds or they undermine their languages.

Conclusion and Recommendations

In this article, we have shown that lecturers are happy to supervise students in isiZulu and have demonstrated why it is necessary for lecturers to consider using isiZulu as the medium of instruction when supervising research at postgraduate level. We explored policies that inform the use of isiZulu in research at UKZN. We also reviewed literature about postgraduate studies in South Africa. In our analysis, we discussed different aspects in relation to supervising research in isiZulu. We have also discussed lecturers' preferences in disseminating their research, firstly, by means of presentations, secondly, by means of publications. We have demonstrated how some lecturers are 'swimming against the tide' in elevating the status of isiZulu in research. We argued that even those isiZulu speaking lecturers who do not disseminate their research studies in isiZulu, are not to be blamed for having negative attitudes towards isiZulu because they encounter challenges when publishing and presenting at conferences using African languages. We also demonstrated how supervisors refute the myth that there are no available concepts that can be used in research through African languages (for example, isiZulu), as many already exist, but are not used by researchers. This is due to the fact that most lecturers do not conduct their research in isiZulu. In conclusion, we say that it is possible for isiZulu to grow as the language of research if lecturers who are proficient in isiZulu will insist on disseminating their research using this language.

Consequently, it is recommended that the following should be addressed:

1. There is a need to encourage students to conduct their research in the medium of isiZulu so that the available isiZulu research concepts are used.

2. There is a need to encourage, by way of incentives, African lecturers, especially those who are proficient in isiZulu, to present and publish their research activities in the medium of isiZulu. This will increase the number of more academics to disseminate research in isiZulu.

3. There is a need for more peer reviewed journals to publish papers written in the medium of isiZulu.

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Harnessing Students' Capital to Teach and Learn: Responsive Pedagogies to Implement Change in a Higher Education Lecture-room

Ansurie Pillay

Abstract

This article considers the unanticipated findings gleaned from the base-line information collected prior to a two–year participatory action research (PAR) study and explains how the study was shaped to respond to the findings. The study, shaped by critical pedagogy and aimed at change agency, was conducted over six PAR cycles in an English Education lecture-room at a School of Education. At the end of each cycle, data was collected and analysed qualitatively. The findings revealed that a nurturing lecture-room environment, which responds to students' cultural capital, encourages active engagement. Secondly, despite an apparent lack of a reading culture, the students could recognise the importance of reading for academic empowerment. Finally, using literacies with which the students were comfortable and competent enabled effective teaching and learning. The article therefore argues that it is imperative that lecturers take cognisance of who their students are and the capital that they bring with them.

Keywords: Capital, Literary texts, Critical pedagogy, Participatory action research, Active engagement, Reading, Literacies

Introduction

This article considers the unanticipated findings gleaned from the base-line information collected prior to a two–year participatory action research (PAR) study and explains how the study was shaped to respond to the findings. The

study, conducted in English Education lecture-rooms in a School of Education, emanated from the student teachers' apprehensions surrounding the poor state of education in South Africa and the fear that they would have to fit into an apparently dysfunctional system. Different to but complementing their apprehensions, was my concern that in English Education lectures, while content and pedagogy were covered, the student teachers were not taught how to make a difference to learners' lives through literature or otherwise. Thus, the power of literature to both empower and transform was often ignored.

I designed an outline of a study and presented it to third-year student teachers and they were asked to consider whether they wanted to be part of the study. The research question guiding the study was: How can student teachers of literature become agents of change? All participating student teachers were assured that participation was voluntary, guaranteed total anonymity and confidentiality, and granted the option to leave the study at any time with no consequences to themselves.

The baseline information, gathered to determine the starting point for a PAR study, provided unanticipated evidence of the cultural capital with which the student teachers arrived. In this paper, I only consider these findings by discussing how the study was shaped to engage with the capital present in the lecture-room. Ultimately, I argue that it is imperative that lecturers take cognisance of who their students are and what they bring with them.

In the article, I consider the theoretical framework, literature review, and methodology used in the study. I then highlight the findings from the baseline information and discuss how we responded to it.

The Theoretical Framework

Critical pedagogy, which served as the theoretical framework that underpinned the study, is founded on the possibility of transformation, and has a critical nature and liberating function. It proposes that education should be located within its socio-historical and political setting, and should assert its commitment to transformation towards justice, equality, democracy and freedom (Giroux 1983; Biesta & Tedder 2007; Giroux 2009).

The study was especially shaped by hooks' (1994) notion of engaged pedagogy which contends that teaching and learning are most effective when

they are responsive to and respectful of the needs of a specific group of students and when teaching and learning conditions are non-threatening and non-discriminatory. A progressive, holistic education, hooks argues, necessitates the lecturer contributing to the intellectual, social and emotional development of the students, while locating the lectures within their realities and histories, and taking cognisance of their cultural capital.

In his theory of cultural capital, Bourdieu (1986) conceptualises capital as being the cultural background, resources, knowledges, assets, dispositions, and skills that are passed down from one generation to the next. Society usually values the cultural capital of dominant groups and sees as less worthy the cultural capital of marginalised groups (Yosso 2005; Rios-Aguilar *et al*. 2011). McLaren (2009) expands the conceptualisation of capital by considering ways of talking, socialising, moving, and acting, modes of style, forms of knowledge, language practices and values.

Educational institutions like universities, McLaren notes, value and reward those students who display the dominant cultural capital of the institutions and their lecturers, and devalue the capital of those in subordinate positions. Many researchers have considered whose knowledges count and whose are discarded (Ladson-Billings 2000; Bernal 2002). Bourdieu and Passeron (1977) point out that knowledges of the upper and middle classes count, and to get those knowledges, you are either born with it or learn it at school, and in this way, society reproduces itself. Lecturers at universities thus impart to students forms of cultural knowledge considered valuable by the dominant society.

Students entering South African universities often emerge from dysfunctional school environments which they use as their points of reference (Bloch 2009). In schools, students are socialised into accepting certain behaviours, and often work out what the 'correct' answers are supposed to be. When these students move to universities, they struggle to ascertain what it is that different lecturers want (Anstey & Bull 2006). Anstey and Bull indicate that students can be disadvantaged by the social interactions in a lecture-room because of the acculturing function and pedagogies used in their former schools.

In lecture-rooms, teaching and learning relationships are often infused with power (hooks 1994). Students see lecturers as representatives of power (Koro-Ljungberg 2007), and the hierarchical structure ensures that lecturers' social values are reinforced by their dominant discourse (McKenna

2004). Heap (1999) and Baker (1999) point out that lecture-room discourse as an acculturing factor transmits knowledge and communicates how the university operates. If students come from social and cultural groups that have not experienced this dominant discourse, then they do not know the rules of engagement, cannot participate in the lecture setting, and lack confidence in engaging in the teaching and learning process (Anstey & Bull 2006).

However, Yosso (2005) urges lecturers to consider the cultural capital that students bring with them, as they could potentially be rich resources to the teaching and learning environment. In the study under discussion, all the student teachers and I had to consider how to use the cultural capital present in the lecture-room to help the student teachers achieve empowerment and transformation and become agents of change. Many studies were drawn on to help inform the study under discussion.

The Literature Review

The study was informed by studies that shared similar aims. Bartolome (1994: 173) found that the teacher should look for a 'humanising pedagogy that respects and uses the reality, history and perspectives of students as an integral part of educational practice'. Bartolome (2009) warns that implementing teaching strategies without understanding who the students are and what they bring with them will not necessarily achieve successful student learning. Various researchers (Edelsky, Altwerger & Flores 1991; Perez & Torres-Guzman 1992; Bartolome 2009) have successfully used a humanising pedagogy where students' languages and life experiences are incorporated into lectures while the lecturer provides academic content knowledge and skills. In the South African context, it becomes imperative for lecturers to identify students' realities, histories and perspectives, nullified by apartheid South Africa and rendered invisible, and utilise them in their teaching practices. The post-apartheid lecturer therefore has the opportunity to tap into students' rich resources and build on them.

To achieve a 'humanising pedagogy', Ladson-Billings (1995) recommends culturally-relevant teaching that is committed to collective, communal empowerment. Culturally-relevant teaching, which this study used as a basis for engagement, is based on, among other ideas, the principle that students are excited and engaged when their knowledges are acknowledged

and built on (Ladson-Billings 2009). In Ladson-Billings' study (1995), teachers used students' cultures as building blocks for learning and teaching and students developed a critical consciousness where they could confront the *status quo* of the existing social order by critiquing social structures, practices and norms that produce, reproduce and maintain the social order.

Villegas (1991) speaks similarly of a culturally-responsive pedagogy where lecturers use strategies that acknowledge and develop culturally different ways of behaving, learning and using language in the lecture-room. Lipman (2009) takes this idea further when she identifies a culturally-relevant, responsive, emancipatory pedagogy that has a liberatory aim. This pedagogy understands that education is political and that teaching cannot be 'colourblind' (Lipman 2009: 364). Instead, lecturers need to connect with and draw on the discourses, cultures and socio-political realities of their students to promote academic competence and socio-political awareness. In this way, lecturers will take the first step to enabling students to develop into citizens informed by a concern for justice, happiness and equality as espoused by Giroux (2009).

The Methodology

The study was framed by a critical paradigm that used critique as a method of investigation to develop a discourse of social transformation and emancipation, as proposed by McLaren (1991). According to Freire (1998), when using a critical paradigm, education is seen to have transformative possibilities that could provide opportunities for progress, an idea that propelled this study in its aim to enable student teachers to become agents of change in their classrooms. While the student teachers critiqued teaching practices and philosophies, they aimed for transformation and thus emancipation from previously held ideas of what a teacher of literature should be.

This study was implemented over six PAR cycles. PAR, a form of participatory, democratic action research, involves a spiral of cycles of research, experiential learning and action (Boog 2003), aims to be responsive to the emerging needs of a situation, and the results of the research should lead to improved actions in a specific situation (Boog 2003). While Hall (1981) suggests that the issue being studied should originate from the group, in this study, while the student teachers were not responsible for suggesting

the idea for the research, they embraced the aims of the study and recognised that it could help shape their future careers, professional identities and professionalism in their workplaces. They also recognised that the concepts of change and transformation were marginalised in their teacher education programme.

Prior to a PAR study, baseline information is collected from participants to determine how to proceed. It enables the researcher to understand how participants perceive and experience concepts and events and thus determines what the first set of interventions needs to be. Interventions refer to a set of planned actions designed to increase the effectiveness of a situation, and deliberately disrupt current practices (Cummings & Worley 2005).

In this study, each cycle comprised an intervention designed collaboratively by the student teachers and me to attempt to answer the research question, and within each cycle, the intervention was implemented, observed, reflected on and theorised before further action. Interventions used the literary text as a springboard to focus on literary theories, social justice issues under scrutiny, innovative pedagogical tools, and unpacking the concept 'agent of change'.

After each cycle, different research methods were used to collect data on the effectiveness of the interventions in facilitating the student teachers becoming agents of change. Some data was collected from all the student teachers (observations; student evaluations; drawings; questionnaires) and some data was collected from different groups of randomly selected student teachers (interviews; focus-groups). The data collected served to inform the student teachers of what the intervention should be.

Since the study worked with student teachers' descriptions and understandings of change, we chose a qualitative approach that focussed on in-depth accounts and interpretations. In this study, PAR and a qualitative approach reinforced each other, as student teachers and the researcher were open to allowing the findings to determine the study's progress, adapted the study as the situation changed, and thus had to work closely together implementing the interventions and analysing the outcomes.

All data was analysed by me and by a group of student teachers (different groups for different data collection methods) by reading and segmenting data into meaningful analytic units that were coded. The codes used were both a priori (a set of codes developed before the data is examined)

and inductive (the other codes developed by the analysers as the data is examined). For example, the research question initially determined a priori codes, but as further data became available, other factors presented themselves (such as the characteristics of the emerging professional identity of student teachers), requiring further sets of codes to be developed.

Analysis was an ongoing, iterative process of collecting and analysing data (Johnson & Christensen 2007) and all analyses were verified with persons involved in the research process. While PAR does not aim to be objective and impartial, it does aim to be authentic, credible, and rigorous. Dick (1999) comments that PAR, by its nature, gives added rigour to an enquiry as the use of cycles and the action-positioned nature of the research ensures that data collection and interpretation coincide, and subsequent cycles are informed by the interpretations from previous cycles.

The subjectivity of the researcher and participants and the relationships that emanate from the various processes make PAR different from traditional objective research. The student teachers and I worked together as research partners and responsibility for the process was shared. However, throughout the study, we reflected upon the process as ethical issues emerged, and we planned and implemented new cycles of research as carefully as possible.

As the primary facilitator of the study and the student teachers' lecturer and assessor, I understood my power within the research process. I aimed to be socially responsive and reflexive at all stages of the research, and had to ensure a clear mediation of the research process and a seamless integration of the various roles played by me. Perhaps the most crucial aspect of the study involved the dialogical relationship between the student teachers and me, which included collaborative critical reflection and shared planning and facilitation.

Findings from the Baseline Information

Collection of baseline information took the form of anonymous questionnaires addressed to the student teachers, in which they were asked questions to ascertain their reading histories, encounters with literature, understandings of literacy and experiences of university, among others. The questionnaire also included open-ended questions, which allowed for the expansion of ideas.

The questionnaires, from sixty-six student teachers in their third-year of a four-year degree, revealed that 63% of the participating student teachers considered English as their home language with 37% speaking an African home language. The majority were in their early twenties with just over 10% being in their thirties. Just over half the group (52%) indicated that they were Indian; 36% were African; 8% were White; 3% were Coloured; 1% was classified Other (racial categories are still in place at universities, presumably to redress past inequities). All the student teachers had chosen to study English Education at university to teach English at primary or high schools. The initial questions in the questionnaire allowed me to place the findings in a social and historical context. For example, three student teachers attended private schools, six attended rural government schools, and the majority attended either middle-class suburban schools or working-class township schools run by the state.

The baseline information revealed, among other findings, four important aspects of relevance to this article:

- Most of the respondents indicated that they rarely spoke in lectures, even if asked to
- Many indicated that they enjoyed a participatory oral culture of storytelling, listening, speaking and memorisation
- The majority did not come from homes that had a reading culture (parents had not read to them as children and parents were not seen to read)
- Visual media (including electronic media and social media) shaped their daily lives

Responding to the Baseline Information: A Discussion of Findings

The first finding was that the student teachers did not speak in lectures even when asked to. Once the study began, I had to consider how to address the finding and to consider how to engage the student teachers in the lecture-room. Each lecture was placed within a flexible structure that allowed for adjustments. Generally, a lecture began with an open-ended question or problem. The ensuing discussion helped to disclose what the student teachers

were thinking and we then explored and built on the suggestions that emerged from the discussion. Issues that emerged from the texts were discussed as a class, and then the student teachers worked in pairs or as a group to answer, orally and then in writing, a challenging question or respond to a provocative statement, and answers were discussed with the class. Throughout the lecture, the student teachers were encouraged to confront views (mine or their peers') and as the cycles progressed, they did so more easily. Issues were open to deliberation, and they were urged to interject during the lecture to ask questions.

When they asked questions, I often restated or reworded the questions to enable second-language speakers of English to understand, and then answers were invited from the group. Throughout the lecture, I posed questions, initially convergent ones and then divergent ones. During certain times in the lecture, I tried to use interactive group-questioning to involve as many people as possible. Time was also allocated at the end of the lecture for their questions.

To ascertain if the strategies were making a difference, data was collected from the student teachers. The findings from the student evaluations, created especially for the study, revealed that as the study progressed, the student teachers felt more comfortable speaking in the lecture-room.

At the end of cycle one, where the novel, *The Madonna of Excelsior* by Zakes Mda served as the catalyst for engaging with issues of empowerment and transformation, the responses to the statement, I felt comfortable to participate in class, revealed a large majority (83%) who indicated an 'unsure' response to the question. They were indicating that they were not sure about their comfort in participating in class. It is possible that the use of interactive, collaborative learning, which was a distinct contrast to the traditional lecture mode, made them unsure of their levels of comfort in embarking on a new way of knowing. However, the fact that no student teacher answered 'disagree' or 'strongly disagree' seems to indicate a general feeling of ambivalence and since they had not rejected the idea of participation outright, there was hope that, with greater exposure to co-operative methods, they would feel more comfortable in subsequent cycles.

My observations of the lecture-room verified the student evaluations. While some student teachers actively participated in the discussions, not all engaged in the class discussions and in the feedback from the pair-work. Often, when they were asked to respond, they declined and I respected their

choice. I was aware of the need to build trust in small incremental steps.

During the reflections at the end of cycle one, I pointed out to the group that in lectures and tutorials, they sat, in most instances, in racial groups. A student teacher responded that she was 'comfortable with our friends'. In some tutorials, I asked the student teachers to work with people they had not worked with before and they appeared to work well. However, a student teacher revealed, 'I don't like working with some students. They act like we're not there'. The fact that a student teacher could articulate a feeling of being disrespected and ignored had to be discussed, but no-one in the class responded. Thus, many deep-seated concerns of the student teachers were not being articulated and, it was possible, that the disrespect and disregard experienced by some student teachers resulted in their not talking in class. While the student teachers did not react to the comment, it was just as revealing that they did not challenge it nor express surprise at hearing it. However, they did reveal that they mixed with people of their own races during breaks and when having lunch. A student teacher noted, 'It's a language thing. When we meet, we speak a language that we're comfortable with and can understand'. While the comfort of speaking a common language was understandable, the fact that the student teachers could not and did not articulate perceptions of racial tensions meant that such tensions needed to be actively challenged in the following cycles.

In cycle two, the student teachers worked with the film, *The Colour of Paradise*, directed by Majid Majidi, and the majority indicated, in student evaluations, a level of comfort with class participation with five student teachers still being uncertain. During the focus-group discussions, many of the student teachers indicated that they were comfortable talking in the English Education lecture-room with one student teacher saying, 'This is the only class I talk in. I would die if I had to say anything anywhere, you know, in other lecturer's lectures'. When asked why she believed this was so, she answered, 'You know how you say, "Try. Get it wrong". You get us to try and no one laughs if it's not right'. Another student teacher quipped, 'We wouldn't dare to laugh at others in your class'. A third student teacher pointed out, 'In other lectures, you just try to answer and sometimes, if it's wrong, people find it funny. They're stupid like that'. The comments indicated that if student teachers experience a sense of trust and respect in the lecture-room, they perceive it to be a safe place for them to share their views.

Similarly, the student evaluations at the end of cycle three indicated

that the majority of the student teachers felt very comfortable to participate in class. The play *Sophiatown* by The Junction Avenue Theatre Company was used as the literary catalyst in that cycle, in which the student teachers shared their memories (to understand the use of memories in the creation of the play). Despite many stories revealing personal histories, the student teachers felt safe enough to tell them with candour and honesty, and the others listened intently and responded empathetically. It was clear that the group was building a sense of community that supported each other. It was therefore a challenge to have a new student teacher enter the research process.

He had not been part of the introduction to the PAR study and no baseline information was collected from him. He did not participate in cycles one and two, was much older than most of the others, and did not engage in reflections from cycles one and two and the decisions that emerged from those reflections. He was informed about the study and he asked if he could join the study, albeit for one cycle. However, he made his hostility felt by shouting out answers, rudely challenging opinions, typing on his cellphone, and passing snide comments. The group, who had gelled over the past two cycles, appeared annoyed by his behaviour, seemed to feel intimidated to speak and at one lecture, a student teacher had to be stopped from threatening him. In many ways, I found him destructive and yet, he had to be seen as a challenge, typical of the many challenges that the student teachers would face in their own classrooms. The new student teacher agreed to being interviewed, and while all other interviews occurred at the end of the cycle, he was called in at the end of the first week of the three-week cycle.

After the questions from the interview schedule were complete, I said, 'Now tell me what is really going on.' He soon revealed his many frustrations (academic, financial and personal). He was assured that his views were valued, and he needed to be aware that he was being disrespectful to the others. This student teacher forced me to step back from the research and to consider whether it was important to stop his disrespectful behaviour in the lecture-room or work through his concerns first, a dilemma that was not truly resolved. However, he did alter his behaviour and refrained from creating an atmosphere that stopped others from talking.

By cycle four, where we engaged with the novel, *The God of Small Things* by Arundhati Roy, the lecture-room observations emphasised the findings in the student evaluations where most of the student teachers were seen to engage in class discussions, and in group- and pair-work. The

reflections, too, on cycle four with the group revealed that they felt confident engaging in lecture-room activities, comfortable sharing ideas, and during the reflection, they appeared to demonstrate a protective stance towards each other. During the reflection, what was significant for both their personal development and the study was that the student teachers could suggest, without prompting, what they wanted to focus on in the next cycle to move towards becoming agents of change.

During cycle five, during which the student teachers explored the film *Much Ado about Nothing*, directed by Kenneth Branagh, the focus-group participants, who had just returned from Teaching Practice at schools, were asked if the study had any effect on them thus far. A student teacher revealed,

> The best part of the study is the freedom, the liberty to speak, and share your opinions. [During the Teacher Practice] I tried to get my learners to speak their minds. I encouraged them to try even if they got it wrong. That's what you say to us. It's what I'll remember.

The comments indicated the importance of democratic participation in the lecture-room and, by extension, to the school classroom. More importantly, she recognised the importance of enabling learners to have a voice in the classroom. The student teacher understood that the opportunity to share opinions enabled her to have a voice, and her view reflected those of the student evaluations where all the participating student teachers indicated that they felt comfortable speaking and participating in class.

In the final cycle, the student teachers worked with *The Tempest* by William Shakespeare. The student evaluations confirmed what previous cycles had indicated about the student teachers' comfort in participating in class, and the individual interviews held with six student teachers at the end of cycle six reinforced it. A student teacher observed that the use of 'questions, discussions and debates' was effective in 'making me see ... understand things that you sometimes just accept'. In their drawings and accompanying explanations, the student teachers recognised the need for 'student-centred', 'creative' and 'interactive' lectures. They appreciated the 'stimulating questions'; 'discussions'; 'debates to encourage higher order thinking'; and that 'views were respected'. It was clear that when the lecture-room environment is nurturing and supportive, agency and participation are allowed to thrive.

However, the student teachers did point out their views and capital were not always respected in other lecture-rooms. A student teacher related her experiences of speaking in lecture-rooms by saying, 'When lecturers ask you something in a lecture and some of them will put on this stupid accent, trying to imitate a Black accent. I want to ask, you think you're funny? And then people laugh. I don't get the joke. I just see it as racist and stupid'. The comments provided insights into how certain lecture-room contexts belittled people. It was clear that the student teacher had not articulated her thoughts with the lecturer, thus reflecting an understanding about how relationships are controlled by power and advantage.

The second finding, from the baseline information, that the student teachers enjoyed a participatory oral culture, appeared to contradict the first and yet, was understandable. They enjoyed a participatory oral culture, not the culture of an alien lecture-room. The student teachers indicated respect for participatory ways of acting and reacting, empathy for others, verbal memory skills, sound features and expertise in being able to tell a good story (often by a grandmother or great-grandmother). In a lecture-room dealing with literary and other texts, or any other lecture-room, the emphasis is on the print word (whether read or written), and therefore appears to be at odds with an oral culture. And yet, the student teachers in this study were studying to become teachers of English and would teach the language to school learners. It was thus imperative that they used the language to speak, listen, write and read.

To exploit the student teachers' backgrounds of a rich oral tradition and enjoyment of a participatory environment, the student teachers and I decided to use class discussions, group- and pair-work, debates, problem-solving activities, and music. When studying *Sophiatown*, the music from South Africa in the 1950s was played and students were able to recognise songs and sing along to them. We also used role-plays, scenarios and other drama strategies, where empathy for characters and situations played an important part. While at the initial lecture of cycle three the student teachers demonstrated great resistance to the methodology, subsequent lectures proved completely different. Each of the concerns they raised - 'Will we need to act?'; 'I'm not coming to the front'; 'I'm very self-conscious' - was addressed. They were assured that there was no performance involved and sharing was optional; no one was to come to the front of the class as all strategies were designed to take place at desks; and the strategies were ways

to bring texts alive in their own classrooms. Most importantly, they were assured of confidentiality and respect.

Using role-plays, the student teachers stepped into other persons' shoes, and, working in pairs or groups, grappled with a tension in the form of a question or problem. They then responded in character and used the information from various sources to create scenarios. The sharing sessions allowed the group to see how nuances in each group's performance led to different interpretations. As the lecturer, I used a teacher-in-role strategy (where I stepped into the role of a character in the text and questioned or challenged their responses) to increase their knowledge and comprehension of the texts and for them to identify and empathise with characters and incidents in the texts.

We also used storytelling when I asked the student teachers about their memories of loss, during the teaching of *Sophiatown*. Initially, they were highly reticent to share stories but once I shared a story (about my grandmother's forced removal from her home) with them, they felt more comfortable sharing their stories of removal, loss and oppression, and how they (or their parents) remembered, spoke about or acted in the past. Telling their stories helped to affirm their own histories and voices, and to engage with and interrogate their own experiences. It was also an attempt to understand their situations both intellectually and emotionally.

The interviews conducted after studying *Sophiatown* revealed that, in the main, the interviewees enjoyed the use of role-plays and teacher-in-role. This finding reinforced those of the student evaluations where all the student teachers strongly agreed that they 'enjoyed the lectures' and that the teaching strategies used helped them to understand the play. Nine of the ten interviewees indicated that they would use the strategies in their own classrooms and indicated a preference for the use of teacher-in-role. Teacher-in-role required greater input from the teacher than from the learners and could indicate a need for control on the part of the student teachers or could reflect their uncertainty of who their learners would be and, thus, uncertainty about how learners would react to such strategies. The student evaluations, too, reflected that all the student teachers knew how to implement the teaching strategies in their classrooms.

In the reflections conducted after cycle three, the student teachers noted that, through the use of participatory co-operative learning strategies, they had built relationships, had to learn to respect each other's views,

enjoyed working in groups, and perceived a sense of trust in the lecture-room. What I realised, however, was that despite enjoying a participatory oral culture, it was still imperative to explicitly assure the student teachers of confidentiality, trust and respect to ensure comfortable participation in lectures.

The third finding that the majority of participating student teachers lacked a reading culture was significant. The English Education modules, which they had chosen, required extensive reading of varied texts and they would one day teach texts to learners at school. The findings by Evans *et al.* (2010), gleaned from studies in twenty-seven countries including South Africa, indicate that reading books and academic progress are clearly linked. As the researcher and lecturer, I had to consider how to counter the student teachers' lack of reading models or reading materials in their lives.

During the first cycle, when I asked the student teachers to read aloud extracts from a literary text, there was great reluctance to do so and they appeared to be afraid of making mistakes. I then read the extracts aloud and they listened. As the cycles progressed, I asked them to read and they acquiesced, and by the third cycle, they volunteered to read aloud. Some of them also volunteered to present dramatised readings from *Sophiatown* and later from *The Tempest*. They also grew increasingly comfortable reading out their answers to questions. Reading aloud from texts or from their own answers was the first step to enabling comfort with and confidence in reading.

The student teachers and I realised that we needed to foreground reading to enable access to higher education in general and to English Education, with its emphasis on varied texts, in particular. I gave them academic articles to read and critique. When working with an article, which the student teachers were to have read before the lecture, questions were asked and issues from the article were alluded to from time to time so that they realised that it was worth their while doing the reading without my being overly prescriptive. At various times, language issues were pointed out incidentally with particular emphasis on the role of language as it constructed realities and social categories, and highlighted or suppressed agency, among many other functions.

During the various cycles, besides their prescribed texts, they also read newspaper articles, interviews with authors and filmmakers, critiques of novels and films, and poetry and novels of people cited in the texts they were

studying. In cycle four, the student teachers, recognising their lack of a strong reading culture, asked if they could independently source articles written on their texts, a suggestion that was wholly that of the student teachers.

However, the lecture-room observations noted that five student teachers did not access any articles, four copied other student teachers' articles (they cited time constraints as their excuse), and three stated that they found the articles difficult to read. However, the majority successfully accessed, read and engaged with the articles both in and out of the lecture-room. When I asked them to access an online print-interview with an author, twelve student teachers did not and thus could not fully engage in discussions about the interview. I began to question the decision taken by the group and wondered whether I ought to have supplied material to them. However, I knew that they needed to empower themselves, should they wish to succeed. Overall, the majority were able to engage with the reading strategies in the lecture-room, on condition that they came prepared to do so. In the reflections, the student teachers re-asserted the need to become independent and empowered to rely on themselves.

The final interviews revealed that, in the main, the student teachers recognised the usefulness of reading aloud to enable understanding, and indicated that they would do so in their future classrooms. They also recognised the importance of providing a good reading model in their own classrooms. According to their drawings and explanations (where they were asked to represent an ideal teacher of English), they indicated that a teacher of English 'loved reading'; was 'able to make learners enthusiastic about reading'; 'engaged with learners if they had problems with reading'; 'surrounded learners with books'; and 'loved inspiring generations to pick up books'. Thus, the student teachers recognised the importance of a reading culture.

The final finding, of relevance to this article, indicated the student teachers' reliance on visual media, which played a significant role in their lives. They indicated that they read and wrote text-messages, emails and social messages (most indicated that Facebook was their social media of choice), and that they accessed information and messages on their cellphones, not via a computer. In addition, they were comfortable taking photographs or videos with their cellphones. As the researcher, I had to consider how to achieve the aims of the study while being responsive to who the student teachers were and what they brought to the lecture-room.

We decided to use aural and visual media such as music, digital video disks (DVDs), pictures, and film clips in the lectures. I also asked them to keep their cellphones on and access information from the internet (about the texts, authors and/or pedagogical strategies) when needed. In addition, all student-notes or messages were sent electronically to them, thus working with a medium with which they were comfortable.

Before cycle three, I made a DVD using still pictures and music of the 1950s to understand the era and events depicted in *Sophiatown* and the interviews revealed that the student teachers believed that the DVD enabled understanding. I also showed them how to make a DVD using still pictures and music. They were introduced to simple computer software, available on most computers, to make their DVDs. They could thus make their own resources and play it off a laptop or a DVD machine and television when in their own classrooms. In cycle four, I played a DVD, using moving images and music of Kerala, which forms the setting of the novel, *The God of Small Things*. As in cycle three, the student teachers were shown how to make their own DVDs using moving images and music. The change from cycle three to four was vast with most of the student teachers, having experimented with the computer software, being very familiar with the technology and who then taught me and their peers many important techniques, including animation. They had assumed agency and, in many respects, served as experts who could share their knowledge.

After cycle four, the student teachers went on Teaching Practice in schools. On returning, a student teacher explained that he made a one-minute DVD of the poem he taught. He noted,

> I read the poem out, used simple images from the Net and added music. The learners were like ... wow. They wanted to know how I did it and I showed them some techniques. My mentor asked me to teach her, but she couldn't get it. I don't think she wanted to.

While the comments seemed to indicate that the mentor-teacher did not want to learn and change her practices, it is important that the learners and the student teacher recognised the effectiveness of using visual media as a teaching and learning tool.

Despite their comfort with visual media, the student teachers noted that they were not comfortable with studying or teaching a film. Prior to

studying the film, *The Colour of Paradise* in cycle two, a questionnaire, given to the student teachers to ascertain their film histories, revealed that while they enjoyed watching films, a majority (79%) were not taught how to analyse a film in school.

Despite indicating a reliance on their cellphones, when asked if there was anything they did not like when watching films, the most repeated answer was people talking on their cellphones during a film. When the film *The Colour of Paradise* was screened, they all agreed to turn off their cellphones.

By the end of cycle two, the group still appeared unsure of how to read a film. The focus-group helped to understand the finding. A student teacher noted, 'I know this film and can read and analyse it. What happens with another film? Can I do it? Can I apply the rules?' Her lack of confidence in applying her knowledge to other contexts and films was evident. She also believed there were certain 'rules' that needed to be applied. In retrospect, perhaps more needed to be done by me to scaffold their understanding of films.

When the film, *Much Ado about Nothing* was taught in cycle four, I assumed that because film study was undertaken in cycle two, the student teachers would remember everything done then. I failed to revise work done previously and they therefore still found film analysis difficult. In the reflections, the student teachers were asked how the film could be more successfully taught, and they noted that they needed constant reminders of definitions of terms and concepts. I recognised that I had not adequately engaged with their understandings and had wrongly assumed that their comfort with visual media equated to being visually literate. This recognition proved to be an important learning lesson during our reflections.

Conclusion

Reflections on this study emphasised to me the importance of acknowledging and responding to student teachers' capital and ways of being as starting points into my lectures. I understood that a nurturing environment may enable empowerment and transformation while, at the same time, challenging ideas and beliefs. The study demonstrated that the teaching and learning experience has to affirm and build on the various contexts that shape student teachers' lives.

By using active engagement, dialogue and learning through inclu-

sion, the study enabled the student teachers to ask questions and challenge assumptions. Thus, the student teachers were provided with opportunities to develop agency, voice and democratic participation while they constructed meaning together. They also recognised the value of regular critical reflection, which enabled them to acknowledge and understand the contradictions and confusions in their own lives, and had to learn that they needed to make choices about how to act.

Students also recognised the importance of grappling with and practicing a reading culture in order to succeed in higher education. They understood their agency in their success or failure and most of them made the important decision to assume agency for their success. In addition, visual media, they realised, could play more than a social role and could serve as an asset in the classroom.

By the end of the study, all role-players in the study (the student teachers and the researcher) understood that transformation and empowerment are possible if the environment is conducive to maximising teaching and learning and if a responsive pedagogy that acknowledges and respects student teachers' capital and ways of being is foregrounded. Thus, the study developed an awareness in the student teachers that they could take into their classrooms. Whether they choose to do so, is not known.

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Responsive and Innovative Pedagogies: Exploring Postgraduate Students' Insights into the Use of Technology in Mathematics Teaching

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Abstract

Exploring the use of responsive and innovative pedagogies is central in sustaining and improving teacher development at higher education institutions. As lifelong scholars, teachers are invested in preparing and developing a new generation of democratic citizens. To attain this goal, teachers should be aware of emerging trends in education, innovative teaching strategies and responsive teaching tools and resources. This qualitative study, which was located at one university in KwaZulu-Natal, South Africa, explored postgraduate students' insights into the use of technology in mathematics teaching. The study was framed using Shulman's teacher knowledge model, focusing on teachers' pedagogic content knowledge. During the 2012 and 2013 academic years qualitative data were collected from 22 postgraduate mathematics students via interactive workshops, a discussion session focussing on learnings from the workshops, a questionnaire and semi-structured interview schedules. Thematic coding and interpretive techniques were used to analyse the data. The findings of this study provide a glimpse of what is valued in mathematics classrooms; therefore they are important for advancing mathematics curriculum development. They may also be useful to mathematics teacher educators at higher education institutions. Moreover, in view of the role played by technology and mathematics in everyday life, these findings are clearly relevant.

Keywords: insights, instructional tools, mathematics, postgraduate students, technology

Introduction

Mathematics plays a key role in influencing how individuals deal with various domains of life (Anthony & Walshaw 2009:147). Mathematics today has a considerable impact on science and society (Aguele & Usman 2007:293): it underpins social development and the global economy at every level; its language is universal and it plays a significant role in one's personal and work life (Vorderman, Porkess, Budd, Dunne & Rahman-Hart 2011:19). However, currently there is global concern about the poor performance of learners in mathematics (Siyepu 2013:1; White Paper 2011a:10). The significant role that mathematics plays in every career path implies that a decline in learners' mathematics results will affect every domain of a country's economy (Raghunathan 2003:290); therefore, mathematics is seen as a gatekeeper for many career paths. The level of proficiency in mathematics has a direct bearing on the economy of a country since the economic wellbeing of any country is reliant on the abilities and knowledge of its workforce (White Paper 2011b:13).

The teaching and learning of mathematics has been a contentious issue throughout the world. Mathematics teachers are constantly looking for innovative and stimulating instructional tools to encourage and sustain learners' attention in mathematics classrooms with the aim of improving mathematics pass rates. One innovative instructional tool is the use of technology in the mathematics classroom since we live in a society which thrives on technology as the foundation of our existence. Not too long ago learners were reprimanded for bringing cell phones to school; however, now schools encourage the use of hand-held devices such as cell phones if it adds value to the learning process in the classroom.

Thus, technological advancements have made their way into the classroom and the use of technology in teaching is regarded as a responsive and innovative pedagogical tool. Shallcross and Harrison (2007:78) point out that the use of technology has increased immensely in education environments. Hence, the study on which this article is based sought to answer the following research question: What are mathematics postgraduate

students' insights into the use of technology in mathematics teaching? 'Insights' in this study referred to the postgraduate students' understanding of the use of technology in the mathematics classroom and its relationship to promoting the effective teaching and learning of mathematics.

Postgraduate Students

The postgraduate students participating in this study were in-service teachers who were registered for a master's or doctoral degree in mathematics education. All the participating postgraduate students were teachers of mathematics at primary or secondary school level; hence, they are referred to as in-service teachers. Postgraduate students are an important part of any university's vibrant and active research culture. The PhD (Doctor of Philosophy) degree in mathematics education is a research-oriented degree which does not require coursework. This degree concludes in the presentation of a thesis or a dissertation. The thesis involves making an original contribution to knowledge in mathematics education. In addition, some universities require the candidate to defend their dissertation orally.

The PhD students at the participating university are expected to attend PhD cohort seminars which are held six times a year over six weekends. During these seminars the students are assisted with all stages and phases (from the proposal development and data gathering up to and including data analysis) of their PhD thesis. The PhD students are expected to present aspects of their thesis to their peers and facilitators at each of the six seminars. After the presentations, students receive feedback pertaining to their presentations. The feedback is aimed at assisting students with conceptualising and clarifying aspects of their thesis. All theses or dissertations at this university are undertaken in collaboration with a member of the academic staff called the supervisor. Some students may also have the assistance of a co-supervisor.

Typically, the Master's in Education (MEd) degree requires postgraduate students to construct a thesis in mathematics education. The thesis ought to foreground and demonstrate the student's ability to undertake research and should involve an original investigation. An MEd student can select to do a full thesis or a thesis with coursework. At the university at which this research was conducted, students who are enrolled for a full MEd

thesis are encouraged to attend the generic research methodologies and discourses module offered during the first semester of the first year of registration. Apart from this generic research module, the coursework MEd in mathematics education students at this university attend lectures that focus on various issues and trends in mathematics education. One such module focusses on innovative teaching strategies in mathematics education.

Technology in Teaching

It is evident that many factors influence or effect learners' learning (Morony 2009:262); however, learners gain much of their learning and thinking skills from classroom instruction (Cai, Perry, Wong & Wang 2009:1). The classroom milieu is neither fixed nor linear (Anthony & Walshaw 2009:149) since learners are diverse in their backgrounds, needs and aptitudes. Additionally, the knowledge of learners within a classroom can differ widely and gaps in knowledge are distinctive to different learners (White Paper 2011b:6). Moreover, learners today are bombarded with technological information in their daily life; hence, the traditional classroom environment is not suitable for learners in today's society (Yelland 2001:8).

Research has indicated that there are important benefits of using technology in teaching and learning (DelliCarpini 2012:14); thus, information and communication technology (ICT) has become an important tool in educational contexts (Bingimlas 2009:235). The use of ICT in classrooms creates many opportunities for learners to work within a global technological platform. Schools ought to keep up with the technological evolution of daily living since the use of technology in teaching demonstrates encouraging consequences for learners (Niess 2005:150, White Paper 2011b:6). However, despite claims that technology is important in teaching and learning, the use of technology within teaching is still limited (Putnam & Borko 2000:10).

Teachers can now search different internet websites and find various video clips and lesson plans to foster excitement and interest within the learning environment. By using technology in teaching it is possible to create an interesting and stimulating learning environment that seeks to accommodate the different learning styles and different learning abilities of today's learners. The appropriate use of technology in teaching has the

potential to transform teaching and learning in schools and higher education (Putnam & Borko 2000:10).

Additionally, technology assists in improving communication, cooperation and learner competence within the teaching environment (DelliCarpini 2012:15, Franz & Hopper 2007:1). Moreover, the use of ICT in teaching may enhance learner achievements and teacher learning (Kadijevich, Kokol-Voljc & Lavicza 2008:5; Mistretta 2005:18). Likewise, the use of ICT in teaching increases the teaching and learning resources that are available to both the teacher and the learner. Technology ought to be integrated into teaching so as to ensure that learners also improve their electronic literacy skills (DelliCarpini 2012:14). Thus, the use of ICT in teaching may be regarded as a responsive and innovative tool in the classroom for both the learner and the teacher.

Teachers and Technology

Teachers are important assets for developing learners' mathematical identities (Anthony & Walshaw 2009:150). To be successful in the classroom, teachers need to be knowledgeable in both their content knowledge and pedagogic knowledge of the subject being taught. Teachers are also required to know how to teach the relevant content effectively. This is referred to as pedagogic content knowledge (Shulman 1987:8). In addition, to use ICT in teaching, teachers are required to be confident and competent in their use of ICT (Anthony & Walshaw 2009:157; Franz & Hopper 2007:6; Mistretta 2005:19; Niess 2005:510). Teachers are required to make intelligent decisions about how technology is integrated effectively within their teaching. Furthermore, teachers are required to assist learners in choosing the correct technological tools and to advise them on the correct techniques to use when working with the selected technological tools (Forster 2006:146). Thus, teachers are required to possess technological pedagogic content knowledge (Niess 2005:510).

Nevertheless, research (Lin 2008:135) has revealed that teachers are not confident or competent in the use of ICT in their teaching. Some teachers fear changes in the work environment while others lack the training, technical support and knowledge of how to use technology effectively in their teaching (Bingimlas 2009:238). Additionally, research has indicated that both learners

and teachers have suggested that some barriers to the use of technology in teaching could be related to teacher knowledge and skills (Bingimlas 2009:237-238; DelliCarpini 2012:18). Still, to transform education, teachers ought to become the agents of change (Ertmer & Ottenbreit-Leftwich 2010:267). Schools, communities and government ought to ensure that their teachers are sufficiently skilful and prepared to provide learners with superior learning opportunities (Anthony & Walshaw 2009:159; Mistretta 2005:23). Teachers ought to make a concerted effort in improving both their pedagogic content knowledge (Shulman 1987:8) and their technological pedagogical content knowledge (Bingimlas 2009:240) in order to effectively integrate technology within their classrooms.

Mathematics Teaching with Technology

With socio-economic and cultural multiplicity in schools today, teaching effectively to accommodate these different levels of ability, background and learning styles is a considerable feat for any teacher. Effective teachers draw on a range of resources to support the development of mathematics concepts within the classroom (Anthony & Walshaw 2009:156). Instant precise computations, construction of graphs and symbolic processing using technology has shown to be beneficial in the teaching and learning of mathematics topics and concepts (Forster 2006:148). Generally, teachers recognise technology in their teaching as an important tool for effective mathematics instruction (Franz & Hopper 2007:1; Mistretta 2005:23). In mathematics classrooms, technology influences the mathematics being taught and supports the mathematics learning of learners when integrated appropriately within the classroom (Centre for Technology in Learning 2007:1-2; Li & Edmonds 2005:143; Lin 2008:140-141).

Furthermore, the use of technology has had a far-reaching effect in areas of school mathematics (Anthony & Walshaw 2009:157). For example, by using technology to monitor learners' strengths and weaknesses while solving different types of problems, teachers may encourage success in the classroom. The use of technology in teaching creates new ways of teaching and understanding abstract concepts in addition to addressing multiple learning needs (White Paper 2011b:6). Technology in mathematics teaching creates a stimulating and collaborative learning process which engages

learners in the material being taught (Anthony & Walshaw 2009:157; Loch & Donovan 2006:1). Through the use of calculators, computers and dynamic software, learners can study complex abstract mathematics concepts (Franz & Hopper 2007:1). Additionally, the use of technology within mathematics classrooms, when integrated suitably with teaching methods, policy documents and assessments, has proved to support learning and has demonstrated an improvement in learners' mathematics achievement (Centre for Technology in Learning 2007:1-2; Lin 2008:135).

Methodology

The Participants

This qualitative study was located within an interpretive paradigm to explore postgraduate students' insights into the use of technology in the teaching of mathematics. The population for the study were master's and doctoral mathematics education students registered in the 2012 and 2013 academic years. Student participation was invited from master's and doctoral mathematics education students based at two different campuses within one university. All participants were in-service teachers at primary or secondary school level. Both groups of students were provided with an informed consent form that gave a detailed description of what would be expected of the participants during the data collection phase.

A total of 30 postgraduate students were invited to participate in the study. Of the 30 postgraduate students who were invited to participate, 22 responded positively. A random sample of five postgraduate students was selected for a pilot study. Data were collected through the use of interactive workshops, a discussion session, a questionnaire and semi-structured interview schedules. After minor adjustments were made to the questionnaire, each of the 17 participants in the main study was asked to complete the questionnaire.

The Research Process and Tools

Workshops

Three workshops were held in 2012 with 22 postgraduate students registered for a master's or doctoral degree in mathematics education. These workshops

were held on three Saturdays during semester 1 and semester 2 of the 2012 academic year. The workshops were titled as follows:

1. Trends in the teaching of mathematics at institutes of higher education
2. Improving practice: exploring innovative teaching approaches
3. Teaching tools and resources: using technology effectively in mathematics teaching

Each workshop lasted three hours. The workshops were facilitated by three master teachers. The master teachers in this study were expert teachers as identified by the KwaZulu-Natal department of basic education. Master teachers are experienced teachers with the potential to mentor new teachers. At the workshops, postgraduate students were provided with teaching notes, sample lesson plans, sample assessments and demonstrations of how innovative teaching approaches, teaching tools and resources could be used effectively in mathematics teaching.

The third workshop was followed by a discussion session involving the three master teachers and the 22 participating postgraduate students. During this discussion session participants voiced their views of the three workshops and how learnings from these workshops could be translated into improving their own practice as mathematics teachers. At the end of the discussion session the participants were made aware that they would be invited to complete a questionnaire in the second semester of 2013. This meant that they would each have the opportunity of reflecting on what they had learned from the three workshops with a view of improving their own practice at their schools during the first two teaching terms in 2013. The questionnaire was designed to gauge important insights into what was happening in each postgraduate student's classroom after the students were exposed to innovative teaching approaches, teaching tools and resources in mathematics education.

The Questionnaire

The questionnaire was piloted with five randomly selected participants. These five randomly selected postgraduate students had participated in the interactive workshops in the 2012 academic year. After the reliability and

validity of the questionnaire was established, the questionnaire was distributed to the remaining 17 participants for the main study. The distribution of the questionnaires took place during the second semester of the 2013 academic year. The questionnaire consisted of three sections. The first two sections focused on the profile and the infrastructure of the schools at which each postgraduate student taught. This approach was considered important so as to identify common attributes between the schools and to make it possible to analyse the context and social background of each school.

The third section of the questionnaire focussed on the postgraduate student's profile. Here it was important to analyse the experience and exposure each postgraduate student had with using technology to teach in the classroom. The data collected revealed that the participants used different types of technologic resources in the mathematics classrooms at various levels of instruction. This section also provided important data regarding each postgraduate student's training and qualifications with respect to using technology in the classroom. In this section the professional development each of the participants had undergone and the professional bodies of which they were members were also examined. This could provide valuable information for re-envisioning the curriculum for teacher development and preparation at higher education institutions.

The Semi-structured Interview

Each participant was interviewed after individual questionnaires were analysed. The interviews were audiotaped (with each participant's permission) and then transcribed. The purpose of the interview was to probe responses to items on the questionnaire and to gain more clarity on each postgraduate student's insight on the use of technology in the teaching of mathematics. Each interview lasted between 30 and 45 minutes. The interviews were conducted at a venue and time that was suitable to each participant. All interviews took place after teaching hours or on weekends. Each interview began with a few general questions so as to place the participant at ease, and then progressed to specific questions based on individual responses on the questionnaire.

Ethical issues

Gatekeeper access was obtained from the university research office and the

Dean of the School of Education. Each postgraduate student that registered for a master's or doctoral degree in mathematics education in 2012 was provided with an information sheet detailing the purpose and process of the study. The participants were informed that each interview would be audio–recorded and they subsequently gave permission for the interviews to be audio–recorded. Each participant was informed in writing of their right to withdraw from the study. They were also informed that they would be invited to a discussion session on the dissemination of results at the end of the study.

Theoretical Framing

Pedagogic content knowledge in mathematics requires the merging of mathematics content and pedagogy. Within the ambits of mathematics pedagogic content knowledge, this study examined postgraduate students' insights into the use of technology in mathematics teaching. Shulman (1987:8-9) used seven categories to categorise the different kinds of professional knowledge that an effective teacher ought to possess (Van der Sandt & Nieuwoudt 2003:199). Aspects of these categories (Shulman 1987:8-9) were used to frame this article. The categories are the following (adapted from Ball, Thames & Phelps 2008:391):

- General pedagogical knowledge
- Knowledge of learners and their characteristics
- Knowledge of educational and social contexts
- Knowledge of educational purposes and their philosophical and historical grounds
- Content knowledge
- Curriculum knowledge
- Pedagogical content knowledge, the combination of content and pedagogy that is unique to teachers

.

The postgraduate students in the study knew their learners and used this knowledge to reflect on and adapt their lessons to ensure maximum benefit of the learning process for their learners. In order for the postgraduate students to succeed at this undertaking, they needed to have a good knowledge of the content being taught and they needed to know how to teach this content

(pedagogic content knowledge) in order for the effective teaching and learning of mathematics to ensue.

It was evident from the interviews and discussion session that the postgraduate students in this study possessed mathematical pedagogical content knowledge which enabled them to convert their own mathematics content knowledge into a form that was comprehensible to their learners; in addition, they were skilled at effectively using resources available to them to support them in explaining mathematical concepts successfully (Bukova-Güzel, Cantürk-Günhan, Kula, Özgür & Nüket Elçí 2013:1; Piccolo 2008:88).

The postgraduate students in the study also demonstrated that they knew what their learners were interested in and how to maintain this interest. Through their knowledge of their learners, the postgraduate students inspired learner collaboration and engagement within the classroom environment. Although many participants (58%) were not formally trained in the integration of technology within the mathematics classroom, the participants in general exhibited sound technological and pedagogical content knowledge.

Coding of the Data

Twenty two postgraduate students attended the three interactive workshops. Five of the 22 participants participated in the pilot study. However, owing to work, study or family commitments only 12 of the 17 participants in the main study completed and handed in the questionnaire. These 12 participants were interviewed using a semi-structured interview schedule. All interviews were audiotaped and transcribed. Three phases of coding were used to analyse the data collected. The first phase involved open coding in order to reveal unanticipated insights from postgraduate students focusing on the use of technology in the mathematics classroom. Next, all data were re-examined using a list of anticipated codes and themes focusing on postgraduate students' insights into the use of technology in the mathematics classroom, and common themes were identified. Finally, the similarities and differences between postgraduate students' responses were compared.

The majority (75%) of the participants used technology for the effective teaching of mathematics in their classrooms. The participants that

did not use technology in their teaching (25%) attributed this state of affairs to the lack of facilities and resources at their schools. The participants (PGS 2[1], PGS 8 and PGS 10) indicated that the absence of resources and facilities did not allow them the freedom of choosing to use technology in the classroom.

Findings and Interpretation of Results

An initial interpretation of the data revealed that the majority of participants were using technology in the mathematics classroom. A detailed discussion follows below.

The Workshops

The workshops proved to be both productive and enlightening for the participants. The postgraduate students were inspired and motivated by the workshops and they felt that the workshops were useful in enhancing their pedagogic content knowledge. This feeling was evident from the postgraduate students were asked about their views pertaining to the workshops during the course of the semi-structured interview. The excerpt that follows is a snippet from one postgraduate student's (PGS 1) interview transcripts:

> PGS 1: The workshop has made me re-think … how I teach mathematics in my school … now I am in the process of putting a number of ideas into action ... I have a better understanding of how to integrate technology while teaching algebra ….

[1] Codes were assigned to each participant to ensure anonymity of the participants. Each participant was assigned a number from 1-12 based on the sequence of their interviews. PGS 2: Postgraduate student 2 was the second of the 12 postgraduate students that were interviewed. PGS 8: Postgraduate student 8 was the eighth of the 12 postgraduate students that were interviewed.

The quote provided above demonstrates that on reflecting about what had transpired during the workshop, the postgraduate student was inspired to reflect on how he/she was currently teaching mathematical concepts in the classroom. The postgraduate student was introduced to new ways of teaching mathematics concepts; thus, based on the student's response, his/her pedagogic content knowledge was improved due to an enhanced understanding of how technology may be effectively integrated when teaching mathematics. The postgraduate student's improved pedagogic content knowledge was an indication that a transition from the role of the postgraduate student to that of a mathematics teacher (Piccolo 2008:89) had ensued.

Comments by other participants indicated that they found each workshop beneficial in their development as mathematics teachers. This is evident from the comments that follow:

> PGS 6: … for me, the best of the workshops were some of the discussions that took place around some of the topics ... it was helpful to know what others are doing in their mathematics classrooms ....

> PGS 2: … thanks to all in the class for sharing and letting me learn from each one of them ….

The quotes provided above illustrate that the workshops were valuable: the postgraduate students were exposed to new approaches and innovative ideas and strategies, and they were encouraged to discuss openly what they were doing in their own classrooms. They were allowed to share and socially construct ideas and meaning (Naidoo 2006:94-95) during the workshops.

Furthermore, the participants were excited about what they had learnt from the workshops and they were eagerly planning their future lessons with this new-found pedagogic knowledge as is evident from the extracts that follow:

> PGS 7: … I am going to use what I learnt in my classroom ….

> PGS 8: … the best part of the workshops was learning about the resources available … I also valued the input from other teachers in similar schools to mine … I had the opportunity to hear from others about what was happening in different schools ....
> PGS 8: … I want to find out if my pupils[2] are a little more focused than when I use traditional methods to teach. I think it's time for a change …
>
> PGS 12: … I now have access to lots of material … I now have many ideas … for my own teaching ….

It was evident from the excerpts above that the participants valued the knowledge gained from knowing about the different resources that were available to them as mathematics teachers. It would seem that they appreciated having discussions around what was happening at other schools so that they did not feel isolated (Gaikwad & Brantley 1992:14-15). There was a thirst for knowledge about what was happening in other schools and other teaching contexts. The workshops assisted the participants in gaining additional insights into how to improve their own teaching (Palmer 1993:6).

The Questionnaire

Important information was collected using the questionnaire. From the analysis of the questionnaire it was established that each of the participants taught at schools with the average teacher learner ratio of 1:35. All participants had been teaching between 5 and 30 years. The participants were between 25 and 55 years of age. The data collected demonstrated that all the participants belonged to a professional development body and that all of them had access to computers at their school. A minority of the participants (42%) participated in previous workshops focussing on the use of technology in the mathematics classroom. These workshops were part of their professional development training provided by each of the professional bodies of which they were members. A small percentage of the participants (25%) indicated that their school did not have access to technology to support the teaching and learning of mathematics. Some participants (25%) indicated that they

[2] Another term used for learners in a classroom.

were informally trained by colleagues in the use of technology-based tools for the mathematics classroom.

The Semi-structured Interview Schedule

This research instrument was used to probe responses obtained on the questionnaire. The workshops were also discussed during the interview. The responses to the interview assisted in answering the research question: What are mathematics postgraduate students' insights into the use of technology in mathematics teaching? The insights gleaned from the postgraduate students were organised into four themes as follows.

Technology is Being Used because it is Available and Easy to Use

Technology ought to enhance the learning of mathematics. There is no value in having access to technology and using technology at an elementary level in the classroom; it is important to use technology to ensure that it adds understanding and value to the learning process. Some of the postgraduate students indicated that they used technology in the classroom. However, on probing their use of technology it became evident that a small percentage (25%) of the participants sometimes used technology 'marginally'.

Technology in these instances was used at a very fundamental level and did not add real value to the lesson. In these cases, the use of technology in the classroom had no real impact on the learning process. It would appear that in these cases technology was used because it was easier than using the chalkboard. These comments are substantiated by the following excerpts from the interviews:

> PGS 1: … I use the OHP because it's in my class ….
>
> PGS 4: … yes, I use the data projector to teach my lessons … I don't have to write on the board ….
>
> PGS 7: … I show learners geometry examples on the computer … it's easier than drawing over and over on the board ….

As can be seen, a minority of the postgraduate students (25%) used technology at a marginal level because technology-based tools were available to them. It would appear that in these instances no real thought was given to the value that would be imparted to the learners through the use of the technology-based tool. It was evident from these examples that the postgraduate students used the technology without having a real purpose to ensure the effective teaching and learning of mathematics concepts.

While technology-based tools were used in the mathematics lessons, one must concede that the purpose of using technology in the classroom is to enhance communication, provide access to resources, and guide learners to analyse, visualise or express ideas. Yet, in these instances this was not the case. Rather, the technology-based tools were used as an 'add-on' or at a very rudimentary level, thus it would seem that no real educational goals or milestones were achieved through the use of the technology-based tools in these instances.

Allows the Teacher to Teach the Same Content in New Ways

A significant percentage (58%) of the participants valued the use of technology in the classroom because the use of technology-based tools allowed them to teach the same content in new and interesting ways. The majority of these participants used technology-based tools to teach graphs and proofs in mathematics. The participants commonly believed that technology adds more value to the lesson because the learners, through the use of computer software, were now seeing the evidence of the shifts in graphs and proofs. These comments are substantiated by the excerpts that follow.

> PGS 3: … demonstrates proofs/theorems through dynamic software … instead of just talking about it … we can see the proof ….
>
> PGS 5: … when displaying graphs especially in shift … to show intersection etc. ….
>
> PGS 7: … activity based on dynamic representation because it requires hands-on work from learner ….

> PGS 9: … I use sketchpad … … The workshops provided me with ways to use the data projector in my teaching … as well as how to use it for assessment and what to look for ….
>
> PGS 12: … I have no formal training in technology; I learnt to use the smart board from a colleague. I use this as another method when teaching shifts in trig graphs ....

In addition to teaching shifts in graphs and proofs in mathematics, the participants also used technology to demonstrate concepts that learners had not seen or been exposed to previously, as is evident in the comments that follow.

> PGS 4: … I use games and video clips to teach maths …,
>
> PGS 6: … some learners did not know what a prism was … I showed this in 3D on the smart board ….

It was evident from the comments above that the postgraduate students were indeed agents of change (Ertmer & Ottenbreit-Leftwich 2010:267) since they were changing how their learners viewed and learned mathematics. These postgraduate students were exposing their learners to new ideas and innovative strategies to help make mathematics more interesting and fun. It addition, the learners could now see mathematics concepts that were once considered foreign and abstract. Being able to visualise and manipulate 3D objects is seen as an advantage for effective learning (Shallcross & Harrison 2007:76). Thus such activities do not only deepen learners' understanding of mathematics and its applications but also help make mathematical ideas and concepts more meaningful (Huang & Li 2009:171).

Allows for the Creation of New and Interesting Learning Experiences

Most of the postgraduate students (75%) valued the use of technology and were willing to use it in the classroom if it added value to their lessons. This claim is evident from the interview excerpts that follow.

> PGS 3: … lessons must capture the child's interest … I use transparencies to do this ….
> PGS 9: … use the internet for interesting approaches to the topics ….
> PGS 11: … lessons must be made interesting … the use of technology promotes this ….
>
> PGS 5: … my students will accept new technology as long as they value it … it must make a difference to their learning something ….

The comments above exemplify the belief that the use of technology in the classroom assists teachers in teaching mathematics effectively. Technology provides learners with interesting learning experiences (Klopfer, Osterweil, Groff & Haas 2006:9). These learning experiences must provide value to the learning process; they ought to be interactive and allow learners to explore concepts off-line for revision purposes (Shallcross & Harrison 2007:76).

Moreover, it was evident during the interviews that the workshops had an impact on the postgraduate students' pedagogic knowledge. The postgraduate students were introduced to innovative technology-based strategies that fostered a sense of excitement in them. This is apparent from the following excerpts taken from the interview transcripts.

> PGS 4: … I didn't have a good grasp on how to assess my students' knowledge by using these tools before the workshops ... I now see how I can incorporate technology in a meaningful way ….
>
> PGS 10: … now I am amazed at all that I have learned … and what I still have to learn, and what I need to do to use this new knowledge in my maths class ….
>
> PGS 12: … I am finding that many of the tools I am learning about can be adapted into my classroom in some way … I know it has inspired me to have more technology in my classroom just seeing what was done in the workshop ….

The above excerpts demonstrate that the postgraduate students were introduced to knowledge about technological tools that led to a shift in their pedagogic understanding. This correlates with Shulman's (1987:13) notion of

pedagogic content knowledge (PCK), according to which PCK ought to involve a shift in teacher understanding from being able to understand content for themselves to being able to clarify this content in new ways so that it can be grasped by the learner in the classroom (Tsamir & Tirosh 2009:22).

Challenges Affecting the Use of Technology in the Classroom

A major challenge associated with the use of technology in the classroom appeared to be the lack of resources and infrastructure at schools. The study revealed that a minority of the postgraduate students (25%) were based at schools which were poorly resourced. According to comments made by the participants during the interview, these challenges had an impact on their choice of instructional strategies they used in the mathematics classroom, as shown in the excerpts that follow:

> PGS 2: I want to use dynamic geometry software[3] to help my learners understand the movement of graphs, but our school does not have electricity … I am forced to just use the board.
>
> PGS 8: Even though I may like to show learners some aspects on Geogebra[4] or sketchpad I can't because there is no data projector … I know how to use a data projector to make mathematics more interesting and understandable but our school does not have a data projector ….
>
> PGS 12: … However, there are struggles … I am interested in using these tools in my teaching but our school does not have them ….

[3] Dynamic geometry software is used for teaching geometry in a discovery mode. Learners are encouraged to use computer software (such as Geometer's Sketchpad or Geogebra) to construct figures that can be altered by dragging points around the computer screen while the underlying relationships are unchanged.

[4] A type of dynamic geometry software that may be used for teaching geometry in the classroom.

The above excerpts provide evidence that the students are willing to attempt innovative technology-based strategies in the classroom but teaching in poorly resourced schools do not provide opportunities for this. The teacher is thus forced to use traditional methods such as the 'chalk and talk' method. Research (Shallcross & Harrison 2007:76) suggests that electronic presentations are more suitable for effective learning in that through this approach avoids learning issues associated with poor handwriting and legibility of material that are common in 'chalk and talk' methods. The excerpts also highlight that the postgraduate students want to embrace and integrate technology in the classroom and that they possess the necessary pedagogic content knowledge to do so, but their creativity in introducing technology-based instructional strategies in the classroom is affected by their being based in a poorly resourced school (Klopfer *et al*. 2006:7-9).

On analysing the data collected it was evident that while one postgraduate student (PGS 10) lamented the fact that he did not have access to a computer to support him when teaching mathematics, this challenge could have been overcome. Besides being the mathematics teacher at the school, the student was also the school principal. He had access to a computer (as the principal) but felt he did not have access to this computer as a mathematics teacher. This is evident in the interview excerpt that follows.

> PGS 10: … I would like to use a computer to help me teach in the class, but I don't have access to one … there is one computer in the school in the principal's office.

The excerpt above demonstrates that the postgraduate student referred to above (PGS 10) found it challenging to merge his two roles and identities at the school. The postgraduate student did not see his role as the principal as an intersection of his role as the mathematics teacher; thus, the professional identity of this postgraduate student was being challenged (Lopes & Tormenta 2010:53).

Conclusion

This qualitative, interpretive study sought to answer the following question: What are mathematics postgraduate students' insights into the use of

technology in mathematics teaching? It was apparent from the data collected that all participants valued the use of technology in mathematics teaching. The participants agreed that through participating in the interactive workshops that introduced and exposed them to trends in higher education, innovative teaching approaches and responsive teaching tools and resources, they were inspired to use technology meaningfully in their own practice. The participants felt that these interactive workshops ought to become part of the module on teaching in their mathematics method lectures at university level.
The participants were also of the view that dialogue around what was happening in other schools and in other mathematics classrooms ought to be encouraged. There was a positive response to hearing about what was happening in other mathematics classrooms. In discussions – both during and after the interactive workshop sessions – the postgraduate students welcomed the idea of sharing teaching strategies and effective teaching tips. It was evident during the discussions that the postgraduate students valued discussions with other teachers who taught in similar school contexts. The participants indicated that they had gained valuable pedagogic knowledge and new ideas from the interactive workshops and discussion sessions. This correlates strongly with Shallcross and Harrison's (2007:73) view that discussion methods are instrumental in improving intellectual learning.

Another insight acknowledged by the postgraduate students was that using technology in the mathematics classroom is more possible now than when they were learners at school. They felt that they were more comfortable with using these innovative tools after being introduced to them and being exposed to demonstrations on how the tools could be used to teach and assess learners. The postgraduate students indicated that they were looking forward to sharing these strategies with their learners.

An additional insight of the postgraduate students was that it is valuable to use technology-based tools in the mathematics classroom in teaching as well as assessing. During the workshops the master teachers demonstrated various technology-based assessment tools that learners may use in mathematics to assess their own learning at various stages at their own pace. This links well with Kaasila and Pehkonen's (2009:212) view that it is important to assess mathematics learners in various ways and that it is equally important for learners to assess and reflect on their own learning.

The participants also felt that the mathematics professional bodies of which they were members ought to include topics such as using technology in

the mathematics classroom as part of the scheduled workshops for teachers. Furthermore, they believed that teacher education conferences ought to foreground studies on using innovative methods in the classroom. Such presentations would provide valuable examples for teachers to learn from and emulate in their own classrooms. The postgraduate students felt that if practising teachers had more exposure to and knowledge of technology-based teaching strategies, the more likely they would be to implement these strategies in their classrooms.

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An Exploration of Regularities in Mathematics Education Pre-service Students' Responses to Variation in Number Sequences

Sarah Bansilal

Abstract

The study of number patterns is an essential part of learning mathematics; however, the shift required from noticing patterns to expressing the patterns symbolically may require sophisticated algebraic techniques. The study reported on in this article focused on a group of 57 pre-service mathematics students in order to explore their interpretations of the mathematical symbolism embedded in pattern descriptions as well as their proficiency in using this symbolism to generate descriptions of the patterns. Four tasks were designed in line with Mason's theory of variation which asserts that carefully structured variation within learning activities can be used to enhance learning. The results show that although students were able to produce correct responses to the more direct questions, some students could not handle the added dimensions of variation. The study identified different strategies used by the students to reduce the elements of variation. Many students were unable to generate terms of the sequence which contained repeating cycles, and also struggled to generate a description of the general term of such sequences. It is recommended that such types of sequences may require additional scaffolding especially with respect to the use of the modulo *n* function.

Keywords: mathematics education, patterns, dimensions of variation, sequences, modulo *n*, pre-service teachers

Introduction

Noticing generalisation and then attempting to describe these regularities lies at the heart of much of mathematics. In fact, Devlin (1997) has described mathematics as the study of patterns real or imagined, visual or mental, arising from the natural world or from within the human mind.

Experimenting with number patterns constitutes an important resource activity in developing mathematical reasoning. Asking different questions about the patterns enables the student to work at different levels of mathematical thinking. It can also provide learners with the opportunity to engage with mathematical thinking in the sense that the processes we engage with when we study patterns is a reflection of what mathematicians do when they study mathematics. The process of observing and describing patterns using mathematical notation is therefore a fundamental experience in learning mathematics.

It is important for learners as well as mathematics teachers to experience these activities with various types of patterns. However, since the study of patterns was incorporated into the South African school curriculum (DoE 2003) much of the mathematical activity around patterns has been centred on the algorithms that can be used to generate descriptions for the number patterns; thus the study of patterns has largely been reduced to learning and applying these algorithms. For example, with patterns whose terms can be described by linear functions there are particular rules for finding the general term. By looking at the first difference of a sequence T_n, say, with a first difference of d, then the formula for the general term is given by $T_n = dn + T_0$. As with sequences which can be described using a quadratic formula, teachers have developed numerous 'short cuts' allowing learners to find the values of a, b and c in the general expression $T_n = an^2+bn+c$. Samson (2008) provides a synthesis of various strategies that are used to generalise number patterns that can be described using the quadratic formula.

Zazkis and Liljedahl (2002) comment likewise that the predominant pattern-related activity for learners at schools is extending number sequences and finding an algebraic expression for the general term; that is, given the position of the element in the sequence, the goal is to find the corresponding element. Many studies focused on patterns have discussed issues related to this type of problem (Samson 2007; 2008; 2011; Lannin 2005; Dindyal 2007; Mason, Burton & Stacey 1985). In this study, two of the tasks (1 and 2) are

also based on this type of problem, with one of them being based on a sequence of repeating cycles of length 3. A further two tasks (3 and 4) are of the type where the algebraic description of terms is provided and students are asked to generate some of the terms. The task of generating terms from a given description has not received much attention in the research literature perhaps because 'the ability to continue a pattern comes well before the ability to describe the general term' (Zazkis & Liljedahl 2002:388). Generating elements of a sequence when given a formula should be even simpler than continuing the pattern, because it involves substituting values into a formula and then computing the result, which could explain why there is limited literature on this area of generating terms from a given description. In this study, this basic task of generating terms of a sequence whose description is provided was raised in two different ways: first by using a sequence with repeating cycles and then by using a sequence whose terms were described recursively.

The purpose of this study which was carried out with a group of 57 pre-service mathematics students was to explore their interpretations of the mathematical symbolism embedded in the pattern descriptions as well as their proficiency in using this symbolism to generate descriptions of the patterns. The four tasks were designed in line with Mason's theory of variation (Scataglini-Belghitar & Mason 2011; Watson & Mason 2006) which asserts that carefully structured variation within learning activities can be used to enhance learning.

Literature Review

In their book, *Thinking Mathematically*, Mason, Burton and Stacey (1985) elaborated four processes which are central to mathematical thinking. These are specialising (turning to examples to learn about the question), generalising (moving from a few instances to making guesses about a wide class of cases), conjecturing (making a reasonable statement whose truth has not been established) and convincing (showing that the conjecture does hold). The authors used a variety of activities, many of which were investigations of patterns, to illustrate how these processes can be developed by asking pertinent questions. Since then many authors have used similar descriptions to capture some of the complexities of engaging with patterns. In his study of

high school learners who were engaged in pattern identification tasks, Dindyal (2007) identified four sequential stages through which successful strategies evolved. The first was the direct modelling stage where learners used strategies such as counting, drawing or systematically listing the first few cases, similar to Mason *et al*'s. (1985) process of specialising. The second stage was the pattern identification stage, which is similar to the generalising process described by Mason *et al*. (1985). Dindyal's third stage was the proof testing stage where students tested their emerging generalisation with further cases, and this can be related to the conjecturing stage of Mason *et al.* (1985). The fourth stage in Dindyal's sequence was the generalisation stage where the successful students find the actual rule which is, of course, the stage where one needs to formalise what one has found to convince others. Samson (2012:8) drew upon these ideas and described pattern generalisation as '[resting] on an ability to *grasp* a commonality from a few elements of a sequence, and awareness that this commonality is applicable to *all* the terms of the sequence, and finally being able to use it to articulate a direct *expression* for the general term'.

Both Samson (2011) and Dindyal have cited Lee (1996) who identified three types of conceptual obstacles in generalisation: (1) perceptual obstacles related to seeing the actual pattern; (2) verbalisation obstacles which involve expressing the pattern clearly; and (3) obstacles at the symbolisation, which involves using mathematical notation skilfully to express the pattern that is observed. In trying to describe some of the symbolisation challenges experienced by students, Arcavi (2005) introduced the notion of symbol sense as an essential and multifaceted way of working with symbols in algebra. He defined symbol sense as the 'ability to manipulate and also to 'read though' symbolic expressions as two complimentary aspects' (Arcavi 2005: 43). It also includes the ability to select one possible symbolic representation of a situation and if necessary to discard it in favour of a more suitable one. Arcavi concedes that using symbols as a productive tool to investigate relationships is not easily accomplished and requires focused interventions by the mathematics educator. In this study the focus was on the problems experienced by pre-service mathematics education students at the symbolisation level, both in expressing the pattern by manipulating symbolic expressions and being able to read through and interpret the algebraic symbolism used to describe patterns.

Dindayal (2007) noted that one of the issues related to symbolisation is that students 'often focus on inappropriate aspects of a number pattern' which may side-track them from arriving at an explicit and appropriate generalisation. Another factor that may affect the success of the symbolisation process is the strategy that students use to come up with the generalisation. Hershkowitz *et al*. (2002) observed that generalisations could be expressed in terms of the step-by-step recursive method or in terms of the independent variable. Samson (2011, 2012) focused on embodied processes that learners experience when they are engaged in pattern generalisation tasks embedded in specific situations modelled by linear sequences. He found that the articulation of an algebraic generalisation is complicated by tensions between local and global visualisation. A local visualisation is similar to the recursive step-by-step method described by Hershkowitz *et al*. (2002). Generating a formula in this case involves looking at how the pattern in the new stage has changed from the existing one, by adding or subtracting a structural unit into the existing term. A global visualisation is one that tracks the behaviour of the independent variable in the different cases of the pattern setting and expresses the generalisation in terms of this behaviour. However, local generalisations are not always easier than global generalisations. An example of this will be illustrated in this article, when the formula for a pattern is expressed recursively.

Zazkis and Liljedahl (2002) explored the attempts of a group of pre-service elementary teachers to generalise a repeating number pattern. The authors found that students' ability to express generality verbally was not accompanied by and did not depend on their use of algebraic notation. There was a gap between students' ability to express generality verbally and their proficiency in using algebraic notation. The authors concede that the difficulty was related to the task itself consisting of a pattern with repeating elements which did not 'lead to a 'smooth' algebraic notation, presented in one 'neat' formula that connects the element n to its location' (Zazkis & Liljedahl, 2002:399). Repeating patterns have a recognisable repeating cycle of elements, and this aspect was a focus of the study by Threlfall (1999). Threlfall advocated the varying of some attributes of elements while keeping other elements constant in order to add complexity to a repeating pattern. Although the numbers themselves did not repeat in the pattern investigated by Zazkis and Liljedahl (2002), applying the same transformation to each element produced an explicitly recognisable repeating cycle. It was the

position of the numbers that formed the repeating cycle of length 8, and the authors used the function modulo 8 as a tool to describe how the position of a number could be identified based on the output of the function (that is, the remainder of the division of the number by 8). It is believed that this study will extend the research in the area of symbolisation of patterns with repeating cycles.

Theoretical Framework

Being immersed in pattern-spotting and pattern-extension activities undoubtedly contributes to learning mathematics. However, Watson and Mason (2006) caution that 'learning does not take place solely though learners observing some patterns in their work' even if they have developed generalisations of the patterns. The authors comment that activities such as pattern-spotting, generalising and reproducing patterns are just the means by which people make sense of experiences and these activities need to be carefully planned and sequenced in order to facilitate meaningful learning. Watson and Mason (2006) contend that by being exposed to structured or structural experiences aimed at exposing underlying mathematical form, learners' ways of working can be shifted to higher levels. The authors identify mathematical variation as a scaffolding tool that can be used in mathematical activities to shift learners' thinking towards a more conceptual orientation. Watson and Mason (2006) focus on 'dimensions of possible variation' which refer to 'features, aspects and parameters that can be changed in an object whilst remaining an example of a concept.'

Watson and Mason have argued that by paying attention to variation in the design of tasks, a teacher can provide more structured opportunities for learning. As learners move from working with familiar and similar examples to not-quite-so-similar tasks, they are shifted to working on higher levels. Scataglini-Belghitar and Mason (2011) cite Marton and Booth (1997) who defined learning as 'extensions of dimensions of variation of which a learner is aware'. Watson and Mason (2006:97) support Martin and Booth's definition as a means for 'describing learning, for relating learning to mathematical structures as afforded to, and perceived by, learners'. Hence, the responses to structured variation provide a means of observing learning. For teachers the construction of tasks that use variation and change optimally

constitutes an ongoing 'design project' which requires constant revision and changes based on the observed learning (Watson & Mason 2006:100).

Herscovics (1989) defined the term 'epistemological obstacles' as obstacles that are encountered in the development of knowledge in a discipline. Learning is enhanced as a person finds ways of overcoming the difficulty posed at that point. Didactically speaking, teachers need to identify these epistemological obstacles so that they can better help the students to move forward. Sometimes it may be the case that the approach taken by the teacher may cause further conceptual difficulties for the students. Olivier (2013) refers to 'didactical obstacles' as difficulties experienced by students which may result from the teaching approach employed by the teacher.

In the study on which this article is based I focused on the epistemological obstacles caused by the contrived introduction of mathematical variation in the context of sequences in an effort to observe the regularities evident in the ways in which the students respond to these variations. As the instructor of the module in which this study was carried out, I hoped that the identification of these regularities would inform the refinement of the study materials so that the didactical obstacles can be reduced in future offerings of the module. Hence the study will contribute in general to pre-service mathematics teacher education pedagogy.

Methodology

The study utilised an interpretive approach because the main goal of this study was to understand the students' interpretations of reality (Cohen, Manion & Morrison 2011) with respect to algebraic problems set around sequences. The participants in the study were 57 students out of a class of 59 who were enrolled on a Real Analysis course for pre-service teachers where students study topics in set theory, topology of the real line, number theory, proof, and sequences and series. The unit on sequences and series was designed to extend the students' experiences of patterns and sequences beyond arithmetic, quadratic and geometric which they encounter at school. The unit consisted of many exploratory activities which involved continuing sequences, generating terms of sequences whose *n*th term was provided and providing formulae to describe the general terms of various types of sequences. A selection of the test items in the module was specially designed

both for assessment and research purposes and the four tasks were included in a larger module assessment. The analysis of the responses can be regarded as content analysis which 'simply defines the process of summarising and reporting written data and their messages' (Cohen *et al.* 2011:563). In this case the students' responses are the source of the communication intended to convey their engagement with the sequences. The analysis of students' responses to assessments or specially designed tasks for research purposes serves as a valuable resource for analysing academic activities. These data can be used to provide information about students' varying engagement with particular concepts; the competence of students in the area being assessed; the mathematical demands of the task, thus improving the conceptual understanding of the researchers doing the analysis; and possible sequencing of the teaching of particular concepts. Hence, in such studies, the work of teaching strengthens and is in turn strengthened by the work of research.

The data analysis process involved studying the responses of the 57 students with a view to understanding firstly the 'what', and then the 'why' and the 'how' underlying the data (Henning 2004). Dey (1993:30) describes data analysis as 'a process of resolving data into its constituent components to reveal its characteristic elements and structure'. In a similar manner the students' responses were broken down into constituent parts reflecting their reactions to those elements of variation identified in the problem setting. This was done in order to classify and make connections across the data elements (Henning 2004:128). The responses were coded, which means representing 'the operations by which data are broken down, conceptualised, and put together in new ways' (Strauss & Corbin 1998:120). Hence, each written response was analysed in terms of how the student reacted to the perceived dimensions of variation present in the tasks.

The research question guiding the study was: How do students respond to the dimensions of variation in tasks based on sequences?

One task required students to find a formula for the *n*th term of a sequence. The first task (Task 1) required students to generate terms given the formula of the general term. The demand of this basic task of generating terms of a sequence was then raised using two approaches. One way of raising the demand (Task 3) involved a sequence with repeating cycles, hence the position of the term was made dependent on output of the modulo 3 function. The challenge in this case seems to be that both the term and the position were now being varied. A second way in which the task of

generating terms of a sequence was made more complex was by providing the description in recursive terms, and Task 4 took on this dimension. The third task required students to find a formula for the *n*th term of a sequence with repeating cycles of length 3.

The responses to four tasks are analysed in this article. A detailed discussion follows in the next section.

Tasks

Before presenting the tasks, I first discuss the definition of a sequence that was used in the real analysis module.

> A *sequence* of real numbers (or a sequence in $\mathbb{R}$) is a function on the set $\mathbb{N}$, of natural numbers whose range is contained in the set $\mathbb{R}$ of real numbers. That is, (a_n) can be seen as a function f: $\mathbb{N} \rightarrow \mathbb{R}$.

The general way of writing a sequence is $a_1, a_2, a_3, a_4, \ldots\ldots a_n, \ldots\ldots$, so that for each element there is an element of the sequence, a_n. This means that a sequence must be an infinite (not finite) list of terms, though repetition is allowed. Such a sequence is denoted by (a_n) or (x_n) or X or $(x_n: n \in \mathbb{N})$. Note that x_n or a_n is the single number denoting a term of the sequence and is also denoted by T_n. The independent variable, *n*, marks the position of the term. For example, the fourth term means T_4 while the value of the fourth term refers to the actual value of T_4 or f(4). Sometimes students experience difficulties in distinguishing between the position *n* with the value $f(n)$ or T_n. For example, consider the sequence $T_n = f(n) = 9n + 4$. When asked: For which value of *n* is T_n equal to 40, say, some take *n* to be 40, and they find T_{40}, instead finding *n*, when $9n + 4 = 40$.

It is important to note that 'no finite sequence of numbers uniquely generates the next term' (Zazkis & Liljedahl 2002:384) and that a finite array of numbers may be extended in a variety of ways. Hence, the questions specified a possible formula for the general term and not 'the' general formula.

The details of the four tasks are now presented. In each case the salient elements of the task are discussed. The detailed interrogation of each task that is presented is necessary for the discussion of the results that follow.

Task 1

Write down the first four terms of the following sequences, and the tenth term $\frac{(-1)^n.n}{n+1}$	Solution: x_1=−½; x_2=²/3 ; x_3=−¾; x_4=$\frac{4}{5}$; $x_{10} = \frac{10}{11}$

The mathematical skill assessed in Task 1 was the ability to calculate the terms *f*(*n*) of the sequence, given the description *f*, and the value *n*.

Task 2

Find a formula for the *nth* term of these sequences: 1, 3, 4, 1, 3, 4, 1, 3, 4, 1,3,4, ……	**Solution** $x_n = \begin{pmatrix} 1 \ if \ n = 3m+1, \\ 3 \ if \ n = 3m+2 \\ 4 \ if \ n = 3m+3 \\ where \ m \in \mathbb{N}_0. \end{pmatrix}$

In this task, the demand for using a formula to describe the *n*th terms has been raised by making the sequence one that repeats in strings or cycles of three numbers. Hence there are three possible values taken on by terms in the sequence depending on the position of the term. The **modulo** (sometimes called **modulus**) operation which finds the remainder of division of one number by another, is used to address the issue of the repeating terms.

Given two positive numbers, *n* (the dividend) and *a* (the divisor), *n* **modulo** *a* (abbreviated as *n* mod *a*) is the remainder of the Euclidean division of *n* by *a*. For instance, the expression ‘5 mod 2’ would evaluate to 1 because 5 divided by 2 leaves a quotient of 2 and a remainder of 1, while ‘9 mod 3’ would evaluate to 0 because the division of 9 by 3 has a quotient of 3 and leaves a remainder of 0; there is nothing to subtract from 9 after multiplying 3 times 3. The operation of modulo 3 is one which can be used in this problem. The operation results in a partitioning of the set N into three subsets, corresponding to the elements which are evaluated to 0, 1 and 2 respectively by the operation *n* mod3. Note that

$$n \bmod 3 = 1 \;\; if \; n = 3m + 1,$$
$$n \bmod 3 = 2 \; if \;\; n = 3m + 2$$
$$n \bmod 3 = 0 \;\; if \; n = 3m + 3$$
$$where \; m \in \; \mathbb{N}_0.$$

For discussion purposes I will refer to the expressions $3m$+1, $3m$+2 and $3m$+3 as g_1, g_2 and g_3 respectively. Furthermore, I will refer to the subsets of $\mathbb{N}$ as G_1, G_2 and G_3, where $\mathbb{N} = G_1 \cup G_2 \cup G_3$ and

$G_1 = \{n \in \mathbb{N} \mid n \bmod 3=1\} = \{1; 4; 7; 10; \ldots.\}$.
$G_2 = \{ n \in \mathbb{N} \mid n \bmod 3=2\} = \{ 2; 5; 8; \ldots.\}$
and $G_3 = \{ n \in \mathbb{N} \mid n \bmod 3= 0\} = \{3; 6; 9; \ldots.\}$

Task 3

Find the first four terms and the tenth term for the following sequence. $x_n = \begin{pmatrix} 2n, \; when \; n = 3m + 1 \\ 2n - 2, when \; n = 3m + 2 \\ 2n - 2, \; when \; n = 3m + 3 \end{pmatrix}$	Solution. x_1=2; x_2=2; x_3=4; x_4=8; x_{10}=20

Here the function defining the sequence is made up of different rules for elements from each of the subsets G_1, G_2 and G_3. For the discussion, I will refer to the three functions that are applied on the subsets G_1, G_2 and G_3, as f_1, f_2 and f_3 where

$f_1: G_1 \rightarrow \mathbb{N}$ and $f_1(n) = 2n$ $\quad$ $f_2: G_2 \rightarrow \mathbb{N}$ and $f_2(n) = 2n$-2; $\quad$ $f_3: G_3 \rightarrow \mathbb{N}$ and $f_3(n) = 2n$-2

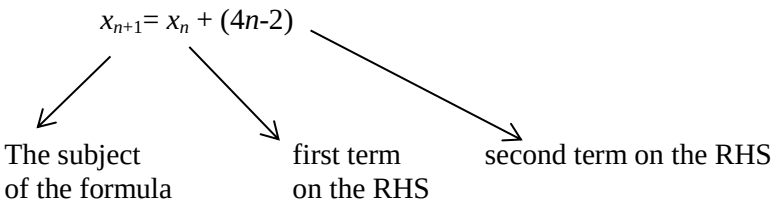
Hence the sequence can be represented as follows.

$$x_n = \begin{pmatrix} f_1(n) = 2n \text{ when } n \in G_1 \\ f_2(n) = 2n\text{-}2, \text{when } n \in G_2 \\ f_3(n) = 2n\text{-}2, \text{ when } n \in G_3 \end{pmatrix}$$

Task 4

Consider the sequence defined by x_1 = 8, and x_{n+1}= x_n + (4*n*-2). 1. Write down the first four terms of this sequence. 2. Find a formula to describe the *n*th term of this sequence.	Solution. x_1=8; x_2=10; x_3=16; x_4=26

The description of the general term given in Task 4 can be broken up into three parts:



Thus the formula or function is $f(n+1) = x_n+(4n-2)$. When n = 2 say, the term on the LHS takes on x_3, while the first term on the RHS is x_2 and the second term of the RHS is (4(2)-2). Although the value of n is being consistently substituted, the resulting expression consists of both $x_3$and x_2, which is a dimension of variation that seems to have created some sort of unease.

Results

The students' responses to the four tasks were first categorised as either correct or incomplete or incorrect. The incomplete and incorrect responses were then analysed for emerging themes through a general inductive analysis. The initial results for the four tasks are summarised in Table 1.

Table 1: Overall results for the four tasks

Task	Number correct	Number incorrect or incomplete
1	46	11
2	31	26
3	14	43
4	33	14

As suggested by the results in Table 1, students found Task 1 least difficult while Task 3 was most challenging. The details of the results for each task follow next.

Results for Task 1

For this task, most students (46) were able to substitute the five values of n and correctly calculate the first four and tenth terms. There were 10 students who did not specify the tenth term, but they correctly presented the first four terms. One student made a slip with the negative sign on one term. Thus it can be said that all the students were able to substitute various values into the given formula to generate terms.

Results for Task 2

There were 26 students who did not produce a correct response for Task 2. The key tool for Task 2 was the use of the mod 3 function. That is, they needed to identify that the terms of the sequence were appearing in cycles of three and therefore the mod 3 function could be used to help them describe the values of terms that appeared in certain positions. These students' responses indicate different degrees of struggle with using the mod 3 function as a tool.

Some students tried to generate a general formula that could describe all the terms, such as student 29, whose response appears in Figure 3

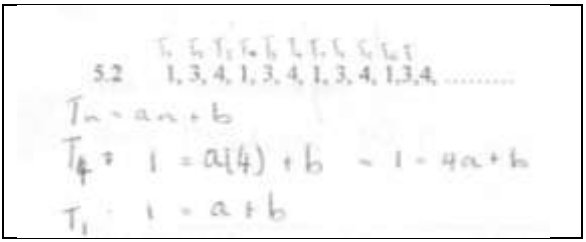
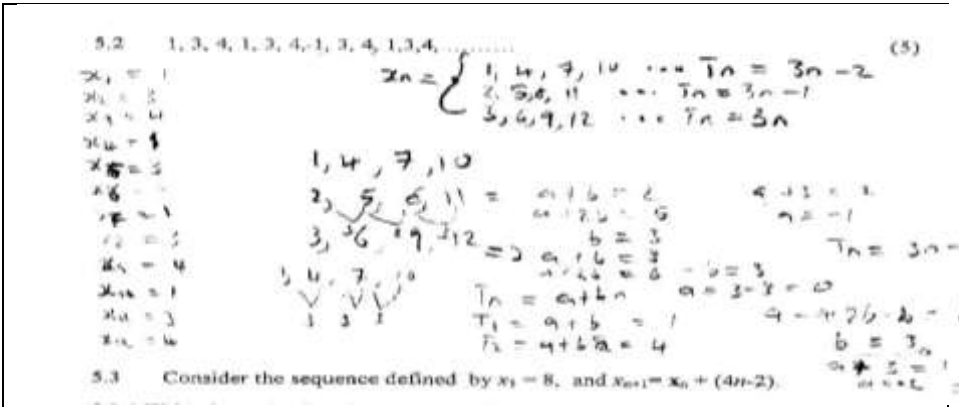


Figure 3: Response of student 29 to Task 2

Figure 3 shows that S29 tried to find one formula to represent all the terms. Perhaps this was an attempt to reduce the variation caused by the repetition of the terms cycles of three. However he did not succeed with this approach.

Other students did not ignore the fact that the terms were appearing in cycles of the three terms and recognised that the *n* mod 3 function could be used to address this issue. For example, 15 students listed the sets G_1, G_2 and G_3. The response from student 24 appears in Figure 4. The student provided a description of the elements which belonged to the three sets, as $T_n = 3n-2$, $T_n = 3n-1$, $T_n = 3n$.



Student 24

Figure 4: Response of S24 to Task 2

The responses in Figure 4 show that the students generated expressions to describe the elements of the sets G_1, G_2 and G_3. However, giving such a description is only a first step to the solution. A further step was to specify the values taken on by terms T_n where, *n* belongs to each of the Gi which these students did not get to, but presented the descriptions as formulae for the terms, T_n. The neglect of the second step indicates that the students did not distinguish between the position *n* and the value T_n of the terms.

Results for Task 3

There were only 14 students who produced the correct answers. I will now discuss some of the common trends behind those responses which were incorrect.

There were eight learners who listed the elements of G_1, G_2 and G_3, as shown in the response by student 7 in Figure 5.

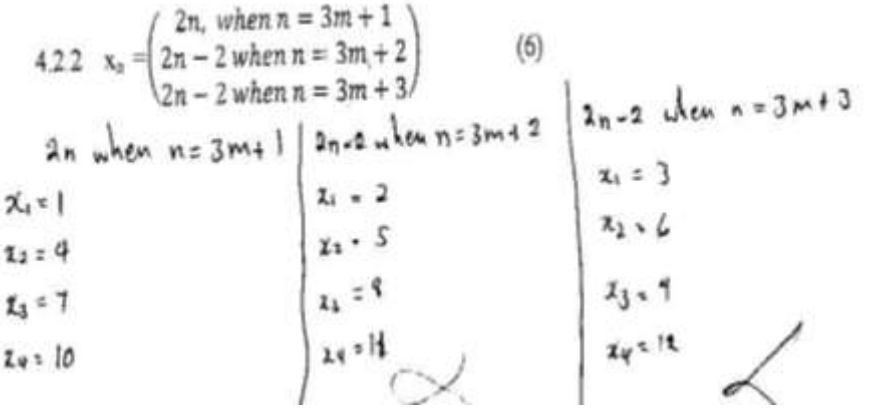


Figure 5: Student 7 response to Task 3

This student wrote the elements of the sets G_1, G_2 and G_3. The student transformed each of the expressions $3m+1$, $3m+2$ and $3m+3$ into functions g_1, g_2 and g_3 respectively where $g_1(m) = 3m+1$, $g_2(m) = 3m+2$ and $g_3(m) = 3m+3$. That is, he systematically worked out $g_1(0) = 3(0)+1 = 1$, by substituting the

values m=0, 1, 2 into the expression 3m+1 and generated the values 1, 4, 7, ….., which are the elements of the set G_1.

He then substituted the values m=0, 1, 2 into the expression 3m+2 (or g_2), and generated the values 2, 5, 8, etc., which are the elements of set G_2. Finally he substituted the values m=0, 1, 2 into the expression 3m+3 (or g_3), and generated the values 3, 6, 9, etc., which are the elements of set G_3. The student's response indicates that he took the expressions g_1, g_2 and g_3 as functions for calculating the value of T_n. However these are descriptive conditions that are satisfied by certain natural numbers, and depending on which condition the number satisfies, the number becomes an input of the functions f_1, f_2 or f_3, to produce the required term value.

Some students tried to use the sets of expressions and functions in various ways. One of these students was student 3, whose response appears in Figure 6.

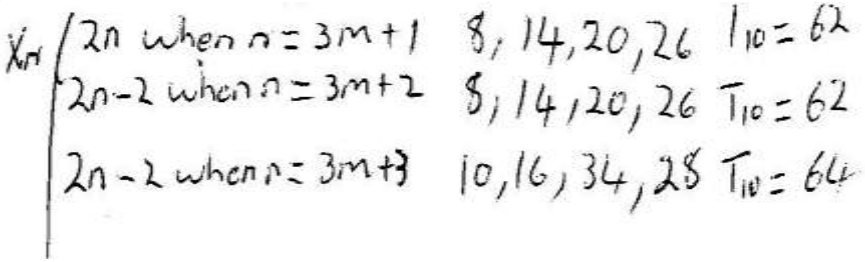
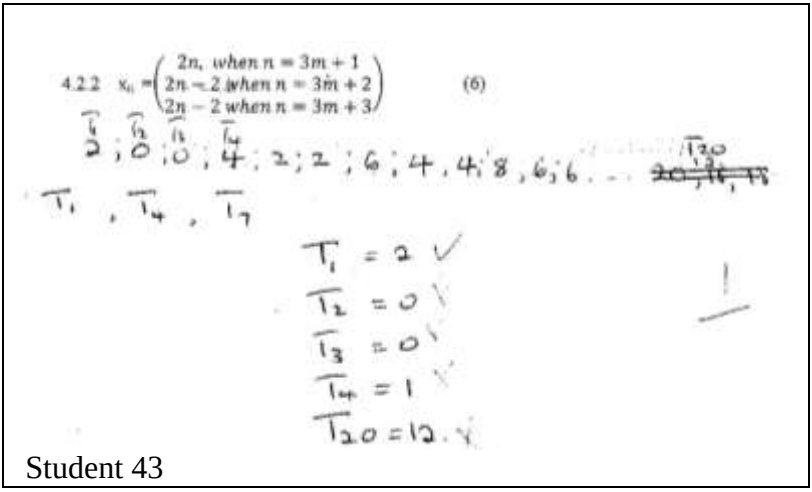


Figure 6: Response by student 3 to Task 3

It can be seen in Figure 6 that the student considered the three possibilities of f_1, f_2 and f_3 separately. She also took the expressions 3m+1; 3m+2 and 3m+3 as functions g_1, g_2 and g_3. This enabled her to calculate $f_{1o}g_1$ (n) for n=1, 2, 3, 4 and n =10 and she generated the list of values in the top row. Thereafter she found $f_{2o}g_2$ (n) for n = 1, 2, 3, 4 and n =10 and generated the values in the middle row. Finally she found $f_{3o}g_3$ (n) for n =1, 2, 3, 4 and n =10 and wrote the values in the bottom row. The student generated three sets of terms and she did not find a way to coordinate these sets into one sequence.

There were three students who wrote the first few terms as 2, 0, 0, 4, 2, 2, as shown in Figure 7.



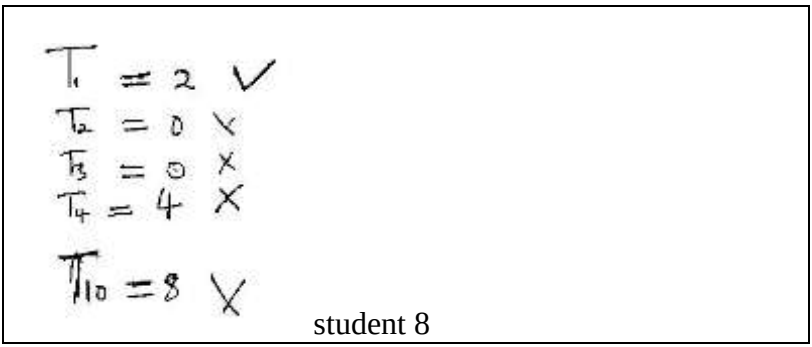


Figure 7: Responses of students 8 and 43 to Task 3

From Figure 7, it seems as if in trying to deal with the cyclic nature of the sequence these students tried to hold or pin one quantity down while allowing the other to vary. They kept n constant at n =1and found $f_1(1)$, then $f_2(1)$ and $f_3(1)$. Then they moved to n = 2 and found $f_1(2)$, then $f_2(2)$ and $f_3(2)$ and thereafter moved to n=3 found $f_1(3)$, then $f_2(3)$ and f_3. Moving on to n =4, they then calculated the tenth term using n=4, that is $T_{10} = f_1(4) = 8$. They

tried to keep n constant while going through the three functions f_1, f_2 and f_3 in turn.

Many of the students (5) produced a repeating sequence, 1, 2, 4, 1,2 4. One of these students was student 11, whose response is shown in Figure 8.

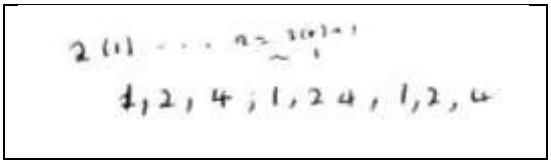


Figure 8: Response of student 11 to Task 3

This approach of repeating terms may have been influenced by the form of the sequence in Task 1.

It is important to note that all except four of the 26 students whose responses to Task 2 were incorrect did not produce a correct response to Task 3. It is possible that their response was incomplete for Task 2, but they nonetheless had an understanding of the n mod3 function which was also a tool used in Task 3.

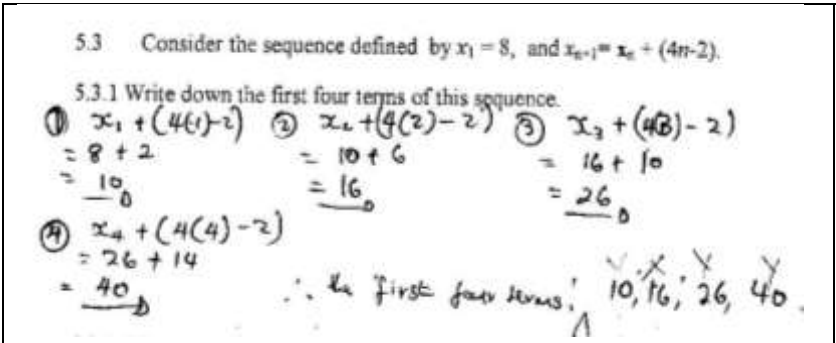
The other 22 students whose responses to Task 2 were incorrect also gave an incorrect response to Task 3. That is, 85% of those who did not produce a correct response to Task 2 were unable to produce a correct response to Task 3. There were 11 students who had produced a correct description of the terms of the sequence in Task 2 but could not do the same for Task 3. It may therefore be surmised that for this sample of students Task 3 presented a greater challenge. An examination of Task 3 confirms that the demand was increased by the introduction of a further dimension of variation. Whereas for Task 2, the value of T_n was fixed at 1, 3 and 4 when n was an element of each of the three sets G_1, G_2 and G_3 respectively; for Task 3, this was now varied further. Instead of fixed values, T_n was now described using a different rule for elements from each of the three sets.

Results for Task 4 (Question5.3.1)

In Task 4, the additional dimension of variation is not with the addition of new variables but with the variation of the notation of the terms x_n and x_{n+1}. Whereas in the former the substitution of n results in a term x_n, for the latter the substitution of the same value of n now results in the subsequent term x_{n+1}.

There were 33 students who found their way around the three substitutions of n in the formula and who correctly computed the first four terms.

There were 11 students who produced the response 10, 16, 26, 40. An example of this is the response by S5 presented in Figure 9.



Actual response: 10, 16, 26 40

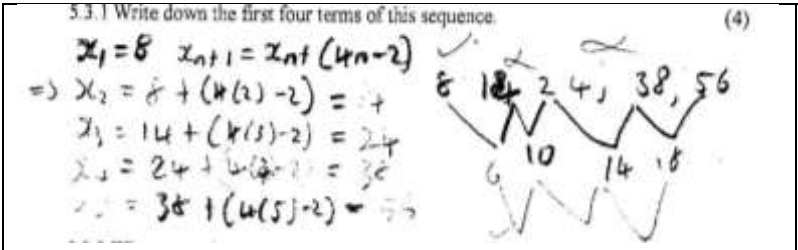
Effective formula $x_n = x_n+4n-2$

Figure 9: Response by S5 to Task 4

These students substituted n=1 in both parts of the formulae on the RHS but implicitly took n=0 in the subject of the formula for the first term; similarly for the second term they substituted n=2 into the expressions on the RHS and implicitly took n=1 in the subject of the formula on the LHS. The response of student 5 shows that she took the first term as being different from x_1 which was given already as 8. She used the x_1 as something to be substituted into the formula to find the first term of the sequence, and did not take x_1 as the first term. Similarly, she saw the second term as being a different entity from x_2. In general, her nth term= x_n+4n-2. These approaches have actually changed the given formula to $x_n = x_n+4n-2$, which is mathematically incoherent and as

an equation it has no solution. The misconception here is that *n* can take on different values in one formula, and also that x_1 is different from the first term.

Another common misconception is revealed in the responses of nine students, who wrote the first four terms as 8, 14, 24, 38. The response of S24 appears in Figure 10.



Response 8, 14, 24, 34

Effective formula used $x_{n+1} = x_n + 4(n+1) - 2$

Figure 10: Response of S24 to Task 4

From Figure 10 it can be seen that for the calculation of x_2, the student took n=1, in the subject of the formula and in the first part of the formula but took n=2 in the second part of the formula. Similarly, for the calculation of the third term, n was taken as n=2 in the subject and the first part of the formula, while it was taken as n=3 in the second part, hence the effective formula was $x_{n+1} = x_n+4(n+1)-2$.

Some students used an incomplete formula by taking only the second part of the formula such as 6, 10, 14, 18 or 10, 14, 18, 22, which can be represented as $x_n = 4(n+2)-2$

One student wrote 8, 10, 12, 14, which was effectively taking $x_{n+1} = x_n+2$. Another variation in the formula was 8, 14, 18, 22, 26, which involved adding $4n-2$ to 8 and the effective formula was $x_{n+1} = 8+4n-2$.

Therefore, for Task 4, the ways in which the students used the given formulae resulted in rules that were different from the original formula. Their

attempts at trying to reduce the variation resulted in substantial changes to the sequences.

Discussion

The responses to the questions show that there were often common strategies in the ways in which the students interpreted the pattern descriptions and the ways in which they generated patterns whose descriptions were provided. These regularities provide an indication of the students' interpretations and use of the symbolisation. The students' struggles may be related to similar struggles experienced with studying rates of change, where the change in one quantity is observed with respect to the change in a second quantity. Students' difficulties with examples such as acceleration as the rate of change of velocity as the rate of change of distance are well documented (Tasar 2010; Thompson & Thompson 1994; 1996). Another example of change involving two quantities is that of inflation and price of goods (Tasar 2010; Bansilal 2011). In the cases considered in this article the changes are somewhat different from those observed and described in rates of change, but relate to the discomfort of dealing with variation on different levels. Whereas with rates of change, there is one dependent variable which is changing with respect to a second independent variable. In this study, the changes were somewhat different. With Tasks 2 and 3 change was occurring on three fronts. There was variation in position, which was dependant on the value of n or term number; there was variation in conditions, where n could satisfy either of the three conditions, g_1, g_2 or g_3; and then there was variation in the formula for computing the term value which could be f_1, f_2, or f_3. With respect to Task 4, the variation was in the term taking on the value of x_n and x_{n+1} in the same expression.

One of the demands that the changes or the variations induced was that the students' conceptions were challenged. Without the variations, substitution into a formula in mathematics may be a straightforward exercise. Usually when the formula is given, one just needs to substitute the given value and then carry out the computation using operations on numbers; in fact, almost all the students in the class were well able to deal with this demand, as revealed in their responses to Task 1. Mason (1989:4), writing in the context of learners who are being introduced to algebra, notes that

learners can often express a general rule but find it difficult to see the expression as an object which can be manipulated or transformed. Mason's theory of shifts implies that 'they need continued exposure to such acts of expressing so that they begin to find it relatively easy' (Mason 1989:4) so that it almost becomes routinised, allowing them to shift their perception from seeing it as a formula to seeing it as an object. In terms of Task 4, many students were able to use x_n in the substitution to calculate the n+1st term, using x_n as an input into the formula. This was in following a rule as in 'to get the next term substitute the previous term and add 4n and subtract 2'. However, the formula required a variation in the role of x_n as moving from an input for the n+1st term to being an object in its own right as the result of the formula for the nth term. The responses show that many could not make the shift in the perspective of x_n as an object that is the nth term. The variation in the role of x_n thus constituted an epistemological obstacle, which if passed results in extended learning. As a person finds ways of overcoming the difficulty posed at the point of the epistemological obstacle, learning is enhanced (Herscovics 1989). Students who work with such expressions, and develop a dual perspective of x_n as an input for the n+1st term while also being an object, have become aware of the extension in the dimensions of variation of x_n (Scataglini-Belghitar & Mason 2011).

Mason's theory of shifting one's perception from seeing a formula as an object also adds insight into the case of the n mod3 function that appeared in Tasks 2 and 3. In Task 2, many students struggled to move from the expressions which specified the positions of terms to specifying the value of the terms. Some (15) were able to find a formula to describe the elements which belonged to the three sets G1, G2 and G3, or the positions of terms. They generated the three lists of n-values which satisfy the three expressions related to the outputs of n mod3 function respectively. The generation of these lists may have crystallised the operation of n mod3. However, they needed a further shift that would have allowed them to see the partitioning (G1, G2 and G3) as the result of the operation of n mod3. They struggled to shift their attention to seeing these n-values as objects upon which the different functions f_1, f_2 and f_3, could operate; hence the added variation of the repeated cycles of length three also constituted an epistemological obstacle. There were students (22) who did not produce correct answers for Tasks 2 and 3. This demonstrates that not making the shift from formula to object in Task 2 also hampered them in working with the repeated cycles in

Task 3. In order to perform further operations on the elements of the sets G1, G2 and G3, it was necessary to have an object-conception of the *n* mod3 function. However, the students were stuck in a process conception (Mason 1989) – they had not moved further than seeing the *n* mod 3 function as a process, so they could not perform further operations on the elements of those sets or lists.

In attempting to deal with the dimensions of variation embedded in Task 3, students seemed to be trying to find ways to keep certain quantities constant while varying others, as seen in the various responses that were presented. The introduction of one set of expressions (g_1, g_2, g_3) for checking the position and another set of functions (f_1, f_2, f_3) for evaluating the terms (T_n) introduced multiple dimensions of variation that complicated the problem. Some students responded by focusing only on the expressions g_1, g_2 and g_3, and did not consider the functions f_1, f_2 and f_3. Others considered expressions g_1, g_2 and g_3 as functions which could operate on the *n*-values. Some considered the composition of the g_i's and f_i's to make up three different functions which led to three different sequences. Some kept *n* constant while they cycled through the various f_i, and some came up with a sequence which had repeating cycles of length 3. It is worth noting that this type of pattern with repeating cycles also proved to be challenging in other studies. Zazkis and Liljedahl (2002:399) noted that the pattern with repeating elements presented difficulties because it did not 'lead to a 'smooth' algebraic notation, presented in one 'neat' formula that connects the element *n* to its location.' In their study with 36 pre-service elementary school teachers, there were only three teachers who used a strategy related to the *n* mod 8 function supporting my finding that patterns with repeating cycles were experienced as very difficult.

Conclusion

The study reported in this article was an exploration of pre-service students' responses to induced dimensions of variation in representing sequences. These dimensions of variation presented epistemological obstacles to them which some tried to overcome by looking for ways to minimise the variation by trying to keep some aspects constant. However, the definition used by Watson and Mason (2006), that sees learning as an extension of '[dimensions

of variation that a student is aware of, implies that as students overcome these epistemological obstacles their learning will be extended. It is suggested that these experiences should be brought to the fore for these students who are going to be teachers, so that they can reflect on what made them struggle and how this effort contributed to their learning. As teachers the lessons they learn from their own learning experiences may help them plan learning experiences for their own learners in future.

In terms of my own introspection, the students' struggles with the concept of the mod 3 function suggest that they may have needed additional help. The experience of encountering it for the first time in its role in generating and describing repeated cycles of terms in sequences indicates that the introduction via this route constituted a didactical obstacle (Olivier 2013). Perhaps these repeating sequences needed to be scaffolded first by introducing the mod *a* function first so that students could gain familiarity with the operation of modulo *a*. They may then see the value of the mod *a* function in representing cycles of length *a* in a sequence.

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Imagining a Post-structural Curriculum for Palliative Care: Reflections on Rural Healthcare Workers' Experiences in KwaZulu-Natal

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Laura Campbell

Abstract

This paper, based on the experiences of healthcare workers in rural parts of South Africa, offers an imagined curriculum for palliative care and its impact on patient care. Palliative care is a medical intervention for a patient facing death due to an incurable disease, or poor health prognosis. In this study, many of the patients receiving palliative care live in impoverished homes and have had minimal access to healthcare. Thus there is uncertainty about whether they will die because of a life-limiting illness, or because sophisticated medical care is not available. An additional anxiety is the tensions between their spiritual beliefs and cultural practices and the palliative care approach. Six healthcare workers, four qualified and two unqualified volunteers cared for patients in their homes. Photo-elicitation techniques were used to generate data during interviews. The caregivers' experiences of home-based care made apparent the limitations and ineffectiveness of a curriculum that excluded patients' spiritual beliefs and cultural values in respect of healthcare, dying and death. A curriculum, reconceptualised through a post-structural lens, we argue, will not only respond to the needs of patients and caregivers, it is also a more resilient means to capture the simultaneous, yet different realities within the same context or across multiple contexts.

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Keywords: Post-structural curriculum, palliative care, rural communities, healthcare workers

Introduction

What kind of a curriculum is suitable to prepare healthcare workers to care for persons who, presumably, are facing death due to an incurable disease, or poor health prognoses in South Africa? This is an important question considering the high rates of mortality linked to HIV and AIDS and drug resistant tuberculosis in recent years (Avert 2009). There are many persons with a life-limiting illness who, despite the poor prognoses, are still in need of physical and psycho-emotional care. This paper, based on findings from a study about a small group of palliative care workers' experiences in patients' homes (Campbell 2012), offers ways to imagine a palliative care curriculum framed by three questions: who should be cared for, who should provide palliative care and what should be the roles of palliative care providers?

The principles that underpin the imagined curriculum emerged from gaps between the prescribed and the enacted curriculum experienced by palliative caregivers in rural parts of KwaZulu-Natal. For instance, the prescribed curriculum was silent about care in conditions of abject poverty, profound neglect and absence of medical facilities. It is not surprising, therefore, that caregivers discovered that they were ill-prepared for the socio-cultural practices and the spiritual beliefs of their patients which challenged the prescribed approach to palliative care. The healthcare workers, some of whom were semi-skilled volunteers, were seen as bearers of death. Many patients refused to discuss impending death and sought pain-relief medication from the healthcare workers who were not qualified to dispense medicinal drugs. The curriculum, it appeared, did not factor in the peculiarities of a developing context to provide appropriate care (Campbell 2012). Consequently, we propose the use of post-structuralism as a lens for curriculum designers to acknowledge and to take into account the uncertainties, challenges, insecurities and dilemmas which caregivers are likely to encounter in rural spaces.

The focus on curriculum is crucial because a curriculum constitutes and prescribes the totality of actions of a practice. The contents of a curriculum are captured through language with words constructing, as in this

case, the realities of palliative care practice. Language, from a post-structural perspective, is open to multiple interpretations, creating ambiguity. Post-structuralism is often associated with the 'linguistic turn', a term coined by Bergmann (1964:177), due to an inherent interest in language and its deployment to represent reality. Meaning that is constructed through language, an order of symbols arranged in predictable patterns, gets subverted by cultural, spiritual and social influences resulting in discursive, elusive and obfuscated interpretations because words do not represent common understanding. Expressed differently, language constructs multiple realities that are peculiar and particular to the interpreter as she is influenced by history, culture and locale (Anderson 2003; Williams 2005). Language, therefore, is not about capturing the certainty of reality; it is instead, a disrupter, and an interlocutor introducing multiple paths, each representing a different meaning. For example, the notion, 'rural' is open to interpretation. For some individuals it means sparseness, for others, remoteness, or a combination of sparseness, remoteness and lack of resources. So it could be geographic, demographic, under-development or a combination of one or more of these factors. Under these circumstances, only rich description can reveal the reality. Without description, the term 'rural' is characterised by undecidability, leaving it open to multiple interpretations. From a post-structural perspective, multiple interpretations are not regarded as disruptive, but as vital fragments that reflect complexity (Campbell & Amin 2012). We argue for reconstructing the curriculum by exploring how the language of the prescribed palliative care curriculum constructed a reality of care that was inconsistent with and contradicted the realities of palliative care in practice, because it assumed that all contexts are alike.

In South Africa, the care curriculum has been influenced by a European model for home-based care. Palliative care, a specialized form of nursing of persons whose health prognoses are poor, and for whom death is imminent, emerged in the early 1970s as a response to perceptions that patients who faced death were being neglected by healthcare professionals and, therefore, had unrecognized, unmanaged, severe and frequent symptoms related to the silence surrounding dying and death (Doyle, Hanks & McDonald 1998). It was also a response to a pervasive assumption that the 'death denying' culture was symptomatic of a failure to care for end-of-life patients (Ariès 1974; Zimmermann 2007). Thus palliative care emerged with three inter-connected aims. The first was to ensure that specialized and

holistic care was provided to individuals, for whom every curative attempt had been made to no avail, the second, to enable patients and caregivers to access and participate in the discourses of dying and death as preparation for the inevitable for patients and their families, and three, to manage pain. Palliative care would, presumably, remove the shroud of uncertainty and reconcile the divide between patient and healthcare workers.

One can infer that the European model, which takes these three principles of palliative care into consideration, is based on the principle of certainty. In Europe, qualified medical doctors take all appropriate measures to provide holistic care, to manage pain and to make attempts to cure patients before making end-of-life prognoses. Only when there is no hope of prolonging life, is palliative care recommended. In essence it means that the physical, psychosocial and spiritual domains of patients' lives are the foci for palliative care (see e.g. the WHO 2012 definition).

In South Africa the situation is different. In the next section we discuss, in particular, the complexities and dilemmas emerging for caregivers because there is an assumption that physical, psychosocial and spirituals needs are common to all communities and individuals.

The Palliative Care Curriculum in South Africa

Palliative care is a fairly recent medical intervention in South Africa (Gwyther & Rawlinson 2007) with a course for professionally-trained palliative nurses developed by the Hospice and Palliative Care Association of South Africa (HPCA) in collaboration with the Foundation for Professional Development (FDP)[1]. The contents of the curriculum are discussed in this section and have been organized around three questions: what does the curriculum say about which patients should be cared for; who should do the caring; and, what are the purported roles of the caregivers?

[1] This curriculum is not available on-line. It is only made available to nurses who attend palliative care training run as a collaboration between HPCA and FDP. The course is run as a 'distance', part-time course and lasts for two years. This paper focuses on four written manuals designed to accompany the course. It is noteworthy that the course includes lectures and practical, experiential learning at palliative care sites, such as hospices.

Firstly, regarding who should be cared for, the curriculum identifies the following individuals:

> Patients with a life-limiting or life threatening illness (Vol. 1:19, 2009) or
> Patients and their families for who care is no longer an option (Assessment guide:12, 2009).

The curriculum implies some knowing on the part of palliative caregivers about those they care for. The patients, from the impoverished socio-economic strata, have minimal access to healthcare and resultantly, do not have the benefits of technologically advanced medical scans and tests or treatments like chemotherapy and radiotherapy. Poor prognosis is not based on the certainty of diagnosis; instead palliative care is sometimes the first and only healthcare option. The diagnosis of 'incurable', it can be assumed, is arbitrary. Consequently, a patient can make a 'miraculous' recovery, or shun the care offered by healthcare providers or the rural community expects that anyone who is ill be attended to by the palliative caregiver irrespective of whether the illness is fatal or not. As a result, healthcare workers often face dilemmas not anticipated in the curriculum (Campbell 2012). In rural and remote areas of South Africa, the assumption that a patient has access to a skilled diagnostician, tests or scans or potentially curative therapy has already been established as a probability, which is often not available. This means that those identified for palliative care may not be threatened by a life-limiting illness. They could, for instance, be in poor health because of inappropriate nutrition or a curable condition (Campbell & Amin 2012). Palliative care workers are, therefore, not in a position to know whether those they care for are dying or what is causing the illness. They do not know if the illness is potentially curable or how long the patient will live.

Secondly, regarding who should be the caregiver, the curriculum prescribes well-trained, 'specialist' healthcare providers*:*

> Curing for patients and their families, for whom cure is no longer an option, is a rapidly developing area of medicine and nursing which requires specialist skills and knowledge (Assessment guide:12, 2009).

In the developed-world, in an effort to increase access to palliative care, models of palliative care include home-based care. Home-based care workers (HBCW) visit patients' at home. These HBCWs are generally trained, accredited and are supported by professional nurses and doctors (Delvin & McIlfatrick 2010). In South Africa, well-trained and well-supported home-based care workers may not be readily available in rural and remote areas. As a result palliative care in patients' homes has been offered by volunteer HBCWs who have unaccredited training and intermittent support from nurses or doctors (Uys & Cameron 2003; Defilippi 2005).

Thirdly, regarding the roles of caregivers, the curriculum describes the roles of caregivers as providers of physical, psychological, social and spiritual care:

> Palliative care is provided in order that that patient and their family receive optimal care at physical, psychological, social and spiritual care (sic) (Assessment guide:20).

The curriculum supports the World Health Organization's (WHO) definition of palliative care which signifies three specific constructs of care: physical, psychosocial and spiritual (WHO 2012). In a South African context, the community, family and patients' expectations of the roles of care-giving differ from those in a developed-world context. For example, rural African patients expect their caregiver to mediate the relationship between the dying patient and their ancestors, introducing an unanticipated cultural care role. Cultural care is briefly mentioned in the curriculum (six pages in total are allocated to cultural care and include brief, stereotypical descriptions of the cultural practices of Christian, Hindu, Jew, Muslim, Buddhist and Traditional African followers (Vol. 4:57-61).

The South African curriculum currently in use, if imagined (see Fig. 1), mirrors the model designed for developed contexts. It is a reproduction that ignores contextual specificities and complexities.

The application of a curriculum without due consideration to contextual peculiarities is problematic for the reasons discussed heretofore. The complexities of the South African context require translation into palliative care practice that is coherent with and works for the benefit of patients and caregivers. A curriculum for palliative care should include an element of uncertainty as some patients may have erroneously been offered

care in the absence of equitable, appropriate and sufficient healthcare provisioning.

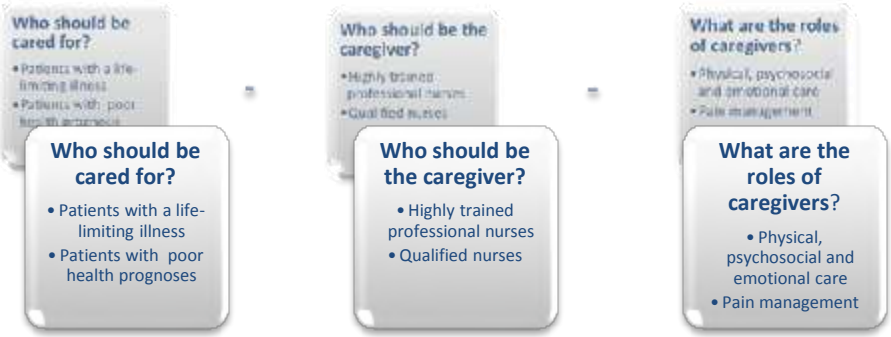

Fig. 1 ***Palliative care curriculum - a mirror image of the developed world curriculum***

When contrasted to their counterparts elsewhere, the varied experiences of the healthcare participants necessitate a curriculum that is informed by particularities which are unanticipated, ambiguous and uncertain.

As a post-structuralism view makes visible contradictions, variations, complexities, and uncertainties in practice and its experiences thereof, it would serve to influence curriculum design so that it is relevant for, and responsive to contextual differences, and makes it possible for uncertainty to be consciously integrated into design and enactment. The data elicited from palliative care workers will be used to imagine a responsive curriculum. In the next section we outline the methodology used to produce palliative caregivers' experiences in rural spaces of KwaZulu-Natal.

Research Methodology

The study was an exploratory, qualitative one with the aim of documenting and analysing experiences of caregivers who provided aspects of palliative care in rural patients' homes in relation to the curriculum which prepared

them for home-base care. The intention was to produce thick, descriptive data which is generally not feasible in large-scale studies. The data revealed details which would have been undetected in quantitative studies. Furthermore, because experiences are subjective, social methods that are commensurate with personal encounters between researcher and participants are relevant in a study like this one. The claims, resultantly, are not generalizable as findings apply to peculiar contexts and individuals. The notion of generativity (Vithal 2008), which leaves it to readers to decide to the extent to which the findings apply to their own context, may be more appropriate in this case.

Setting

The setting for the study was rural homes in KwaZulu-Natal, South Africa. Most of the patients attended to by participants presented with conditions associated with HIV and AIDS. Many of them had not travelled far from the area of their birth and had limited formal education. In this setting, poverty and starvation are rife, unemployment is high and many people live in makeshift, unstable dwellings. Electricity is not available and water is sourced from rivers and community taps shared by households. The prevalence of HIV is very high and many people do not have access to healthcare as the clinics and hospitals are situated far away from their homes, and transport costs are unaffordable. There is a strong affinity for traditional medicine and many people see a traditional healer before seeing a nurse at a clinic or a doctor at a hospital. For many patients, palliative care is the only medical intervention available.

Participants

The participants consisted of six palliative healthcare workers. Four, of the cohort of six, were trained nurses and two informally trained home-based care workers. The latter were volunteers from the local community, and were intermittently supervised by nurses with professional credentials in palliative care. The participants had all been trained in palliative care using the HPCA and FDP curriculum. Participants were deliberately chosen as they were rich sources of information. The participants were isiZulu speakers with insider knowledge and familiarity of the culture, beliefs and social mores of their patients. They were chosen because they were ideal candidates to explore

gaps between the curriculum that they were trained in and their experiences of palliative care in a rural context.

Data Production

The participants were made aware of the aims of the study, namely, to find out more about their experiences of a curriculum and of providing palliative care in patients' homes. The dominant study method employed was photo-elicitation in which participants were asked to take photographs to serve as reference points for subsequent data production strategies. The participants then discussed these photographs in one-to-one interviews with the researcher, referred to as 'auto-driving' by Mitchell (2008). The photographs were used indirectly to stimulate the production data during interviews, which were the primary sources of data for the study. During the interviews, participants were asked to explain why they took the photographs. The role of the researcher was simply to prompt, ask for clarification and to encourage discussion about the photographs taken.

Ethical Considerations

Ethical clearance was obtained from the social sciences research ethics committee of a higher education institution (reference number HSS/0079/ 10D). Participants were volunteers and assured of confidentiality and anonymity. This was achieved through the use of pseudonyms and by omitting specific details that could lead to accidental or unintentional discovery of the identities of both patients and caregivers.

Palliative Care Workers' Experiences of the Curriculum

The experiences of the healthcare workers are presented in terms of their views linked to the same questions asked about the curriculum: who should be cared for, who should provide care and the roles of caregivers.

Who is Cared for?

The curriculum that the participants were exposed to identified patients as

those who have a life-threatening, life-limiting or incurable illness. Participants noted that in the rural context where they visited patients in their homes, it was not always possible to know whether the patient had a 'life-limiting illness',

> Even with all your experience as a nurse, you cannot identify the ones that are going to die because sometimes you find a very ill patient and they just miraculously recover when they get food.

The recovery of the patient implies that the patient could possibly not have had a life threatening disease or illness. In another interview, a participant related how patients were often very ill because they were starving and that once nutrition was offered they recovered. The recovery was seen as a 'miracle'. Another reason for not knowing the nature of the illness is because she offered care to patients who had never seen a doctor and had no accurate diagnoses or prognoses. The palliative care curriculum did not prepare the caregiver for this scenario because the possibility was not considered. Participants also discussed that 'rationing' care to specifically labelled patients (those with a life-limiting illness) was a new and foreign concept in terms of their worldview:

> We don't do it as you guys are doing it, you see? It's just we don't say OK because you are dying we have to let you die peacefully or alternatively we are not letting you die we are trying to save you. It doesn't happen like that …. We care for both the ones who are dying and the ones who are not dying.

This participant drew a distinction between white (western) people's approach (you guys) and Zulu (African) people's approach to who is cared for. In her opinion, white people offer palliative care to those who are dying, whereas Zulu people offer care to both dying and not dying individuals. The distinctions between the dying and the not dying are erased as both groups are cared for in the same way with the same expectation of getting well. Language, in this instance, does not clarify the distinctions, and the prescriptions of the curriculum are ignored to make care relevant in this community.

> White people must look after their dying as it is how they do it. But we must be available for whoever needs us - that is how we do it … White people have got their own ways to comfort their ill. White people have got words that they use to tell a person they are dying. We don't have a word that means to care for the dying … In Zulu you take care of the living ones as well …We use a word *Ukumakekela* which means to care for all the ill.

The data illustrates that offering care to some patients and not to all patients may be culturally inappropriate. Here we have an insight into the constitutive force of language – a practice (specific to the care of the dying) is not a reality because they 'do not have a word that means to care for the dying'. The limitations of the curriculum contradicted the cultural mores of the care givers who, as Zulu insiders, realized that their training ignored cultural dimensions of care. In a sense, the curriculum was experienced as a restricted one, only concerned with narrowed needs identified by the medical fraternity as necessary basics of care and ignorant of the desires and needs of the patients. It means that home-based care restricts the kind of care that poor persons in rural communities can access, echoing a similar argument made by Wedin (2010), in an educational setting, that a restricted curriculum restricts success.

Who Offers the Caring?

The curriculum, which was designed for nurses, expected nurses (as specialists) to offer care for the very ill and dying and did not consider a context where a nurse or a doctor were unavailable. Care, in this study, was provided by non-specialists HBCWs who had little formal training and poor access to support and advice. They were placed in stressful situations when they did not know how to react:

> Hey, look at this one {she is discussing a photograph of a patient}. I am scared.
> Can you see what this is? It is a sore on someone arm. This lady is very sick and I have never seen this thing before. It is rotting. It smells. I see sick people but this one is different, she cries when we clean it.

Another volunteer HBCW also describes fear and lack of knowledge around caring for a patient.

> I am frightened even to help her. I am frightened but it is my job. I have to do it … I am frightened of her disease. I don't know how she got this.

HBCWs' discussions provide insight into the fears of caregivers and the intensity of problems faced by both caregivers and their patients. A HBCW was faced with providing care for a rotting, smelling wound and she could not be sure of the cause of the wound. She expressed fear of putting herself at risk of being infected, or of causing pain. This situation hints at a lack of support for a HBCW; no one is readily available for advice or assistance, and adequate analgesia is not available to ameliorate the patient's agony. The nurses' curriculum did not prepare nurses to offer advice to and support HBCWs who are not trained. The data, in this instance, is reflective of the unknowns that circulate on the margins of a curriculum, and not having been encountered in the developed world, was not built into the local version of the curriculum.

The experiences of the caregivers reveals that the curriculum is not only restricted in the way Wedin (2010) describes it; it can also be described as a hidden curriculum (Anyon 1980). Considering that the HBCWs are under-qualified, volunteer caregivers, the hidden message conveyed is that poor communities are not worthy of the best medical treatment available and that qualified personnel are reserved for the richer social classes.

The Roles of Palliative Care Providers

In keeping with the WHO definition of palliative care, the curriculum prescribed physical, psychosocial and spiritual care. Data reflected that the participants also viewed palliative care in this way:

> Palliative care is about pain and symptom management. In palliative care we can be pain experts but we are mainly supporting care for all the patients on all levels because once they leave the hospital they will need somebody who will encourage them to take the medication.

In a context of high HIV and TB prevalence rates, this participant viewed her primary function as providing care on all levels, meaning that they had to offer support beyond pain and symptom management, including a practice of 'drug policing', that is, to regulate and monitor drug-taking activity. She had to encourage patients to continue to take their medication as patients were relatively uninformed about medical treatment protocols; for example, patients believed that medicines were only needed when a person was sick. Data strongly indicated that roles undertaken by the caregivers were often well beyond the roles stated in the curriculum. For example, many participants alluded to the importance of cultural practices, which were only briefly mentioned in the official curriculum:

> I think that on the African side the family as such, no not the family - the clan - they used to acknowledge oh there is a death in that family and that there is a certain way that is expected for them to behave. For instance, especially if I have lost my man, my husband, I'm not allowed to go to the social gathering the family. The women should be quiet; there should be no fighting and no raising of the voice.
>
> Even in peoples' homes you will find to use a certain paintings to show that we are mourning. After one month we have to slaughter a goat to cleanse the family. The people then are allowed to attend the social gathering but you as a woman you have to mourn the whole year. It used not to be the black clothes, the black clothes it came with the Western.

Data highlighted the need for caregivers to be aware of local cultural customs and traditions as patient silence and social isolation could be mistaken by outsiders as symptoms of a psychological problem such as severe depression. Additionally, practices, such as slaughtering a goat could be seen as cruel and primitive to an outsider who is unaware of the value of slaughtering animals in traditional beliefs. Participants noted the relative neglect of cultural care in their curriculum:

> It [the palliative care course] didn't involve people who are prac-

> ticing traditional medicines. You never invited a Sangoma[2] there and you never invited an Inyanga[3] there to tell us what they think we need to do in order to ease the life of the person that is suffering from HIV and AIDS. I believe that it would have worked because they will come with their own understanding of the whole problem because some of the problems are not really physical.

The participant shared her worldview of how illness, death and mourning are practiced in a Zulu community. The involvement of elders and traditional healers are significant in the lives of patients and to help them to cope with illness.

The data is instructive of the absence of vital aspects of care in the curriculum, referred to as the null curriculum (Flinders, Noddings & Thornton 1986). The null curriculum can be inferred as the absence in the curriculum of practices, principles and policies of palliative care in relation to what is valued by the caregivers, patients and their communities. In particular, the curriculum excluded their spiritual beliefs and cultural practices.

Considering that the formal curriculum is restricted, conveys hidden messages that devalue those cared for, and excludes personal, spiritual and cultural care, means that the curriculum has to be reconceptualised.

Imagining a Post-structural Curriculum

In this section we explore how a curriculum can be culturally responsive by integrating uncertainty, contradiction and unpredictability. The possibility of a responsive palliative care curriculum, we argue, is feasible by drawing on a study in education about the importance of context and curriculum, and that has placed uncertainty of context at the centre of any learning and practice endeavour. Amin and Ramrathan (2009:69) foreground the multifaceted

[2] A Sangoma is a practitioner of herbal medicine, divination and counselling in traditional Nguni (Zulu, Xhosa, Ndebele and Swazi) societies of Southern Africa. A Sangoma is called on to communicate with ancestral spirits.

[3] An Inyanga is an herbalist who is concerned with making medicines from plants and animals.

nature of school contexts in South Africa by way of the following description:

> The post-apartheid landscape in South Africa is characterized by multiculturalism and homogeneity, multiracialism and mono-racialism, co-education and gender-specificity, class distinctions and class elitism and a range of disparities, inequalities, similarities, and differences between the polarities presented, and beyond.

They suggest that context is multifaceted and extraordinarily complicated. Their work is based on a premise that a curriculum cannot prepare a teachers-to-be for all teaching contexts and that a curriculum should aim to deliberately encounter, factor in and confront uncertainty associated within a school context or a diversity of school contexts. In assuming that some exposure to a diversity of context is important, they provide a 'context-driven learning approach' (Amin & Ramrathan 2009:72). This approach considers memory, experience, and learning as interconnected processes of the mind. Although their work applied to training of teachers, it is appropriated here to structure a curriculum for the training of palliative caregivers. The four-phase framework, reworked for palliative care training is described in the next section.

Phase One: Reframing Memory of Care

This phase is a theoretical orientation to palliative care. Potential palliative caregivers have previously learnt about some aspects of caring in various contexts, including hospitals and clinics. Their training may have been relevant to these contexts and may have led to a 'circular closure of memory'[4]. This view suggests that as a result of prior experiences of care-giving, palliative care may not be transferable to another context, such as home care. This 'circular closure of memory' suggests linearity and perhaps

[4] By circular closure of memory, we mean that a person's memories around practice may be so deeply engrained that they are unable to be open to new ways of thinking and learning about practice. The term is taken from Dooley and Kavanagh (2007:67).

that a curriculum cannot arise or transform in a context other than the context in which the curriculum was experienced.

A major focus of this phase of reframing memory would be to reposition caregivers who are learning about palliative care by moving their thinking from decontextualized to context-sensitive care, in which they consider shaping their practice for the patients' benefit (e.g. beliefs, culture, needs, language use and socio-economic conditions).

Phase Two: Disrupting Experience of Care

This phase involves supervised visits to a number of patients' homes to which they have previously not been exposed during the training phase. The aim is to disrupt their frame of reference by exposure to a diversity of contexts. The contexts have to be carefully chosen so that the caregivers experience a range of issues that may emerge when they have to work as caregivers without supervision. For example, caregivers could be exposed to a context where they do not know what is causing an illness or how long it is expected that the patient will live. They could also be exposed to a context where analgesia is unavailable. Discussions that follow could assist in anticipating problems and sharing of solutions. The possibility that trainees could be more knowledgeable than trainers (for example, about culture) could raise the level of confidence for volunteer HBCWs.

Phase Three: Destabilizing Learning to Care

In this phase caregivers are given an opportunity to rethink palliative care practice. They would be required to design palliative care plans[5]. By now caregivers may have thought about differing ways of looking at palliative care, will have had been exposed to unfamiliar contexts, and will be given opportunities to develop palliative care plans for each context visited, which can then be discussed in groups. The plans, based on home-based visits, could include travelling to the homes of patients, introducing themselves to

[5] A care plan outlines the care to be provided to an individual/ family/ community. It is a set of actions the caregiver intends to implement. It guides an ongoing provision of care and assists in the evaluation of that care.

patients and their families, responding to sores and wounds, explaining what they can offer and not offer, bathing patients and so on. They will come to realize that each context requires a different strategy or approach.

Phase Four: Reconstructing the Uncertainty of Care

In this phase, palliative care trainees practice care in an arranged context (of their peers). In groups they role-play patient and caregiver. It is an uncertain space which does not resemble the actual site of care work, but it does give opportunities to practice palliative care. Practicing palliative care skills at an arranged site (as opposed to an authentic setting) is an uncertain reconstruction of context. Amin and Ramrathan (2009:75) believe that an important part of this phase is a realization that:

> … the nature of teaching is unpredictable and that the most important aspect of learning for future teachers is to be prepared for unpredictability and uncertainty.

The thinking around teaching and teachers could in some ways be applied to thinking about caregivers who are finding out about palliative care. In this final phase, caregivers could present their understanding of palliative care to a larger group of caregivers who hail from differing contexts, and this phase is the most important as it brings together caregivers' understanding of context and contextual forces in deep, perhaps previously unexplored ways. This phase provides caregivers with a way of looking at and, if possible, dealing with challenges. Caregivers could jointly decide on topics necessary for learning further about palliative care. In this approach to curriculum and training, palliative caregivers could thus expect uncertainty in context, their memories could be reframed, and they could look at new ways of facing challenging issues when practicing in context. Uncertainty could be welcomed as a potential area for growth, and a curriculum for care would not be expected to provide answers for the problems peculiar to each context.

In opposition to the mirror-like curriculum design (Fig. 1), we offer an imagined curriculum framework. This framework is inspired by the experiences of the curriculum by participants in the study and the uncertainty approach to training offered by Amin and Ramrathan (2009). The imagined curriculum is captured by the funnel metaphor in Fig. 2.

Imagine the current palliative care curriculum as manifesting three types of experiences: restricted, hidden, null. Each manifestation of the curriculum is represented by a circle which makes visible the borders that exclude, restrict and limit realities of contexts of care. The funnel represents the post-structural framework to influence the curriculum with contextual specificities and complexities. As the circles filter through the post-structural frame, they lose their borders at the narrow base and are release into a post-structural space making possible a curriculum without borders. A curriculum without borders is open to insertions of various kinds that characterize each context. It is flexible and makes space for the unexpected, the uncertain and the extraordinary. While we do not expect that every problem related to palliative care will be solved, a post-structural curriculum accepts complexities as integral components of its structure.

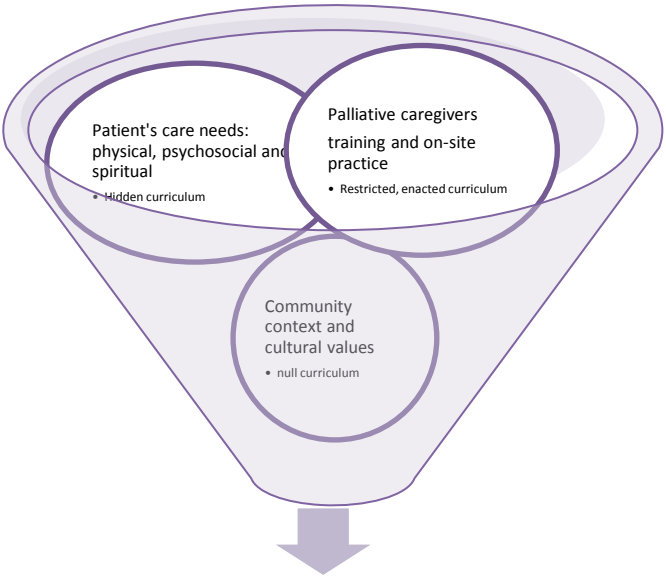

Fig. 2 Imagining a post-structural palliative care curriculum

Conclusion

In this paper we explored the curriculum terrain of palliative care through the experiences of caregivers working in rural KwaZulu-Natal. Their experiences of home-based care have made apparent the limitations and ineffectiveness of an approach that excludes patients' spiritual and cultural beliefs in respect of healthcare, dying and death. The curriculum did not prepare them appropriately, ignored the needs of the community, and marginalized traditional worldviews. The curriculum, it transpires, was imported without adaptation to local needs. The differences in contexts where palliative care originated and its application in a rural part of South Africa are remarkably ineffective for both caregivers and their patients. We have demonstrated too, that a curriculum text constitutes the possibilities and limits of palliative practice, and, the complexities that emerged in practice were traumatic for patients and caregivers alike.

As curriculum design cannot escape language, it must, somehow, integrate a language of uncertainty, of contradiction, and unpredictability for successful outcomes. A post-structural curriculum has the potential to overcome the shortcomings of a simultaneously restricted, hidden and null curriculum. We, therefore, reconceptualised the palliative care curriculum through the lens of post-structuralism. Post-structuralism, we argue, is a more resilient means to capture the simultaneous, yet different realities within the same context or across multiple contexts.

For a country like South Africa, it is unfortunate that unequal healthcare provisioning for its citizens continues as we near the end of the second decade of the post-apartheid era. Those most affected are vulnerable communities like the sick and the dying in rural and remote areas. Considering the above-mentioned conditions, the curriculum shaping the approach to care of those who have a life-limiting illness should at least respond to the specific needs of patients. The model we offer is not more costly than the existing curriculum. It does not require material inputs or resources. It requires practitioners to make changes and to adapt the curriculum for local needs. It asks that we imagine palliative care as the means to make the final days of patients emotionally and psychosocially bearable. It means too, that those who have to implement the curriculum can do so with confidence and experience successful caregiving.

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‘Stretching’ the Undergraduate Curriculum: A Compensatory Response to Curriculum Modelling?

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Rubby Dhunpath

Abstract

In 2013 the South African Council on Higher Education (CHE) proposed an extension to the three and four-year undergraduate academic curricula by an additional year with a concomitant increase in the number of credits. This, ostensibly, was necessary to ameliorate the unsustainably low graduation rates in Higher Education. In this paper, the authors contend that the proposal does not make a sufficiently compelling case for curriculum extension for several reasons. We argue that the pronouncement that the curriculum has an ‘irreducible core’ is inherently conservative and will not result in radical structural curriculum change, perpetuating a pedagogy that fails to move beyond the remedial. Secondly, we argue that the Draft Proposal provides financial modelling scenarios to motivate the feasibility of funding the extension of course duration, but fails to provide analogous scenarios to model the student progression and graduation benefits to be derived from funding such an extension. Our own modelling scenarios provided in this paper challenge the veracity and validity of the modelling scenarios provided in the Proposal and their attendant resourcing implications. We further demonstrate that in the context of minimal structural curriculum reforms, save for the miraculous achievement of near 100% graduation and minimal attrition rates, the proposed extension will in fact increase the burden on students, institutions and the state without any significant increases in graduations. The authors advance an alternative approach which involves the identification of alternative progression routes for students who fail out of the

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mainstream. Based on progression trends of successful students, modern analysis methods such as those originating in the field of Artificial Intelligence, enables data-mining of progression information from successful students to determine how existing curricula and timetables may be optimised to better support students progressing through these alternative routes.

Keywords: student progression**,** curriculum reform, population balance modelling

Introduction

In response to the unsustainable progression rates in South African Higher Education, the Council on Higher Education (CHE) commissioned a task team to report on appropriate interventions to mitigate the 'systemic obstacles to access and success, particularly in relation to curriculum structure' (CHE p. 15) – referred hereafter as the Proposal. In contextualising the problem, the Proposal alludes to the existing curriculum structure which was adopted almost a century ago … and has remained largely unchanged … and constituted a prima facie justification for a review' (CHE p. 15). The proposal eloquently describes and analyses the 'curriculum crisis' in South Africa, making a compelling case for urgent reform.

In principle, the authors of this article endorse the proposed reform to: (a) increase the number of graduates of good quality; (b) improve the equity profile of graduates; and (c) enhance success rates in higher education (CHE 2012). The authors further acknowledge, as originally submitted in the University of KwaZulu-Natal's (UKZN's) official response to the proposal, that redesigned university curricula should address the articulation gap, facilitate key transitions in the context of knowledge areas and cognitive demands, engage meaningfully with student diversity in all its forms, foster deep learning and promote the acquisition of practical skills and experience that all students need for economic, societal, civic and personal success in the 21st century (UKZN 2013).

Noting the above, the authors commend the admission in the proposal that the problems facing higher education in South Africa are systemic and structural, warranting reform that transcends band-aid interventions. In this regard, the proposal inspires confidence in its admission

that 'all signs are that the fundamental problem is systemic rather than a result of student deficits', placing the imperative for systemic change on the higher education sector and individual institutions. Regrettably, this confidence is eroded by the proposal's lapse into the default deficit paradigm evidenced in the declared proposition that the existing curriculum has 'wholly insufficient curriculum space to enable such provision to be incorporated without compromising the integrity of the 'irreducible core' of knowledge in the curriculum' (CHE 2013). What constitutes the irreducible core is not elucidated in the proposal, prompting suspicion that the existing curriculum will in fact, with all of its structural pathologies, be 'stretched' to accommodate an additional year, wherein student un/under-preparedness will be remedied. How enhanced student learning, with a view to increasing the number of graduates with 'attributes that are personally, professionally and socially valuable' (CHE 2013) will be achieved by an extended curriculum, is not elaborated in the proposal, rendering the claims of potential gains little more than aspirational policy rhetoric.

Curriculum Responsiveness: Transcending the Econometric Discourse

The need for curriculum responsiveness has become central to education policy and higher education in South Africa as it has for its counterparts elsewhere in the world. Governments and professional bodies are under pressure as they contemplate curriculum reforms which generate work-ready graduates as economic entities in service of the market and the global economy (Pinar 2014; Standing 2011; Ogude *et al.* 2005). Indeed, market responsiveness and the econometric imperative has taken root in much of the grand narratives of higher education curriculum reform, reducing complexity and multi-dimensionality as a subset of other equally important imperatives such as social, institutional, cultural, disciplinary, pedagogical and learning responsiveness (ibid.). Giroux (2013) articulates this crisis:

> Tied largely to instrumental ideologies and measurable paradigms, many institutions of higher education are now committed almost exclusively to economic goals, such as preparing students for the workforce - all done as part of an appeal to rationality, one that eschews matters of inequality, power and the ethical grammars of suffering

Giroux (2013) notes that casino capitalism does more than infuse market values into every aspect of higher education; it also wages a fully-fledged assault on public goods, democratic public spheres, and the role of education in creating an informed and enlightened citizenry. In a society wedded to narrow instrumentalist values, ignorance is a political tool which nourishes a deep-seated fear of civic literacy. Critical thinking and a literate public have become dangerous to those who want to celebrate orthodoxy over dialogue, emotion over reason and ideological certainty over thoughtfulness (Dhunpath 2014).

Curriculum Reform that Moves beyond the Remedial

The advancement of an informed and enlightened citizenry has not been an imperative for the new democratic regime, as evidenced in its compensatory policy fetish. The post-apartheid policy process underpinning education reconstruction has frequently been characterised by the 'add another policy' syndrome, supported by optimism that policies are in themselves a sufficient condition for reform and reconstruction. In this regard, the Proposal's 'add another year' approach underpinning its proposal is reminiscent of a similar optimism that the structural and systemic conditions that mediate student progression can be remedied by extending students' exposure to the prevailing curriculum. The earlier incarnation of this discourse was derived from the widely accepted belief that under-prepared students bearing the bruises of apartheid education could be healed by being lavished with academic support as they were socialised into the dominant higher education culture (Dhunpath & Vithal 2012).

Meaningful and responsive curriculum re-design requires not only the foundational elements proposed in the additional year to provide epistemological access to mainstream curricula, but should also involve curriculum enrichment through a review of curriculum content and breadth of coverage. This should be underpinned by a shift in pedagogy that privileges the attainment/cultivation of learning principles and the development of intellectual skills rather than the acquisition of discrete content knowledge. The curriculum reform process should result in radical curriculum enrichment with changes in structure, content and pedagogy that move beyond the remedial, to the creation of conditions necessary for

enhanced student learning. This ultimate outcome must require higher education to transcend structural reform and embrace the intellectual project of an emancipatory higher education that resists commodification (see also, UKZN 2013).

Curriculum Reform as Compensatory Legitimation

The outcomes noted above cannot be achieved by financial modelling. The Proposal refers to 'Modelling options for increasing graduate output' (page 24). It is not clear what analytical tools were used to model the projected gains which it claims will be realised from the curriculum extension in relation to a) increased student graduations and b) reduced wastage in resources. The modelling detailed in the document has been primarily concerned with the financial implications of the extension of the undergraduate curriculum and does not convincingly demonstrate how the problem of student progression will be solved. Such a fundamental omission, the authors assert, is an indication of how Higher Education in South Africa risks being appropriated by the state in its quest for 'compensatory legitimation' as proposed by Hans Wieler (1983) to explain the failure of curriculum reform in the Federal Republic of Germany (see also Jansen 1990).

Through the gaze of compensatory legitimation we are alerted to the authority and the gravity conferred to tools and instruments used by the state to legitimise policy proposals and pronouncements. These, Jansen (1990) argues, are 'sanctioned by expert studies and experimentation; participation and … the involvement of citizen participation as an instrument to restore the legitimacy of the state … as a manifestation of scientific `rationality' and objectivity' (p. 3). The CHE consultative process has the necessary ingredients for democratic participation in the policy process, but fails to sustain the confidence it inspires because the proposal advances an econometric model to solve a pedagogic problem.

A Higher Education Pedagogy of Possibility

In embracing a reconceptualised higher education pedagogy of possibility, we have an obligation to shift the gaze to other, more obvious, but unseen

dimensions of student performance that can be equally significant, such as seeking mechanisms to accommodate students' interdependent modes of learning in order to shift them from more independent modes – modes that determine students' ability to actively participate in the academy.

We have argued elsewhere (see Dhunpath & Vithal 2012) that we need to put both the question of underprepared students and underprepared universities under the spotlight, entertaining the possibility that 'institutional culture is often disembedded and disembodied from the culture of the student body it was attempting to socialise' (p. 11). The CHE's Access Three Case Studies (2010) reveals that the caricatured 'underprepared' student is not confined to black students from disadvantaged schools. Many students with excellent matriculation scores struggle to negotiate their alienation resulting from the 'pedagogic distance' which universities fail to effectively manage. Pedagogic distance is not confined to geographic or physical space, but evinces at least five dimensions: 'emotional, political, pedagogical, linguistic and physical' (CHE 2010: 98) and find expression in students' alienation which is a consequence of their ignorance of the primary tools required to navigate university life.

The notion of student alienation is explored by Deil-Amen and Rosenbaum (2002), in their working paper: 'The Social Prerequisites of Success: Can College Structure Reduce the Need for Social Know-How?' They argue that community colleges 'require certain kinds of social know-how' which are often absent from the repertoires of disadvantaged students. They present seven obstacles: bureaucratic hurdles; confusing choices; student-initiated guidance; limited counsellor availability; poor advice from staff; delayed detection of costly mistakes; and poor handling of conflicting demands (ibid. p. 2). Amen & Rosenbaum argue that these conditions do not typify private occupational colleges which create conditions to 'structure out' the need for this social know-how, and address the needs of disadvantaged students more successfully. Their argument hinges on the proposition that higher education institutions assume that students have the social know-how necessary to succeed. The social know-how includes students' knowledge about 'how to handle enrolment, class registration, and financial aid, to initiate information gathering, to access sound and useful advice, to avoid costly mistakes, and to manage conflicting demands' (p. 3), all of which affect their ultimate college success. Conflicting demands, Stephens et.al. (2012) argue, are a consequence of a university culture that promotes

competitive student behaviour which in turn privileges independence, and undermines students' performance. Conversely, they contend, advancing a university culture which values interdependence (i.e. being part of a community) reduced the articulation and performance gap.

In summary, the cultural capital that students require to reduce the articulation gap and enhance students' capacity to negotiate higher education can be provided by anticipating and demythologising access strategies. This can be achieved by institutionalising scrupulously designed and sustained awareness programmes, distinct from the ritualistic orientation programmes that currently typify many South African universities.

Thus far the authors have advanced a socio-political critique of curriculum reform in South Africa. We now return to the primary concern of this article which relates to the allegation that the Proposal advances an econometric solution to a pedagogic problem. Since the Proposal does not explain its modelling approach we can only speculate how it was developed. The speculation would be based on the supposition that the 'model' is based on the assumption that student under preparedness would be remedied by adding an extra year of study, resulting in an increased graduation rate. In this paper we argue that intervention does not require the addition of an academic year, but can and should be integrated into institutionalised academic monitoring and support programmes.

Population Balance Modelling

The alternative model presented in this paper is based on the field of **Population Balance Modelling**, which predicts the changes in properties of a population of entities (in this case students) based on kinetic parameters. In this case, the kinetics are the observed pass and dropout rates. The property being modelled is the academic year of study of the student. Once this model was shown to fit the available data, it was analysed in a series of five case studies to reveal the changes to the rates of graduation, failure and holdup. Holdup is an important concept since it yields the number of students that must be present in the system (in the curriculum) at any given time, and hence reveals the cost of maintaining that academic programme.

The authors interrogate hereunder the modelling scenarios in the Proposal which is based on predicting progression across the student

population according to the year pass rate and the rate at which failed students return. A four-year academic programme was taken as a benchmark, and it was found that the model correctly predicts graduation and failure rates as well as total numbers of students in the system and number of students passing in the minimum time.

Various scenarios were simulated according to permutations of the options proposed by the CHE. No scenarios were found to yield an improvement in the graduation rate with significantly increasing the total number of students in the system. An alternative view of curriculum restructure is proposed that attempts to extract the most useful aspects of the proposal with the view to increasing graduation and retention rates.

Model Outline

To make any progress in assessing the likely outcome of any proposed intervention, a model is required to understand the implications of the outcomes mentioned. A crude 'model' would be to simply assume certain outcomes (graduation, failure rates) as a result of a proposed intervention. A more reliable predictor would result from taking the available student data, distilling from it the intrinsic factors such as likelihood of passing from one year to the next and the likelihood of dropping out of a curriculum, and therefrom to predict the number of students in each academic year of study.

Of the various modelling frameworks available, Population Balances, which predicts the outcomes of a group of members, is the most suitable for this type of prediction. In this branch of mathematics, the proportion of population members which exhibit specific properties is predicted. In the present case, the property is chosen to be the academic year of study, and the population is the group of students registered in an academic programme.

A comprehensive derivation of the model used in this analysis is provided in the Appendix A; in this section, we distil the major aspects of the model.

The number of years N is the number of years in the academic programme, e.g. $N = 4$ refers to an academic programme whose minimum time to graduate is four years. The pass rate p_i refers to the fraction of students in academic year i who will pass a sufficient number of credits to

enter the next year of study i+1 while the return rate r refers to the fraction of students who after failing a year of study return to continue their studies.

We define the number of students who enter that year i to be e_i , where this entry could be due to the admission of new students into year 1, or it could be transfer students from other institutions into higher years of study, etc. We recognise also that the number of students who leave year i due to academically progressing to the next year is $p_i.s_i$. The number of students who fail year i must then be $(1 - p_i).s_i$. The number of students who fail out and who return to year i is then $r_i(1 - p_i).s_i$ and the number who fail and do *not* return is $(1-r_i).(1 - p_i).s_i$.

The rate of change in the number of students in any given year is then the sum of the students entering from external sources plus those who pass the previous year and enter that given year, minus those who pass the current year and enter the next, minus those who fail from the given and do not return to it. The other students are simply retained in the system, hence will not factor in the rate of change equation. The overall balance on year i is then given by:

$$\frac{ds_i}{dt} = e_i + p_{i-1}.s_{i-1} - p_i.s_i - (1-r_i)(1-p_i).s_i$$

Note that the symbol on the left hand side of the equation ds_i/dt is the rate of change of the number of students registered in year i. If N is the number of students in the academic programme, then s_{N+1} can be considered to be the number of graduates per annum, which can be calculated simply as $G = s_{N+1} = p.s_N$. We obtain the value s_N by solving the model equation.

According to the model (see Appendix A) these inputs are adequate to predict in a single year the total number of graduates of the programme G, the total number of students who will be registered in that academic programme T, the number of students who will fail out of the academic programme F and the number of students who will complete in minimum time M.

Model Validation and Scenario Simulation Principles

We wish now to restrict attention to the performance of a single academic

programme as a result of the proposed change by the CHE. By selecting a single programme as a benchmark, we wish to further our understanding of the potential outcomes of the intervention to the institutional system as a whole. In other words, by understanding the influence of the intervention to a single benchmark academic programme, we anticipate that the overall effect upon whole institutions can be understood.

Such an approach also allows for the analysis to be generalised and simplified, in that it is not necessary to obtain data regarding, e.g., individual pass rates for each year in each programme at the university. It is sufficient for our purposes, therefore, to assume an academic programme with a target intake of new first year students of 100 per annum. In addition, the pass rate p will be assumed to be the same for all years of study. Although this is obviously generally not the case, the fluctuations in pass rate from year to year does not affect the analysis. It is therefore pointless to apply different values for each year. A single pass rate p will be used instead. The same applies to the return rate r.

These simplifications allow for benchmarking a representative programme; the fact that the pass and return rates actually differ from year to year does not affect the analysis to come.

We select p and r such that national averages in terms of overall graduation rate and overall dropout rate apply.

For a pass rate of $p = 0.7071$ and a return rate of $r = 0.65$, we find that the model predicts 58 students graduating per annum, 25 graduating in minimum time, 42 failing out of the programme in total and 408 students registered (across all years). These pass and return rates therefore give the typical performance of many engineering programmes.

These values of p and r therefore provide reasonable parameters for benchmarking an academic programme. In the following scenario models, we predict the system behaviour for interventions such as that suggested in the 'CHE proposal'.

Scenario Modelling Results

Table 1 summarises the results of modelling the scenarios described below. Note that scenario A is actually the benchmark case or current situation of an academic programme with four academic years that normally accepts 100

new first year students into the programme. The pass rate *p* and return rate *r* are chosen such that typical overall graduation and dropout rates apply.

Scenarios B, C, D and E consider the Proposal by simulating the model with the addition of one year ($N = 5$). The cases differ from each other in that the additional year of study is presumed to affect the pass and return rates.

The outcome of these changes is then observed in the graduation rate *G*, total in system *T*, failure rate *F* and graduation of minimum time students *M* [students/annum].

The most important output variable is the Graduation Efficiency GE; this value is defined as the Graduation Rate G divided by the total number of students in the system T, i.e. $GE = G/T$, and is the most useful way to summarise how effective a programme is in delivering its graduates.

The reason for this definition is as follows: The total number of students in the programme *T* is the number of students that must be supported by the academic programme in order to produce the number of graduates *G*. In addition, the value T is also the number of students that could be involved in other pursuits, whether academic or otherwise. As such, *GE* is a measure of how efficiently the academic programme is producing its graduates.

Table 1. Model outputs for benchmark A and four scenarios

Scenario	A	B	C	D	E
Years, N	4	5	5	5	5
Passrate, p	0.7071	0.7071	1	0.85	0.85
Return rate, r	0.65	0.65	0.65	0.65	0.3
Graduates, G	58	51	100	74	56
Total in sym, T	408	480	500	493	420
Fails, F	42	49	0	26	44
Minimum time, M	25	18	100	44	44
Graduation efficiency, GE	0.142	0.106	0.200	0.150	0.133

In scenario B, we simulate a doomsday case, where the addition of the year does not change either the pass rate or the return rate. It is useful to consider this case for two reasons: 1) it establishes the influence of the intervention with reference to the present performance level without the intervention, and

2) it establishes the minimum performance outcomes. The result is significantly worse than the case where the curriculum is not extended; the graduation efficiency is the lowest among all scenarios at 0.106. In terms of the unprocessed outcomes, the graduation rate declines (51), the total number of students in the system increases (480), the number of students failing out of the system increases (49), and the number of students finishing in minimum time also decreases (18). All these effects can be summed up simply as: the additional year is merely an extra year that the students can fail out of. It does nothing to change the level of understanding. Scenario B therefore establishes the worst possible case.

At the opposite extreme, in Scenario C, we consider the case where the number of years increases to five, but that the pass rate increases dramatically due to a change in curriculum design. In this scenario, we consider the ideal case that the pass rate goes to 100%. We note that the return rate really does not matter since there are no failures to return to the system. In this extreme/idealistic case, the number of graduates p.a. must equal the number of entrants (100), there are 0 students failing, and the number of minimum time students is 100. However, the total number of students in the system is then necessarily 500, making the graduation efficiency 0.2 (which is still the highest efficiency among the scenarios).

In this scenario, the increase in total student numbers is unavoidable; this is in fact a consequence of the success of the programme: the perfect pass rate results in all students of the given year entering the subsequent year as a block. Even in this ideal case, there are serious doubts regarding sustainability. Does the institution have the capacity for the increase in student numbers? Are there sufficient venues, labs and teaching staff to accommodate this increase in student numbers?

We note that the Proposal calls not merely for the extension of academic programmes by a year, but also for a proportional increase in the number of credits. As such, the classes do not merely become larger in size; rather, there are necessarily more classes, in fact 33% more in the case of three-year degrees and 25% more in the case of four-year degrees. 3) Does the relative cost of maintaining the increased number of students and increased number of classes justify the increased number of graduates?

We note here that the number of graduates has increased under the assumption of the pass rate becoming a perfect 100%, which is unrealistic.

However, this Scenario C was intended only to establish the opposite extremum to Scenario B.

Further to Scenario C, one could consider a modified version; it is possible to keep the total number of students at 400 if one simply accepts only 80 students and one is prepared for a reduced graduation rate (i.e. only 80 graduates even if the pass rate is 100%). Although this appears to be feasible, the national tendency is away from this option; institutions are routinely asked not just to increase the 'throughput', but the admission rates as well.

Further, this does not address the CHE requirement that the number of credits increase. If credits increase, then even if the number of students remains the same, the number of courses, venues and staff must all increase between 25 and 33%.

Scenarios B and C are the extrema, the doomsday and the perfect world scenarios respectively. In scenarios D and E, more realistic situations are explored in which the expectation of the pass rate increase is moderated. We simply average the doomsday and the ideal cases to adopt a value of $p = 0.85$, and apply different return rates, with D having the same return rate as the benchmark. Even with the moderated pass rate, the total number of students in D is unsustainable at 493 (although graduates are up at 74). The graduation efficiency is 0.15, which is not significantly different from the current situation in Scenario A, which has a GE value of 0.142.

If we force the return rate r to a lower value (0.3) in Scenario E, the number is more sustainable. However, the graduation efficiency is even lower at 0.133 and in all the indices, excepting the number of minimum-time students, the values are worse than for the benchmark case Scenario A, which, we note, is the performance of the education system at present without intervention.

To summarise the scenarios simulated, it is clear that should the Proposal be implemented, institutions would have to increase in size by between 25 and 33%, both in terms of number of staff and in terms of the physical size of the 'plant' or institution site.

Even the most optimistic outcomes are unfeasible; should the pass rate become a perfect 100% as a result of an increase in the number of years, the total number of students held up in the system would increase to cause not only the number of classes but also the size of the classes to increase.

When applying realistic estimates of an increased pass rate, it is clear

that the very moderate increase in graduation numbers and negligible difference in graduation efficiency cannot justify the large expenses incurred during implementing and maintaining this proposal. Furthermore, given that the proposal requires a proportional increase in credits taught, the doomsday scenario B is more likely to occur than even the moderate increase in pass rate of Scenario D.

In addition to the expenses already mentioned, it should be noted that the time and effort required in developing the content required of the additional credits will be significant. Furthermore, there is a hidden cost that would not be apparent in the first years of implementation: at some point, for every academic programme that extends its curriculum, there will have to be one year in which that programme will produce no graduates. This cost might also be hidden by the graduation of students recycling through the system, but the overall effect is that there will exist a year in which there will be no graduates.

A third hidden cost is to the students. The extra year of study with new additional credits to pay for is simultaneously an additional cost of education as well as a lost year of employment. Students present at seminars where the Proposal has been discussed have strongly voiced their concern in this regard. These students have gone so far as to state that the proposal is viewed by them as motivated by educational institutions to increase the amount of fees that would be extracted. Considering the growing global concerns about the so-called Education Bubble and the global rise of student debt and the increasing inability of graduates even to service this debt, the fears expressed by students cannot be ignored.

A fourth hidden cost is specific to the education system in South Africa, which appears to be the only country considering this move. The reputational damage to the institutions, students and education system of the country in requiring an additional year to graduate the same degrees as available in other countries is enormous.

The Flexible Curriculum

A potentially valuable feature of the CHE's curriculum proposal is its flexibility which means, theoretically at least, that students who are able to pass the degree in the minimum time under the current curriculum structures

will still be able to do so in the future. Regrettably, this has so far been promissory rather than concrete. The authors of this article concede that they are unaware of appropriate mechanisms to expedite accelerated student progression. However, this ideal does provide cues for how some useful changes might emanate from the notion of 'flexibility' suggested in the proposal.

First, it should be recognised that a 'Flexible Curriculum' already exists in the current regime and evolves in a 'natural' way. For instance, when a student fails a large enough number of credits typically a university's student advisory services develops an alternative progression in consultation with the student. These extra-year plans are in essence what the CHE is proposing should become the norm. If such progression routes are identified proactively rather than reactively, a simpler and more efficient approach would be possible in which the (current) minimum time programmes would be maintained as the default, and the extended year programme would be activated only when a student does not meet the criteria for continuing the minimum time programme.

The novelty of this approach lies in empirically defining these alternative progression routes. At present, when a student fails out of the minimum-time route, s/he is at the mercy of the various advisors to map out a new progression strategy. Indeed, the variety of progression routes attempted by students is well-recorded and documented in the student registration databases of every academic institution. Additionally, in these same databases, the student success rates in these various routes are also recorded. The modern algorithms available in the field of Artificial Intelligence can be applied to data-mine these sources to determine which progression routes yield the greatest chances for success. Such developments are beyond the scope of the present paper, but do feature in the future research intentions by the present authors.

Once these routes are known and understood, it becomes possible not only to label and acknowledge, and thereby de-stigmatise these alternative progression plans, but also to timetable courses such that the progression plans do not clash, or to minimise the extent of the clashes. Here, again, the database of previous student progression data is useful since it can be used to determine, when clashes were allowed, what the likelihood of progress was.

This approach would allow for the 'minimum-time' progression plan to be acknowledged as a route to be aspired to while still acknowledging

alternative approaches are possible and even supported. Stronger students are therefore not denied the credit of completing degrees in a short space of time, and weaker students are still strongly supported and incentivised to perform better.

By contrast, the CHE proposal in its present form relegates all students to the lowest level of performance, and dis-incentivises students from performing optimally. Indeed, the proposal opens the door to future further extensions of academic programmes at a time when institutions are being criticised for fuelling an Education Bubble from which the world will never recover.

Another important concern implicit in the foregoing discussion is the role of pre and co-requisite modules in serving as gatekeepers of student progression. While a detailed treatment of this phenomenon also falls outside the scope of the present paper, it should be abundantly clear to many of us involved in curriculum design and quality assurance, that these gatekeeper modules are often historical and a product of academic rituals rather than the product of any compelling pedagogic justification. A systematic analysis of institutional practices in this regard should yield significant benefits.

Shifting the Deficit Gaze

A crucial and candid admission that underlies the CHE's call for curriculum reform is that not only is the problem of poor student progression a structural and systemic one (having its roots in the Oxbridge academic tradition), it is also a product of layers of institutional under preparedness. In particular, the proposal notes that 'it is clear that meeting the needs of the majority of the intake will require a greater emphasis on entry-level teaching and course design that is geared to bridging the articulation gap and enabling students to develop sound academic foundations, in terms of subject knowledge and relevant academic skills' (CHE 2013:143) [that not only looks but also sounds quite biblical!].

The problem of underprepared university teachers will not be minimised or eradicated by an extension of the curriculum. The problem is likely to be exacerbated as new, early career academics are typically allocated beginner undergraduate classes. It is therefore reassuring to note that both the CHE and DHET are in synch about the need to accelerate

professional development as a pre-requisite for enhanced student success. The various cooperative efforts, including the Quality Enhancement Project (QEP), while not a panacea for radical change, certainly shifts the gaze from the student as the carrier of deficits to a realisation that we should be turning the gaze on ourselves as academics since structural reform alone will not remedy our deficits (see Dhunpath & Vithal 2012).

Concluding Observations

This paper has attempted a critical analysis of the CHE proposal to extend the duration of academic programmes by one year in relation to its claimed outcomes. As a first step, the assumption inherent to this proposal that the extension by a year of study will result in an increased pass rate is challenged, and a more rigorous model based on population balances is proposed. The model was validated using national graduation averages, and a benchmark scenario simulated. A series of case studies showed that in order to achieve increased graduation efficiencies, unrealistically high pass rates were required before even moderate increases in graduation rates could be realised.

In addition, given that the proposal requires a proportionally increased number of credits, the number of courses, academic staff, classrooms and facilities would have to increase for all academic programmes (and hence all academic institutions) by between 25 and 33%. A major drawback of the CHE proposal is that all students, including those who would ordinarily have graduated in the minimum time of N years, would now necessarily graduate in a minimum time of N+1 years. As such, the proposal forces all students to the same low rate of progress and disincentivises students from making better progress.

The proposal incurs heavy costs not only to academic institutions, but to students as well. At a time when the Education Bubble is being discussed globally, this aspect cannot be ignored. With a growing population of students who will never in their lifetimes be relieved of the debt incurred, the South African situation must be treated with particular care.

A simple modification of the proposal is suggested instead, based on using student data to identify alternative progression routes. At present, students who fail out of the minimum time programmes do not have clearly

mapped progression routes. Student data can be used to identify the most frequent and successful alternative progression routes, and practical steps can be taken to acknowledge and support these alternatives. For example, if courses were timetabled such that clashes were minimised, the overall student success rates must increase significantly.

As such, although this paper shows that curriculum extension is not likely to justify the heavy costs enumerated, a modified notion of the flexible curriculum can indeed yield improvements in the education system and achieve more than compensatory legitimation.

Appendix A: Model Development

We wish to predict the student profile of an academic programme. The profile includes number of graduates per annum *G*, number of students failing across all years *F*, the total number of students registered in the programme *T* and the number of students completing in minimum time *M*.

It is expected that these quantities can be predicted when given 1) the number of years of the academic programme *N*, 2) the pass rate p_i, defined as the fraction of the students in year *i* of an academic programme who will pass to enter year i+1, 3) the return rate r_i, defined as the fraction of students who fail year i and who are re-admitted to year i, and 4) the entrance rate e_i, defined as the number of students per annum who enter year i from an external source (e.g. another academic institution).

We also defined s_i to be the number of students registered for the i_{th} year of an academic programme.

We wish to write population balances on the students in each year. We recognise that in a given year i, the number of students who enter that year will be e_i and the number of students who leave it due to progressing to the next year is $p_i.s_i$. The number of students who fail year i must then be $(1 - p_i).s_i$. The number of students who fail out and who return is then $r_i(1 - p_i).s_i$ and the number who fail and do *not* return is $(1-r_i).(1 - p_i).s_i$.

The rate of change of students in any given year is then the sum of the students entering from external sources plus those who pass the previous year and enter that year, minus those who pass the current year and enter the next, minus those who fail and do not return. The other students are simply retained in the system, hence we need not account for them. The overall

balance on year i is then given by

$$\frac{ds_i}{dt} = e_i + p_{i-1}.s_{i-1} - p_i.s_i - (1-r_i)(1-p_i).s_i$$

We note that p_0, which is the pass rate from year 0 to year 1 is necessarily zero; there is no year 0 from which to pass into year 1 since we have already accounted for entrants into year 1 through e_1. This equation is therefore valid for i = 1 as well as for i>1 and i<N+1. If N is the number of students in the academic programme, then s_{N+1} can be considered to be the number of graduates per annum, which can be calculated simply as $G = s_{N+1} = p.s_N$. The challenge then is to predict the number of students in the final year of study.

Constant Performance Assumption

Since in this article, we wish only to evaluate the implications of the CHE proposal, it is not necessary to consider variance in pass rate and return rate across the years. We wish simply to benchmark the performance of an academic programme against an applied change such as a change in the number of years N with a related change in the global pass rate and possibly the return rate. For this purpose, it is sufficient to allow that the pass rate p_i is the same for all years p and similarly, the return rate r_i will be accepted as r.
It is quite easy to relax this assumption when doing more detailed analysis; when we wish to do so, it is trivial to data mine student records for year-by-year values.

New First Years Assumption

When again considering the purpose of the present evaluation, it is sufficient to consider that the entrants to the programme are only in the first year of study; as such, $e_1 > 0$ and ei = 0 for i>1.

Detailed Development for a Four-year Programme

When applying the Constant Performance Assumption (CPA) and the New

First Years Assumption (NFY) for a four-year academic programme the following model equations apply.

$$\frac{ds_1}{dt} = e_1 - p.s_1 - (1-r)(1-p).s_1$$

$$\frac{ds_2}{dt} = p.s_1 - p.s_2 - (1-r)(1-p).s_2$$

$$\frac{ds_3}{dt} = p.s_2 - p.s_3 - (1-r)(1-p).s_3$$

$$\frac{ds_4}{dt} = p.s_3 - p.s_4 - (1-r)(1-p).s_4$$

We can write these equations more conveniently in the following vector matrix form:

$$\frac{d\mathbf{s}}{dt} = \mathbf{A}.\mathbf{s} + \mathbf{e}$$

Where

$$\mathbf{s} = \begin{bmatrix} s_1 \\ s_2 \\ s_3 \\ s_4 \end{bmatrix}, \ \mathbf{e} = \begin{bmatrix} e_1 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

And

$$\mathbf{A} = \begin{bmatrix} -p-(1-r)(1-p) & 0 & 0 & 0 \\ p & -p-(1-r)(1-p) & 0 & 0 \\ 0 & p & -p-(1-r)(1-p) & 0 \\ 0 & 0 & p & -p-(1-r)(1-p) \end{bmatrix}$$

We are now in a good position to perform analysis. Since this a question concerning curriculum design, we are interested in the steady state performance, i.e. ds/dt = 0. In this case, we obtain

$$\mathbf{s} = -\mathbf{A}^{-1}.\mathbf{e}$$

where $\mathbf{A}^{-1}$ is the inverse of the matrix **A** above. It can be shown that for 'reasonable' values of p and r, this matrix is well-conditioned and invertible; this model then has the fortunate property that it is easy to solve.

Model Generalisation to N Years

The model development has so far been for a four-year programme. In accordance with the purpose of this document, the development must be generalised for any number of years *N*.

It is clear from the previous section that for N years, the model becomes:

$$\frac{ds_1}{dt} = e_1 - p.s_1 - (1-r)(1-p).s_1$$

…

$$\frac{ds_i}{dt} = p.s_{i-1} - (p + (1-r)(1-p)).s_i$$

…

$$\frac{ds_N}{dt} = p.s_{N-1} - (p + (1-r)(1-p)).s_N$$

From this, we can derive the simple algorithm as follows:

$A_{i,j} = 0$ excepting

For i=1:

$$A_{1,1} = -p - (1-r)(1-p)$$

For i>1:

$$A_{i,i-1} = p$$
$$A_{i,i} = -p - (1-r)(1-p)$$

While $e_i = 0$ excepting $e_1 > 0$.

We have then

$$\mathbf{s} = -\mathbf{A}^{-1}.\mathbf{e}$$

And the chief outputs of interest are as follows

$$G = s_{N+1} = p.s_N$$
$$T = \sum_{i=1}^{N} s_i$$
$$F = \sum_{i=1}^{N} (1-p_i)(1-r_i)s_i = (1-p)(1-r)\sum_{i=1}^{N} s_i$$
$$M = e_1 \prod_{i=1}^{N} p_i = e_1 p^N$$

[It is not necessary or even normal to provide code in a paper like this; I am simply deleting]

The results are given in the following figures.

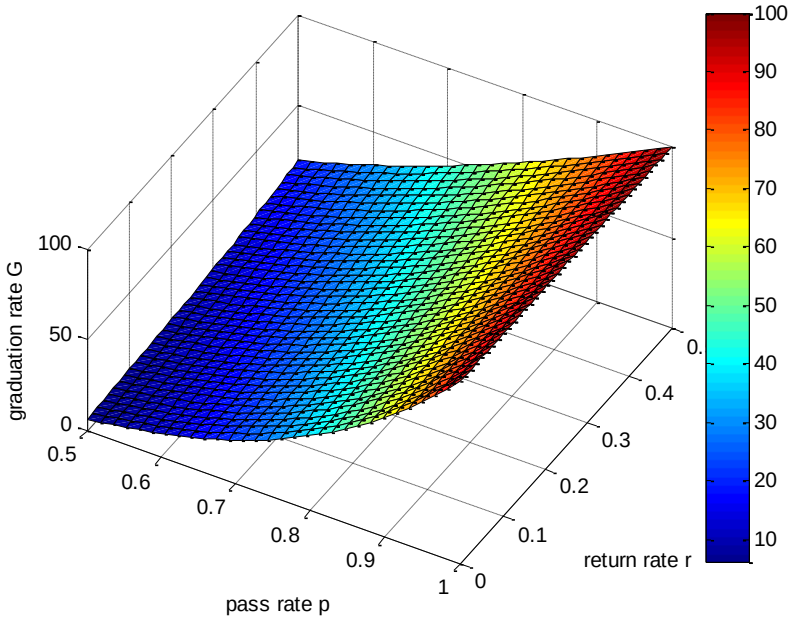

Figure 1. Graduation RateT

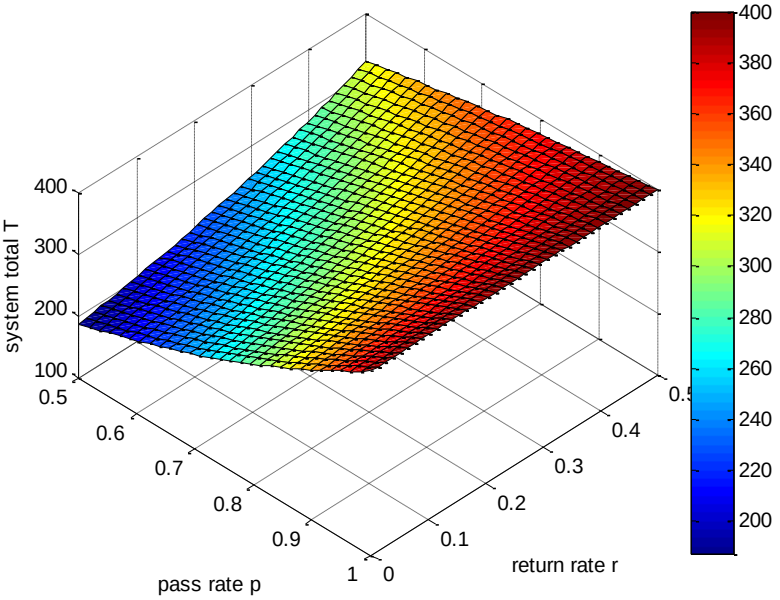

Figure 2. Total Students in System T

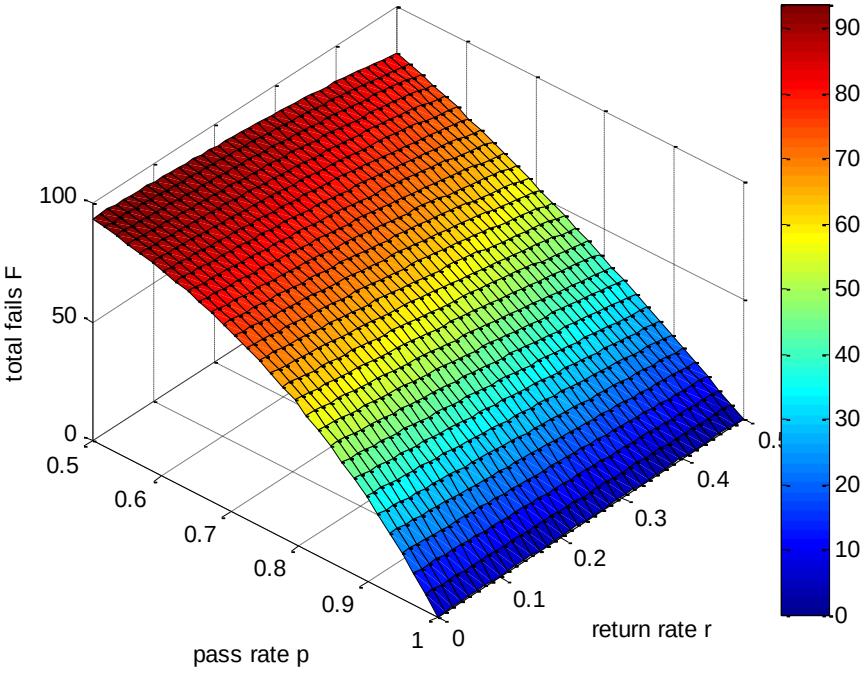

Figure 3. Total Failing out of System F

All figures are returning expected trends and generating reasonable results. More detailed analysis is provided in the body of this document.

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Professional Accounting Associations' Influence on Higher Education Accounting Pedagogy

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Abstract

Few studies of higher education accounting pedagogy include classroom observations in their research design and in South Africa qualitative studies of accounting pedagogy are rare. The larger study from which this paper is drawn explored the pedagogy of Managerial Accounting and Finance lecturers at the University of KwaZulu-Natal (UKZN). One of the significant influences upon the participants' pedagogy was the curriculum and assessment requirements of the South African Institute of Chartered Accountants (SAICA), the regulatory professional association. This paper reports on the influence exerted upon pedagogues by those requirements. A qualitative case-study research design was used and the data collection methods included teaching materials, conventional and video-stimulated reflection (VSR) interviews as well as lecture and tutorial observations. Contrary to the learner-centred teaching approach advocated by SAICA, the participants' pedagogy was found to be teacher-centred. This appears to be explained by their restricted pedagogical knowledge arising from inadequate teacher education and deficiencies in continuing professional development (CPD). VSR, however, proved to be a powerful means of prompting critical reflection from the participants and diagnosing inadequacies requiring CPD. SAICA's curriculum and assessment requirements, given the participants' inadequate teacher training and development, were a pervasive constraining influence on their pedagogy. In particular, pedagogues' preoccupation with preparing students for SAICA's examinations was of concern and warrants further research.

Keywords: professional accounting associations, accounting pedagogy, video-stimulated reflection, higher education, managerial accounting and finance, continuing professional development

Introduction

The extent to which professional accounting associations (PAAs) as regulatory bodies rely on higher education institutions to educate their prospective members varies across the world. South Africa represents one extreme in which the South African Institute of Chartered Accountants (SAICA) has delegated full responsibility for academic education to accredited universities but has retained considerable control of the curriculum (Venter & de Villiers 2013). At the other extreme, the Institute of Chartered Accountants of England and Wales (ICAEW) is fully responsible for professional education and does not require its aspirant members to hold a university degree (Annisette & Kirkham 2007). Under those circumstances the professional association (PA) has considerably less influence over university programmes than does its counterpart in South Africa. The university–professional association relationship has been marked by contestation at times, particularly when universities have perceived their autonomy to be under threat (Annisette & Kirkham 2007; Evans 2008).

Accounting education change has in a number of countries been the focus of investigations and reports over the years and various recommendations have been made to better equip students for their professional careers and for executing their societal responsibilities (e.g., Albrecht & Sack 2000; American Accounting Association (AAA) & American Institute of Certified Public Accountants (AICPA) 2012; American Education Change Commission (AECC) 1990; Botha 2001; Coetzee & Schmulian 2012; Hesketh 2011; van der Schyf 2008a; Venter & de Villiers 2013). One of the consistent recommendations of this literature has been the need for faculty to transform their pedagogy from teacher-centred to learner-centred approaches. Research findings reveal, however, that changes have been slow and limited, with a number of impediments having been identified (e.g. RW Adler, Milne & Stringer 2000; Coetzee & Schmulian 2012; May, Windal & Sylvestre 1995; Palm & Bisman 2010). Most of the studies in this regard were either survey and/or interview based and none appeared to include direct classroom observations, a shortcoming highlighted by some

researchers (Kane, Sandretto & Heath 2002; Leveson 2004) . With a view to remedying this deficiency, the larger study from which this paper is drawn included lecture and tutorial observations in the research design and methodology.

In this paper we explore the pedagogy of academics involved in the Advanced Managerial Accounting & Finance (AMAF) module at the University of KwaZulu-Natal. One of the most important factors affecting their pedagogy was the constraining influence exerted by the curriculum and assessment polices of SAICA, the accrediting body. This finding corroborates and adds to the existing body of evidence on the subject (Botha 2001; Coetzee & Schmulian 2012; Venter & de Villiers 2013). This aspect is discussed in the paper as well as the participants' progress in adopting more learner-centred approaches, SAICA's influence and universities' responsibility in this regard.

The paper is structured as follows: firstly, the difference between didactics and pedagogy is discussed, followed by a consideration of teacher- and student-centred pedagogy which is further elaborated in the literature review. Thereafter research into the relationship between PAAs and universities and their influence on accounting pedagogy is considered. This is followed by an explanation of the research methodology employed, the case study findings and implications and finally the conclusion and recommendations.

Didactics, Pedagogy, Teacher- and Learner-centred Approaches to Teaching

Didactics and pedagogy are separately identifiable concepts and streams of education research enquiry (Bertrand & Houssaye 1999) but the degree of distinction between the two varies across countries. Whereas in continental Europe a clear distinction is drawn between the two concepts, this is not the case in Anglo-American countries where the notion of didactics is downplayed (Hamilton 1999; Melissinopoulos 2013; Uljens 1997).

Drawing on the work of Bertrand & Houssaye (1999) and Bengtsson (1997), Melissinopoulos (2013) distinguishes didactics from pedagogy as they developed in continental Europe. Whereas didactics is more focused on describing current teaching practices, what they are and why, i.e. descriptive theorising, pedagogy focuses more on normative theorising i.e. what

educational goals ought to be, e.g. in respect of learners' role in society, appropriate teaching content as well as teachers' and learners' roles in the educational endeavour. As Melissinopoulos (2013) explains, however, these concepts can be linked through what Imsen (1999) refers to as the Learning Circle which consists of five stages. The first three stages involve describing, critically analysing and explaining the nature of teaching and learning in a particular setting (i.e. descriptive theorising), and the resulting new knowledge then forms the basis for evaluating the appropriateness of observed practice, for revising plans and recommending improvements (i.e. normative theorising).

Although in terms of the above distinction, this study would be classified more as didactics than pedagogy because it focuses more on participants' teaching practices, consistent with Anglo-American terminology and other similar accounting studies e.g. (Coetzee & Schmulian 2011; Palm & Bisman 2010) the term pedagogy will be used.

Two pedagogical orientations frequently encountered in education literature generally (Kember 1997; Kember & Kwan 2000; Lindblom-Ylänne, Trigwell, Nevgi & Ashwin 2006; Prosser, Trigwell & Taylor 1994; Virtanen & Lindblom-Ylänne 2010) and also in accounting education literature (R.W. Adler *et al.* 2000; Bonk & Smith 1998; Coetzee & Schmulian 2012; Kastantin & Novicevic 2008; Koma 2009; Leveson 2004; Lucas 2002) are what is referred to as, on the one hand, a teacher-centred approach and, on the other, a learner-centred one. In essence, teacher-centred pedagogy, based on the principles of behaviourism, is characterised by teachers transmitting or transferring large bodies of knowledge to students who, for the most part, are passive recipients. The focus of this teaching approach is on what the teacher does to organise, structure and impart content to students. Conversely, in student-centred pedagogy, based on constructivist principles, teaching is focused on helping students to construct their own knowledge and understanding through active involvement in the teaching and learning process. In the literature review that follows, the contrasting dimensions of these two approaches will be further elaborated.

Literature Review

Before considering higher education accounting pedagogy, its development and the role played by professional associations, the broader issue of PAAs'

relationship with academic accounting units needs to be discussed.

PAAs and Higher Education Accounting Units' Relationship

Because members of professional associations are generally regarded as possessing highly specialised complex knowledge, and universities are traditionally seen as the custodians of such knowledge (Friedson 1986), it is generally expected that a strong collaborative relationship would exist between professions and universities (Abbott 1988; Annisette & Kirkham 2007). While this is the case for many professions (Annisette & Kirkham 2007), the accounting profession university link is more tenuous and often a source of contestation around issues of curriculum and examination autonomy. (American Accounting Association (AAA) 1986; Arthur Andersen & Co. *et al.* 1986; Botha 2001; Coetzee & Schmulian 2012; Cooper, Everett & Neu 2005; Evans 2008; van der Schyf 2008a; Venter & de Villiers 2013; Zeff 1989). While accounting academics in other countries have by and large resisted the attempts of PAAs to exercise greater influence over their activities, the resistance of their South African counterparts to SAICA's powerful influence has been rather muted. The historical reasons for this are explained below.

Employing institutional theory, Venter and de Villiers (2013) explain how the South African accounting profession managed to gain and maintain its powerful position in university accounting departments and why accounting faculty offered relatively little resistance. Although SAICA was only formally constituted in 1980, from 1945 onwards the profession operated under the auspices of a national coordinating body which in 1950 was able to successfully negotiate an arrangement under whose terms the universities took responsibility for preliminary professional accounting education while the profession took charge of the final qualifying examinations. Then in the 1970s and 1980s the profession was able to further cement its relationship with the universities because at that time foreign based accounting associations were either not operating in South Africa, owing to the country's apartheid-related pariah status, or if they were in South Africa they preferred to maintain a low profile. Also during this period, while other countries, e.g. the UK, were appointing faculty with research-based higher degrees (Annisette & Kirkham 2007), this was not the case in South African universities which were predominantly recruiting CA-qualified

personnel. Thus SAICA members were well represented in university accounting departments, and this situation has persisted because one of SAICA's accreditation requirements is that the majority of faculty teaching on a CA programme must be CA-qualified.

SAICA's indirect legal authority for accrediting university accounting programmes further placed it in a very powerful position vis-à-vis universities. Thus accounting programmes must demonstrate, among other requirements, that they address SAICA's detailed competency requirements and achieve minimum pass rates in its external examination, the Initial Test of Competence (ITC). Not only is poor ITC performance a threat to a programme's accreditation, but the manner in which SAICA publicly compares universities' ITC results exerts considerable pressure to achieve and maintain high pass rates (Botha 2001) and so enhance an institution's reputation. Added to this is the fact that subvention payments to accounting faculty are significantly influenced by ITC performance. All these factors, then, combine to give considerable leverage to SAICA over university accounting programmes even as they encourage a 'teaching to the test' mentality among accounting lecturers (Botha 2001; Venter & de Villiers 2013). The focus on the external examination serves to narrow the curriculum to which students are exposed as they expect to be coached to success (Botha 2001; Coetzee & Schmulian 2012); hence internal assessments replicate those set by the professional association (Coetzee & Schmulian 2012). These are circumstances that tend to favour a teacher-centred pedagogical praxis even though a learner-centred one has far greater potential to empower and develop students (Botha 2001; Coetzee & Schmulian 2012; Hesketh 2011) and prepare them for lifelong learning.

What further reinforces SAICA's influence is the status it enjoys both locally and overseas, being highly regarded by South African employers (Venter & de Villiers 2013) and the CA(SA) qualification being ranked first among 144 nations in respect of 'Strength of auditing and reporting standards' (Schwab & Xavier 2013: 347), one of the indicators used in determining the rankings of the 2013-2014 Global Competitiveness Index.

Further cementing SAICA's influence is the fact that most university accounting department heads are CAs who identify strongly with SAICA since they *'derive their status and financial benefits from their association with SAICA'* (Venter & de Villiers 2013: 1266). Not surprisingly, then, meeting SAICA's requirements has become institutionalised in South African

university accounting departments - which explains why there is, and has been, relatively little resistance to the professional body's powerful influence. Nevertheless, as will be shown below, SAICA's influence on accounting education has not been without its critics (Botha 2001; Coetzee & Schmulian 2012; van der Schyf 2008a; Venter & de Villiers 2013).

With regard to SAICA's curriculum prior to the introduction of its competency-based model in 2010 and 2011 (SAICA 2011), concern was expressed about the narrowing influence of SAICA's requirements on accounting programme curricula (Coetzee & Schmulian 2012; van der Schyf 2008a; Venter & de Villiers 2013). Coetzee & Schmulian (2012), Venter and de Villiers (2013) highlighted the overemphasis on technical content in the financial accounting syllabi and in SAICA's qualifying examinations and hence the low priority accorded theoretical and social issues in the curriculum. They also drew attention to the volume of SAICA's curriculum which thwarted efforts to broaden its scope, e.g. by introducing an Accounting Theory course (Venter & de Villiers 2013). In similar vein, though more generally, van der Schyf (2008a: 20) pointed out that the SAICA's syllabi did not expose students *'... to the conceptual foundations of accounting (accounting theory) and research methodology'*, which resulted in accounting lecturers not gaining proficiency in those areas. In addition, most faculty members themselves being CAs had been taught according to SAICA's curriculum which, as indicated above, did not foster the development of research skills (Venter & de Villiers 2013). Thus the extensive technical requirements of SAICA's curriculum have encouraged an emphasis on technical teaching at the expense of an exploration of wider accounting issues (Venter & de Villiers 2013). Moreover, the volume of the curriculum combined with a lack of research expertise among accounting lecturers has resulted in restricted research activities so that accounting departments contribute very little to knowledge development, which is after all one of the primary functions of a university (van der Schyf 2008a; Venter & de Villiers 2013).

A further narrowing effect of SAICA's curriculum, identified by Botha (2001) and confirmed by Coetzee & Schumulian (2012), was its concentration on knowledge acquisition with considerably less attention being directed to promoting professional skills and attitudes. In 2010, however, SAICA revised its curriculum requirements, replacing its 'knowledge-based' syllabi (SAICA 2011: 3) with a competency-based

framework. A significant change in the framework was the greater emphasis placed on developing students' '*pervasive qualities and skills*' (SAICA 2011: 20-34), listed in detail and grouped into three categories: '*Ethical Behaviour and Professionalism, Personal Attributes and Professional Skills'*. SAICA's intention is that these qualities and skills, together with the required competencies in the core accounting disciplines, Financial Management, Auditing and Taxation, *'... would combine to produce the technical excellence, integrity, objectivity and commitment to public interest for which the CA profession is known'* (SAICA 2011: 20). However, the continued emphasis on technical requirements, particularly in Financial Accounting, Auditing and Taxation, as evidenced by lengthy examinable pronouncements[1], as well as the continued voluminous curriculum requirements, may hamper the development of the desired pervasive qualities and skills, which are indeed better fostered by student-centred teaching approaches, as emphasised in the accounting education change literature, details of which are discussed in the next section of the literature review.

Professional associations' influence over accounting education has been criticised and contested in other countries too. In the US, for example, the American Institute of Chartered Professional Accountants (AICPA) has, like SAICA, delegated academic education to accredited universities but this process has not been without its critics. Cooper, Everett, & Neu (2005) pointed out that because of this arrangement the AICPA's professional examinations have significantly influenced university curricula and both the Bedford Committee (American Accounting Association (AAA) 1986) and the Big 8 accounting firms (Arthur Andersen & Co. *et al.* 1986) recommended that passing CPA examinations should not be a primary objective of accounting education. Kren, Tatum & Phillips (1993) reported that some of the 1980 accreditation standards were criticised for being over-prescriptive and hindering programme innovation and development. Subsequently, however, the standards were revised to allow for greater curriculum flexibility with respect to structure and content.

In the UK, the Institute of Chartered Accountants of England and Wales (ICAEW), like its counterparts in Scotland and Ireland, does not

[1] The examinable pronouncements specify the scope and depth of relevant legislation, statements or standards that will apply to SAICA's specific ITC examinations.

require aspirant members to hold university degrees; instead the Institute itself is responsible for their professional education. Because of this arrangement, UK universities are afforded much greater autonomy over accounting education than is the case in South Africa, and attempts by the professional association to impinge on their independence in the 1980s were rebuffed (Annisette & Kirkham 2007: 19). Similarly, in 1970, higher education institutions in Australia resisted attempts by the Australian Society of Accountants to introduce a qualifying examination for their students (Evans 2008).

To summarise: SAICA exercises considerable influence over the activities of South African university accounting departments through its accreditation requirements, effective control of the curriculum, the reputational and financial pressures exerted by its ITC qualifying examinations, and its strong constituency of members who comprise the majority of departmental staff. In other countries PAAs have considerably less influence either because aspirant professional accountants do not require a university accounting degree or, if they do, the universities enjoy more curriculum autonomy and are not subject to the same pressures related to performance in PAA-administered examinations.

With this as background, the current complexion and possible future development of higher education accounting pedagogy and the role of professional associations will now be discussed.

Accounting Pedagogy's Development and PAA's Influence

There have been persistent calls over a long period of time for accounting faculty to transform their teacher-centred pedagogy and adopt more learner-centred approaches so as better to equip students for a work environment characterised by constant change and a demand for more than just technical proficiency (Albrecht & Sack, 2000; American Accounting Association (AAA) 1986; American Accounting Association (AAA) & American Institute of Certified Public Accountants (AICPA) 2012; American Education Change Commission (AECC) 1990; Botha 2001; Bui & Porter 2010; Coetzee & Schmulian 2012; Hesketh 2011; Howieson 2003; Parker 2001). This body of literature highlights the ill-suitedness of teacher-centred pedagogy to the creation of learning experiences that will enable students to develop the

required professional skills and attitudes, and thus points to the need to adopt learner-centred approaches conducive to the development of critical thinking, problem solving, leadership, team work and communication skills. In addition, Sharma's research (1997; 1998) revealed links between teacher-centred learning environments and students' superficial approach to learning on the one hand and, on the other, learner-centred environments and a deeper, more critically aware approach to learning. This finding is consistent with those in other higher-education disciplines (Ramsden 2003; Trigwell & Prosser 2004).

A teacher-centred pedagogical praxis, in accounting, is characterised by conventional lecture and tutorial strategies (R W. Adler *et al.* 2000; Palm & Bisman 2010), teacher-dominated communication (Williams 1993) and textbook-intensive knowledge transmission during which students remain largely passive (May *et al.* 1995). Highly structured, naively straightforward and often contrived textbook problems with single correct answers are overemphasised to the detriment of exposing students to the kind of ambiguity that characterises much of real-world decision making (Albrecht & Sack 2000; American Accounting Association (AAA) 1986; American Education Change Commission (AECC) 1990; Springer & Borthick 2007; Williams 1993).

A student-centred teaching and learning environment on the other hand is characterised by learners' active participation and interaction in the teaching and learning process (R.W. Adler *et al.* 2000; Keddie & Trotter 1998). In this way each learner, against the background of his/her personal experience, is able to socially construct his/her own understanding of concepts. Lecturers no longer attempt to transfer pre-packaged knowledge and understanding to students; instead they focus on facilitating students' personal meaning-making (Snowman & Biehler 2000). Changing from teacher- to student-centred pedagogy requires the introduction of innovative teaching methods and assessment, examples of which include case studies and group work (International Federation of Accountants (IFAC) 1996), role plays, simulations, writing assignments (Bonk & Smith 1998), and problem-based learning (Milne & McConnell 2001). While subject content, assignments and assessments need to be challenging enough to develop students' critical thinking and problem-solving skills, at the same time, in order to emphasise their relevance, they need to be grounded in real-world practice (Hesketh 2011; Springer & Borthick 2007).

Although some faculty over the years have heeded such recommendations and adopted more learner-centred approaches, it appears that teacher-centred pedagogy still dominates (R.W. Adler *et al.* 2000; American Accounting Association (AAA) & American Institute of Certified Public Accountants (AICPA) 2012; Coetzee & Schmulian 2012; Hesketh 2011; Lucas 2002; May *et al.* 1995; Palm & Bisman 2010). Adler *et al.* (2000) found some evidence of learner-centred activities such as seminar discussion groups and case studies, but these were the exceptions. Palm & Bisman (2010: 192) concluded that although some faculty indicated adoption of more creative teaching and learning practices such as '*... on-line quizzes, ... real-world case studies ... and student group presentations*', the opportunities to effectively facilitate student-centred learning within the conventional large-class lecture environment appeared to be limited.

Researchers have identified a number of impediments to the more widespread adoption of learner-centred pedagogy (R.W. Adler *et al.* 2000; American Accounting Association (AAA) & American Institute of Certified Public Accountants (AICPA) 2012; Coetzee & Schmulian 2012; May *et al.* 1995; Stout 1996). These will now be discussed using Adler et al.'s (2000: 118-128) classification framework, i.e. *'Student readiness, Educator support mechanisms and Non-reflective educator practices'* as well as other categories where necessary.

Student Readiness

Students' conception of their role as passive recipients and of the role of faculty members as expert transmitters of knowledge acted as a deterrent to adopting learner-centred pedagogy (R.W. Adler *et al.* 2000). Similarly, as mentioned before, the high-stakes nature of the professional association's examinations encouraged students to seek to be coached, thereby facilitating the entrenchment of a teacher-centred pedagogy (Coetzee & Schmulian 2012).

Educator Support Mechanisms

A consistently reported impediment to adopting learner-centred approaches is that, compared to research accomplishments, teaching innovation and development is undervalued by educational institutions' reward and

recognition polices (R.W. Adler *et al.* 2000; American Accounting Association (AAA) & American Institute of Certified Public Accountants (AICPA) 2012). Similarly, SAICA's subvention scheme, which places strong emphasis on rewarding success in the ITC examinations, may inadvertently be discouraging teaching innovation. To the extent that success in these exams is achievable through intensive coaching and 'top-down' teaching practices, there will be a continuing disincentive to implement a more progressive pedagogical regime. In addition, faculty members' restricted pedagogical knowledge, arising from inadequate teacher training and development, contributes to the flagging implementation of effective teaching practices (R.W. Adler *et al.* 2000; American Accounting Association (AAA) & American Institute of Certified Public Accountants (AICPA) 2012; May *et al.* 1995).

Non-reflective Teaching Approaches

The tendency for faculty to teach as they were taught, coupled with inadequate higher education teaching development, results in teacher-centred methods being perpetuated (R.W. Adler *et al.* 2000; American Accounting Association (AAA) & American Institute of Certified Public Accountants (AICPA) 2012).

Professional Associations' Curriculum Requirements

Although this category was not included by Adler et al. (2000), their study nonetheless revealed some of its drawbacks. Technically orientated, rules-based curricula encourage the perpetuation of teacher-centred approaches (Coetzee & Schmulian 2012), and voluminous curricula leave little time for learner-centred activities in the quest to address the professional associations' content requirements (R.W. Adler *et al.* 2000; Coetzee & Schmulian 2012).

At a more general level, the Pathways Commission report (American Accounting Association (AAA) & American Institute of Certified Public Accountants (AICPA) 2012: 14) attributed the slow pace of change in accounting education to the fact that *'... most past efforts at renewal have lacked an explicit implementation strategy and structure to move their recommendations forward on a systematic and properly resourced basis'.*

They therefore recommended that the relevant stakeholders - academics, professional associations and practitioners - needed to devise and enact an appropriate implementation strategy.

SAICA's Curriculum Revision - A Possible Catalyst for Learner-centred Pedagogy

SAICA's revised curriculum, as it finds expression in the competency framework (SAICA 2011), may perhaps act as a catalyst for pedagogical change given its implied advocacy of learner-centred teaching strategies. For example, the educational philosophy informing the competency framework is based on:

> ... some of the core ideas of John Dewey (SAICA 2011: 9) and ...if appropriately taught and assessed, the new requirement [pervasive qualities and skills] will materially advance the students' mastery of technical competencies. Students make sense of knowledge when ... the first contact with new material involves some trial and error, 'with something to do rather than to learn' (Dewey 1915: 10) and requiring independent thought and noting of connections (SAICA 2011: 9).

These sentiments are consistent with experiential learning and learner-centred teaching approaches. But, as noted above, the continued emphasis in the curriculum on technical issues, coupled with its sheer volume, may militate against the adoption of a student-centred pedagogy, particularly if the impediments identified heretofore are not addressed. This view is supported by Coetzee & Schmulian (2012: 95):

> ... the extent to which such a change can be achieved is largely dependent on a reduction of the current level of technical knowledge expected of the students, and a fundamental revision of the nature of the professional accountancy examination and/or the academes' focus thereon, particularly at an introductory level ....

While some of the qualities and skills which SAICA would like to see stu-

dents acquire in terms of its revised curriculum are better developed in the workplace (e.g. managing and supervising staff), accredited institutions of higher learning are required to show how their accounting curricula will foster the development of the desired qualities and skills and whether some of them might be beyond their power to address. SAICA for its part does not prescribe how the qualities and skills in question are to be transferred to students but expects the accredited institutions to design programmes that will incorporate learning opportunities conducive to their transfer and development.

Methodology

The study was located within an interpretative paradigm and consequently was qualitative in nature. Given the many and varied factors that impact individuals' pedagogical praxis, an exploratory case-study research design was employed (Hitchcock & Hughes 1995; Yin 2009) involving four participants, two teaching the undergraduate module, Managerial Accounting and Finance 300 (MAF300) and two the postgraduate module, Advanced Managerial Accounting and Finance (AMAF). Multiple data sources were used to explore the phenomena with each participant's data set comprising: module outlines, lecture and tutorial materials (Rule & John 2011); an initial interview (Bogden & Biklen 1992; Patton 1990); six hours of video-recorded observations, three for lectures and three for tutorials (Patton 1990; Simpson & Tuson 2003), as well as two video-stimulated reflection interviews (Lyle 2003; Muir, Beswick & Williamson 2010; Powell 2005). Given the size and richness of each data set, it was decided to confine the study to the two participants teaching the postgraduate module, and for this paper only the lecture-related data were used. Each varied data set not only revealed different aspects of the phenomena studied but also contributed to the trustworthiness of the findings through triangulation.

Findings

The professional association's (SAICA's) general influence on the participants' pedagogy will first be considered followed by a discussion of

each participant's practice. To preserve their anonymity the participants have been given the pseudonyms Dan and Sue.

The Regulatory Body's Dominant Influence on Teaching Practices - Perceived as Constraining

In commenting on the influence of SAICA's qualifying examination (QE) on his teaching, Dan stated:

> ... I mean, if you're teaching at an honours level, you know, most of these students are there because they want to firstly get to write the QE and then secondly to pass it. So, I don't know, rightly or wrongly, a lot of the emphasis is on what could be in the QE and how you need to prepare yourself for it (II 77-79).

From the students' perspective, because they were in their final year of study, the prospect of gaining entry to and passing the QE was that much more real than in the earlier years of their degree and so for most of them that was an overriding objective. To meet their expectations, Dan felt compelled to give a great deal of attention to considering what aspects might or might not be examined in the QE and preparing his students accordingly. He however signalled some misgivings about the extent of the influence that the regulatory body's examinations exerted on his teaching practice, implying that he would have preferred greater flexibility with regard to content and assessment than was currently the case.

Sue's comments during the initial interview concerning changes in the nature of her lecturing over the years bear further witness to the dominant influence of the regulatory body's requirements on her teaching practice:

> I used to teach Strategy to the fourth years ... at DUT [Durban University of Technology] and that was really, it was actually very nice lecturing to do because everything could be contextualised in terms of what was going on in the real world. And you didn't have to worry so much about a SAICA exam or whatever; it was your exam at the end of the day... And I find that difficult now and I think it's for two reasons, because firstly I think there's a lot more work to

> cover so I think you don't have a lot of time ... And also you've got to think about the way it's examined at the end of the day so you're actually trying to get the level of understanding they need in order to answer the exam question. So there's a degree to which you are teaching to an exam at the end of the day (II 527-536).

Sue thoroughly enjoyed lecturing the *Strategy* module at her former employer, DUT, because she was able to relate theoretical content and principles to actual practices in the world at large. In addition, she was not burdened by concerns of ensuring compliance with an external regulatory body's curriculum or of preparing her students for that body's assessment. In her current situation, however, the regulatory body's considerably larger curriculum allowed less time, in her opinion, for contextualising content. In addition, more time had to be devoted to ensuring that her students achieved the necessary level of understanding required by the external assessments. Thus, currently, her efforts were directed more towards preparing students for their external assessments than towards relating concepts and principles to actual business practices, which formerly she was able to do being unhampered by the requirements of an external regulatory body.

Paradoxically, the regulatory body's Competency Framework (SAICA 2011) strongly advocates the linking of theoretical content to its practical application and yet, as far as Sue was concerned, the body's own curriculum and examination requirements were hindering her from realising the desired contextualisation. In further discussion on this matter during the interview, she added, however, that a contributing factor to her difficulty in contextualising lecture content currently was that, in her opinion, the Strategy module lent itself more easily to using current business illustrations than did Managerial Accounting.

It is however possible that the time constraints Sue experienced may have been principally related to what appear to be her content-coverage conception of teaching, as evidenced by her statement above: '*... there's a lot more work to cover so I think you don't have a lot of time ...'*. This possibility will be further explored later.

An analysis of the teaching materials and of the interview and observation data revealed the pervasive influence of the regulatory body's curriculum and examination requirements on Dan's and Sue's teaching practices: e.g. Dan curtailed some of his more advanced lecture content

because he adjudged it to be beyond the curriculum's scope and both Dan and Sue aligned tutorial content and internal assessment practices with recent trends and developments in the regulatory body's external assessment policies and procedures.

Both Dan and Sue stressed the fact that a significant focus of their teaching practice was preparing their students for the regulatory body's external assessments but they also expressed some misgivings, either implicitly or directly, about the constraints that this imposed in terms of their content and assessment decisions.

From the above analysis we may infer that although Dan and Sue had a degree of autonomy over their content and assessment decisions, and, in theory, could have pursued the goal of promoting their students' broader intellectual development instead of teaching towards SAICA's requirements, in practice not only did the accreditation-related threat of the consequences of poor QE performance prevent them from doing so, but they also felt compelled to meet their students' real-world expectations.

Having demonstrated the pervasive influence of the regulatory body's requirements on the participants' teaching practices, we shall now examine Dan's and Sue's lecturing praxis, the tensions experienced and the alternative pedagogies considered or implemented, together with their related constraints. Each case will be dealt with separately initially and then overall conclusions drawn in the discussion section.

Case 1 - Dan's Progress towards Implementing Learner-centred Pedagogy

Conventional Pedagogy Restricts Students' Engagement and Understanding

As was evident from observing Dan's lectures, he adopted a conventional teacher-centred approach in that he tended to transmit information to his students who seldom actively participated through dialogue or interaction with either him or their peers. But his viewing of a particular episode during the VSR interview, in which a student asked him to re-explain a concept, prompted him to question the effectiveness of his lecturing in facilitating conceptual understanding:

> It actually makes you wonder how effective lecturing is as a teaching tool ... it's [the principle he was re-explaining is] really a basic concept ... if she just failed to understand the logic of it, then you really wonder how much do they actually grasp when you're just lecturing continuously without any interaction with the class ... (LVSR 258-265).

The limitation of his pedagogy stood out with particular sharpness because he regarded the issue at hand as being a basic construct, implying thereby that the final-year student should have understood it without any need for further explanation. As will be explained later, the use of VSR interviews unexpectedly proved to be a useful means of collegial continuing professional development (CPD).

Dan's comments above suggest that he regarded student engagement through interaction as an important facilitator of students' conceptual development and his statement below, explaining why he included lecture example solutions in students' notes, confirms this impression.

Time Pressures Constrain Students' Engagement: Content-coverage Compulsion and Inappropriate Timetabling Structure

> I think it's just time constraints, there's so much to go through during the lecture, if you're going to ask them to do the solution every time you're just not going to cover the material. ... Ideally you would want to be as interactive as possible and for them to work out as much as possible, because that's really how they're going to learn, but it's just a matter of time constraints, nothing else (LVSR 276-280).

So Dan recognised the importance of ongoing interaction and student participation for knowledge development during lectures but was prevented from giving this educational imperative its due owing to time pressures related to his perception of the need to complete the regulatory body's required content. By emphasising his sense of a compulsion to make sure the required content was covered, Dan was disclosing an important element of his teaching conception, namely a content-coverage focus which may have

been one of the underlying reasons for the time pressures he experienced, even though he attributed them to external and structural factors as explained below:

> There are two issues, one is just the SAICA syllabus, I think, there's just so much in the syllabus the students are expected to know that it makes it very difficult to spend a lot of time on individual topics. And then the other issue ... we've got a timetable that's traditionally been there. I mean, no one has really questioned it as to whether it should be like that, but maybe that's something we need to explore (LVSR 285-290).

In his opinion there were two contributing factors to the time pressures he experienced. The first was external, i.e. SAICA's curriculum, and the second structural, namely the timetable. We may infer from his comments that if he were to make space for the kind of ongoing interaction he desired, not enough time would be left for him to address what he regarded as SAICA's vast curriculum requirements. The evident tension though is that by limiting interaction during lectures, students' ability to gain the necessary understanding and competencies would be compromised. Possibly if he had been more selective about what content to introduce into lectures and what to leave for students to address on their own, the time pressures would have been less severe, thus enabling him to interact more with his students. The more fundamental question, however, is the impact that SAICA's content-intensive and technically orientated curriculum has on accounting education more generally in the sense that, as discussed above, it is felt that there is no time to spare for engaging with more theoretical issues such as the conceptual foundations of management accounting and their impact on society. This will be considered in more detail in the discussion section.

The other issue Dan raised was that the long established timetable for his module and the diploma as a whole possibly contributed to his sense of always working against the clock. Though no one had questioned the suitability of the timetable structure, perhaps the time had come to do so, having regard to the time pressures he was experiencing.

The diploma's timetable allocates consecutive days to each of the programme's four modules, and each module's lectures and tutorials for the week all occur in the morning of the allocated day. For example, for Dan's

module, the timetable specifies a double-period tutorial (90 minutes) followed by a triple lecture (135 minutes). One of the timetabling issues Dan alluded to in the course of the interview was the merits of packing so much into a single morning. Perhaps student learning and engagement would be better served by spreading the module's content over a more extended period thus allowing time for reflection and the internalisation of one set of concepts before the introduction of others. A further possible benefit of a less concentrated timetable might be a more alert and attentive body of students, capable of grasping concepts more readily, thereby easing some of the time pressures weighing upon Dan.

These pressures, which contributed to his adopting a teacher-centred, content-focused lecturing approach, were driven firstly by a compulsion to cover the regulatory body's oversized curriculum and secondly by a timetable design too concentrated to support optimally the teaching and – from the students' standpoint – the learning of that curriculum.

Further insights into the time pressures Dan experienced were revealed in his response concerning the role of students' prior learning in alleviating them.

Time Pressures: Instrumental Learning Necessitates Re-teaching

> I think it [prior learning] does [alleviate time pressures], but also the problem is ... if you look at the question that was asked by the student where I had to explain a second time ... you again wonder how much knowledge are they retaining ... should I really even be covering this [Financial Statement Analysis] because they do this in first year, second year and third year. But I have to do it because I cannot assume that they know it, there is something missing ... I think it goes back to that problem of exams and people are targeting the learning just to pass an exam and then nothing is retained after that (LVSR 295-300, 306-308).

Although Dan acknowledged that students' prior learning did sometimes ease

time pressures, he expressed doubt about students' prior knowledge in the light, for example, of the above request for a re-explanation of something which would have been addressed in each of her undergraduate years. Consequently, he felt compelled to re-teach this concept and suggested the problem stemmed from students' instrumental approach to learning which targeted passing examinations at the expense, by inference, of acquiring conceptual mastery of the basic postulates of the discipline and their interrelationship. Thus, in his opinion, because of their superficial learning habits, students were often unable to transfer key knowledge from prior to subsequent years. His comments raise questions about the efficacy of undergraduate teaching and assessment given that, as previous studies have shown, (Friedlan 1995; Gow, Kember & Cooper 1994; Mladenovic 2000; Sharma 1997), students' approach to learning accounting is significantly influenced by the teaching and learning context.

Catalysts for Implementing Learner-centred Pedagogy: Enhanced Learning Opportunity and the Professional Body's Assessment Practices

Dan was then asked to suggest the type of learning activities that could be incorporated into the curriculum to foster better knowledge retention as well as transfer across academic levels. He replied:

> ... maybe case studies which give a real-world scenario ... and then group work ... So, that's then more targeted towards understanding the problem and resolving the problem, rather than focusing on a typical type of question where you've got to work out certain numbers and then see whether you've got enough marks to pass that particular question ... and then presenting your solution to a complex ... multidimensional problem that may incorporate strategy, tax, financial accounting and management accounting ... I think they learn a lot more from that. And maybe that is the way that SAICA is moving now, so I think probably now we have to rethink what we're teaching (LVSR 311-321).

Dan suggested that group-based case studies, simulating as far as possible

actual business practices, would be appropriate tools for fostering deeper understanding and knowledge transfer. To be authentic, however, the issues to be resolved should be challenging and not confined to MAF but rather multidisciplinary in nature, incorporating the other core accounting disciplines and situated within a firm's overall strategic context. By undertaking case studies in groups, students would be in a position to share knowledge and insights while grappling to identify and understand the issues to be resolved and then, through further discussion and debate, come up with feasible solutions to be presented to the class. Compared to existing learning activities, which, in Dan's opinion, oversimplified business issues, were too discipline-specific and encouraged a superficial engagement by students, whereas those he advocated had the potential to deepen significantly students' knowledge base and at the same time to improve knowledge transfer. Furthermore, Dan was of the opinion that perhaps SAICA was moving in the direction of case-based assessment and because of that he and his colleagues should consider changing their teaching approach, which, by implication, would entail moving away from teacher-centred to learner-centred strategies. Dan was then asked if, in his opinion, there were any constraints or hindrances that might prevent his implementing case-based teaching, to which he responded.

Catalyst for Change - Critical Reflection Prompted by VSR Interview Methodology

> No, I think it's something we need to look at. I think it's just that we've been caught up in this traditional mode, this is how we were taught and now we're going to teach in the same way. So, I think maybe it's time for a fundamental rethink about this model of just traditional lectures in front of the class and then tutorials... (LVSR 328-331).

In Dan's view, then, there were no specific obstacles to implementing case-based teaching. The reason it had not been considered as an alternative to the existing teacher-centred approach was that accounting academics were

probably unaware of alternative approaches and so adopted the same teaching methods to which they had been exposed as students, in other words teaching as they were taught. But it was now time for a complete re-evaluation of the existing conventional pedagogy, and by using the phrase '*a fundamental rethink'* Dan may have had in mind not just a switch to a different teaching strategy but also an interrogation of the underlying premises and conceptions of teaching and learning held by accounting academics.

The fact that, in his opinion, accounting lecturers had not considered alternative teaching approaches suggests not only inadequate reflection on the effectiveness of their teaching but also a lack of exposure to formal teacher training and continuing professional development (CPD), an issue that will be elaborated on later. It also points to their lack of engagement with the accounting education literature, suggesting perhaps a weak research culture within their academic home.

It is probable that Dan's critical reflection on the weaknesses of the prevailing teacher-centred model of transmissive pedagogy, and the need to consider alternatives, was prompted by his realisation of the shortcomings of his own teaching approach, which the video-stimulated reflection (VSR) interview process thrust into vivid relief. This suggests that VSR interview methodology has the potential to be used for professional development purposes and Dan's comments below, at the end of the VSR interview, lend support to this notion:

> ... and it's actually been very interesting for me, you've got me thinking about certain things, which I think is good, because sometimes we just sort of get into this mode of doing it the same way we've done it every year and we carry on. So, at least, you know, if you ask us questions we start thinking about what we're doing and why we're doing it, which is something we don't often do (LVSR 778-782).

Dan clearly found the VSR interview process worthwhile because it prompted him to critically reflect on his teaching praxis and its underlying rationale, something he had seldom done previously, as reflected in his tendency to adopt unquestioningly the same teaching habits year after year.

The context within which the VSR interview was conducted may have contributed to its success in prompting Dan's critical reflections and

thereby encouraging him to consider alternative pedagogies: Dan's interviewer was a colleague involved in teaching the same module; had similar teaching experience and emphasised that the purpose of the interview was research related and not in any way evaluative. In addition, confidentiality was assured. Thus it is possible that because of the collegial setting and the mutual respect and trust that existed between interviewer and interviewee, Dan considered it safe to acknowledge limitations in his practice and to ponder alternatives. As a vehicle for professional development, the VSR interview, along with the particular format it assumed in Dan's case, may be more effective at stimulating critical reflection than any other CPD activity.

Despite his openness to critical self-scrutiny, Dan's comments regarding the implementation of case-based teaching reveal a rather limited understanding of this pedagogy and point accordingly to the need for training and professional development.

Case-based Pedagogical Knowledge Gaps and the Need for CPD

> So, you know ... you may end up in a situation where you're not doing a lot of teaching, but you're actually listening to students presenting to you and then you're giving feedback to them, rather than it being the other way around which it currently is. So ... does that make up your teaching? Well, I suppose it's contact time, but is that going to be accepted now that you're teaching, I don't know...? (LVSR 353-358).

Dan wondered whether a case-based pedagogy which entailed listening to student presentations and providing feedback, as opposed to his current teacher-led lecturing methodology, would be regarded as teaching in terms of workload protocols. He seemed to betray almost a sense of guilt that perhaps he would be failing in his teaching responsibilities if he were to embrace a case-study model. What Dan's comments reveal is that his conception of teaching was so deeply embedded in teacher-centred paradigms that he found it difficult even to conceive that a case-based pedagogy could constitute

teaching. This is not surprising given the fact that he had only ever been exposed to conventional teaching methodologies and had never participated in any formal CPD programmes.

What also emerges from his comments above is an incomplete understanding of his role in a case-based setting. It appears that he saw his role as being primarily to listen to case presentations and to provide feedback. This suggests that he did not fully appreciate how learning during case-study deliberations could be facilitated by, for example, posing strategic questions as a means of guiding students in their several groups to identify key issues and reach feasible solutions. Nor did he comment on the importance of his role as a facilitator of discussion and debate during case presentations. His comments suggest instead that he saw himself as the sole provider of feedback, which perhaps betrays the abiding influence of a teacher-centred conception of his role, even in the context of a case-based pedagogy. Dan's restricted understanding of his role reflects the absence of, and the need for, CPD as a means of exposing him to alternative teaching paradigms, in particular case-based teaching.

Dan's biographical information, disclosed prior to the initial interview, indicated that he had never received any formal teacher education, training or guidance; and his comments below suggest that accounting lecturers' lack of CPD has worked to the detriment of their proficiency as teachers:

> So, I mean, accountants just came into academia and just taught intuitively without any formal training in education ... so maybe we haven't really benefited by being exposed to the real educationists and different teaching models and teaching approaches. So, I think from that point of view perhaps there is some development that's lacking over there (LVSR 720-726).

In response to the lack of teacher training not just of accountants but of most appointees to academic positions, the University of KwaZulu-Natal has in recent years introduced formal teacher induction modules for all newly appointed lecturers, and it is anticipated that this initiative will to some extent address the problem of the limited pedagogical competence of appointees to academic positions in accounting.

Case 2 - Sue's Progress towards Adopting Learner-centred Pedagogy

In this section we will consider the nature of Sue's existing lecturing pedagogy, the limitations that she identified and an intervention she implemented to address the perceived limitations.

Sue's explanation of her role and that of her students in the lecture setting revealed her approach to lecturing Advanced Managerial Accounting and Finance (AMAF).

Teacher-centred, Content-intensive Lecturing Approach

> ... So I kind of go through most of what the textbook covers on a particular section ... So for me the lecturing is explaining in a fair amount of detail what the topic is, why it's important and then whatever calculations are necessary, how to go about those calculations with examples (II 391-394).
> ... they're [the students are] just there listening and trying to follow and understand whereas it could be more, they could be more participative (II 405-406).

Sue conceived of her lecturing role as involving the transmission of fairly detailed explanations of textbook content, its purpose and importance, and the demonstration, by way of examples, of the application of principles. Within this teacher-dominated context, her students played a largely passive role as they attempted to understand principles explained and techniques demonstrated. She expressed dissatisfaction, however, with her students' passivity and would have preferred them to be more actively engaged and participative. It is also apparent from her comments that her content-intensive lectures were driven, as were Dan's, by a felt need to cover large volumes of material. The lecture sessions observed confirmed her teacher-centred, content-intensive lecturing approach which, however, she attempted to moderate with the introduction of a more learner-centred activity, namely concept questions, details of which are discussed below.

Concept Questions - A Learner-centred Intervention Prompted by an Accounting-specific Initiative and Critical Reflection

As Sue's comments below indicate, her exposure to an intervention aimed at improving tutorial effectiveness in Managerial Accounting and Finance 300 (MAF300), an undergraduate module, together with her reflections on the perceived ineffectiveness of her teacher-centred pedagogy, motivated her to introduce a lecture activity, referred to as concept questions, whose purpose was to raise the level of student engagement:

> It basically is an idea I got from, there were two things - firstly, they used to do a concept question in MAF 300 tutorials when they did that exercise with Rosy[2] ... so the idea came from them ... also when we were having ... the bad pass rate ... I couldn't believe that these people had sat in my lectures for a whole year and then come out and they knew so little. And I thought, there's got to be some way of making the lectures more effective, making them participate more in the classroom (II 457-458, 471-474).

The tutorial intervention for MAF300 was an accounting-specific initiative suggested by experienced educational consultants whose 'brief' was to help undergraduate faculty to improve their tutorial effectiveness. The role it played in prompting Sue to initiate a learner-centred activity to improve her lecturing effectiveness demonstrates the importance of accounting lecturers being exposed to more progressive pedagogical ideas.

A further stimulus to Sue's introducing a learner-centred activity was her students' poor assessment performance, leading to critical reflection on her lecturing effectiveness. It seemed incredible to her that having been exposed to her teaching for a year, their knowledge and understanding appeared still to be so limited. She concluded, upon reflection, that getting her students to participate more actively in lectures would be a way of improving her lecturing effectiveness. It would seem from her comments however, that the way she envisaged achieving greater levels of participation was more by compulsion than by facilitating and stimulating students' voluntary involvement. If such was the case, it demonstrates the pervasive

[2] Name changed to preserve anonymity.

influence of a deep seated teacher-centred pedagogy and suggests that if Sue is to successfully implement a more learner-centred pedagogy, there is a need to make her aware, through appropriate CPD, first, of her conventional conditioning and, second, of the merits of alternative, more progressive teaching paradigms.

Sue explained how she had adapted the idea of concept questions as used in undergraduate tutorials and applied them to her postgraduate lecturing setting:

> ... because that was one of the motivations that Rosy ... gave for having it [the concept question] in the tutorial ... it would mean that when they [the students] were being taught [during lectures] they would realise that they were going to have to answer a question, so ... I thought to myself, well if it's right there in the context of the lecture surely that would work even better (II 465-468).

Sue reasoned that if one of the motivations for introducing concept questions into MAF300 tutorials was to encourage more active listening during lectures, so that students would be enabled to answer those questions in the follow-up tutorials, then requiring them to address concept questions directly in lectures should work to raise the level of student attentiveness and engagement.

She went on to clarify the nature and purpose of concept questions.

Concept Questions - Problem-situated Learning of a Fundamental Principle: Understanding not only the How but also the Why

> ... you can never cover everything that you're going to teach ... it's one of the key new principles in the lecture ... it's something you're going to do during that lecture but it needs to be obviously brief so that they can address it...(II 289-290, 293-294)

As there was insufficient time to incorporate all the principles of a new topic into a concept question, Sue selected a fundamental aspect and constructed a

short question around that, something students could answer in the time set aside for that activity during lectures. She realised, importantly, that the concept questions needed to focus less on issues of how than on why:

> ... when the marks were not so good I decided that the problem was that ... they don't understand why they're learning all these things. So I try to phrase the concept questions in terms of why, not just how do I do something but what problem does it answer?

Reflecting on her students' poor assessment performance, Sue concluded that their key problem was a lack of understanding of the purpose and relevance of what they were learning. To address this shortcoming, she attempted to situate concept questions within actual problems so that students would learn not only how to use the appropriate techniques but would also be brought to see the point and purpose of their calculations. For example, the concept question for the topic *Risk and Uncertainty* was set in the context of a company's having to decide whether or not to accept a new project for which there were four possible outcomes, each with an assigned probability of occurrence. Students were required to calculate the expected value of the project, the probability or realising a profit or incurring a loss, and then were required to discuss whether or not the project should be accepted. Thus students had the opportunity to test their understanding and application of a key principle and to use their calculations to address a specific problem. In that way the point of their calculations came to the fore, rather than being a mere technical exercise. It was hoped by these and similar means to make the relevance of the principles and techniques communicated to students in the lecture setting more readily understood and appreciated.

Sue explained how she implemented concept questions in lectures, commenting on the attendant constraints as well as on the benefits.

Implementation Time Constraints - Content-coverage Compulsion

> Before I start teaching, they read it. Then the theory is that ... they're going to listen in the context of the problem that they've been

> presented with. And then at the end there's supposed to be ... at least ten minutes to answer and discuss. That's why it has to be very short (II 431-433).

The planned procedure for handling a concept question was that it be introduced at the start of the lecture so that students were made aware of the issues to focus on during the lecture and address later when answering the concept question. But, as she noted, she was not always able to execute this plan. Of the three lecture sessions observed, the above plan was followed only in the second and third because by then, as Sue explained, she had caught up with the planned lecture programme. As she observed during the initial interview, time constraints had prevented her from implementing the planned procedure earlier. It is possible that the time pressures she experienced resulted from her attempting to introduce too much lecture content in the earlier weeks of the semester. Lending support to this scenario was her comment after the third session that, in future, she would restructure the lecture programme to avoid such time squeezes.

Commenting on the benefits of the initiative, Sue again referred to the importance of timing:

> The students have been very positive about it. And also ... when you time it right and get it working properly you definitely get more discussion in class than I've ever had before. So it does prompt discussion at least around that particular area if not about the whole lecture (II 481-484).

Sue's experience was that students found concept questions very helpful, possibly because by listening more attentively, then attempting the questions and participating during feedback periods, they were more actively involved than was normally the case during lectures, and this greater engagement not only enhanced their understanding of the particular issue(s) under consideration but also facilitated their general conceptual development. At the time the interview with Sue was conducted, she had not yet been able to implement concept questions as planned, and so her comments concerning students' strong endorsement of the initiative would have been in respect of the previous year's group.

Inability to Sustain Active Student Engagement - Need for CPD

Notwithstanding the benefits flowing from the introduction of concept questions, Sue found that she was unable to sustain the same raised level of student participation throughout her lectures, probably because, as was observed, she tended to slip back into her more familiar teacher-centred, transmissive mode of instruction. Thus, despite her clear desire for improved levels of student interaction and participation, Sue appeared to be unaware of how to achieve that outcome on an ongoing basis, possibly owing to inadequate teacher training and a lack of CPD.

As the analysis below will demonstrate, the VSR interview process prompted Sue to critically reflect on her questioning technique during concept-question feedback discussions and more generally during lectures:

VSR Methodology Prompts Critical Reflection and Highlights the Need for Targeted and Sustained CPD

During the VSR interview, while viewing the feedback discussion of a concept question, Sue commented: ... *do I just give them* [the students] *all of it? ....Did I ask them to answer at all?* Then, having watched students respond correctly to her questions concerning the numerical calculations but failing to respond to her decision-making questions, she commented:

> ... this is definitely where I should have ... just ... pick[ed] on people ... but I always feel that I don't want to put them under pressure.. I never liked it as a student... (LVSR 898, 907-909).

The VSR interview allowed her to critically reflect on and diagnose a problem relating to her questioning technique, and although she identified an alternative approach, she also expressed some reservations about using it. Her hesitation and questioning of the alternative's merits suggest perhaps a restricted questioning technique, an issue that becomes clearer in the analysis that follows. As is evident from her comments below during the VSR interview, she attributed her difficulty in facilitating class discussion to shortcomings in the current year's student group, bearing in mind the fact that the previous year's group, in engaging with the same topics, had been a good deal more responsive and participative:

> I feel that this year's group is more difficult and I certainly felt last year that I got much better feedback on concept questions ... which has been a lot more difficult to generate with this group this year (LVSR 903-906).

While Sue's difficulty in stimulating greater involvement and interaction among the current year's batch of students may to a degree be attributable to shortcomings on their part, it could also point to unresolved deficiencies in her own questioning technique, which in turn could be related to a lack of teacher training and CPD. Her comments elsewhere during the VSR interview support this interpretation:

> ... I know Rosy and them had this thing, well, if you want people to respond and you can't get responses, then you must use the 'blue shirt day' technique ... and I used that a bit last year ... so I think discussion in the class is important, but years of finding it difficult to get any feedback has kind of – you just get, almost give up (LVSR 758-763).

Thanks to her awareness of the MAF300 tutorial intervention, Sue borrowed one of its recommended techniques for stimulating student participation, and used it with a degree of success. Nonetheless, because of her ongoing difficulty over a long period of time in facilitating class discussion, she had become disillusioned despite recognising its value in the teaching and learning process.

The foregoing analysis has highlighted the valuable role that VSR interviews can play in prompting faculty to critically reflect on their teaching, diagnose shortcomings in their praxis, identify areas for improvement and propose possible strategies for addressing the problem(s). In Sue's case, there was recognition that her questioning technique needed improvement but she was unsure of the merits of the alternative she put forward. This uncertainty, coupled with an analysis of the data gleaned from the VSR process and the interviews, suggested that her questioning technique in general was to some extent deficient and that she would have benefited from some targeted and sustained CPD.

Discussion

A common phenomenon in the South African higher education setting, especially in programmes that offer professional qualifications like accounting, is the presence of highly qualified professionals, many with rich work experience but very limited pedagogical expertise. This particular scenario plays itself out in the University of KwaZulu-Natal context. Faculty employed in the accounting departments, who have historically been recruited directly from the corporate world, come to their posts with little or no teaching experience at any level. Their only exposure to pedagogy would have been what they experienced as students at both school and university. Their notion of what counts as normal teaching practice would thus have been acquired through what Lortie (1975) described as the process of 'apprentice of observation'. Consequently, accounting lecturers, as was the case in this study, tend to adopt the conventional teacher-centred pedagogy to which they had been exposed as students. This situation is not unique to South Africa; one finds parallels in, for example, the USA (American Accounting Association (AAA) & American Institute of Certified Public Accountants (AICPA) 2012), Australia and New Zealand (R.W. Adler *et al.* 2000).

Furthermore, the absence of mechanisms and processes for implementing and monitoring CPD programmes for university lecturers, particularly in accounting departments, means that opportunities for, and even the notion of, critical reflection have rarely come to the fore in the discourse of university accounting departments. It is thus not unusual to find a perpetuation of lecturing approaches that are not geared to encouraging students' active participation, a conclusion supported by other studies' undertaken both locally and abroad (R.W. Adler *et al.* 2000; American Accounting Association (AAA) & American Institute of Certified Public Accountants (AICPA) 2012; Coetzee & Schmulian 2012; Palm & Bisman 2010).

A significant outcome of this study was the identification of the power of the video-stimulated reflection (VRS) sessions. While these served as a useful mechanism for generating rich data bearing upon the assumptions underlying the participants' praxis, they had the immediate benefit of enabling them to watch video-recorded footage of their teaching, something they had never experienced before. This proved to be a watershed moment in

their careers as higher education pedagogues. For the first time ever, they had the opportunity to engage with a researcher (in this instance a trusted colleague) on aspects of their practice that they viewed together. Both participants pointed to the value of this kind of exercise, lamenting the fact that it had not happened earlier in their careers. The study highlighted the enormous potential that VSR has for diagnosing both the strengths and deficiencies of individuals' pedagogical praxis. This finding adds to the growing body of research confirming the value of VSR as a tool for stimulating critical reflection and thus for professional development (Muir *et al.* 2010; Powell 2005). Participants declared openly that while they were aware of alternative ways to approach their practice, they would benefit from CPD. Of importance in the present case was the fact that the VRS intervention occurred in a collegial, non-evaluative setting; of equal importance is that the data yielded by the VRS process should lead to CPD programmes that respond directly to the specific circumstances and background of accounting teachers at university level. In this connection, it is crucial that the process of CPD proceeds from the premise that accounting faculty are highly competent professionals who can lay claim to some, albeit limited, pedagogical knowledge. No purpose is served by insensitively harping on the pedagogical deficits of teachers in the higher education sector – something that has been a common feature of professional development initiatives in the school sector (Adler & Reed 2002; Maistry 2008).

At the higher education level, the role to be played, and form to be taken, by continuing professional development initiatives throws up some interesting research opportunities bearing upon a number of important – and contested - issues. For example, should CPD programmes be devised and packaged by institutionalised human resources management units or should they emerge 'naturally' from within departments in response to needs that colleagues identify? This gives rise to the question of whether sufficient pedagogic expertise exists within academic departments as well as the issue of duration and sustainability as it relates to the ability of CPD to fundamentally change higher education pedagogues' perspectives on teaching. It also raises the issue of whether professional associations should play a role in facilitating lecturers' CPD, particularly when, as in SAICA's case, the association advocates the adoption of more progressive pedagogies. The possibility of professional associations becoming actively involved in implementing pedagogical recommendations is hinted at in a recent

investigation into accounting higher education in the USA (American Accounting Association (AAA) & American Institute of Certified Public Accountants (AICPA) 2012).

With respect to the role played by SAICA, the present study found that its accreditation policies, its effective control of the accounting curriculum at the tertiary level and its assessment procedures and practices, taken together, exercised a pervasive and dominant influence on the participants' teaching (and, by implication, on that of their colleagues too), confirming the findings of Coetzee & Schmulian (2012) and Venter & de Villiers (2013). The participants had misgivings, either implied or expressed, about the constraints that SAICA's requirements imposed, in terms of both time pressures and of their limiting effect on content and assessment decisions, confirming the concerns expressed by others (Botha 2001; Coetzee & Schmulian 2012; van der Schyf 2008a; Venter & de Villiers 2013). This has important implications for accounting departments as they undertake their curriculum planning exercises. It is clear that viewing the curriculum as more than a matter simply of content coverage and assessment will be of benefit to faculty struggling to come to terms with how to manage externally imposed constraints within a highly structured university context. In this regard, universities should ensure that accounting appointees are trained to respond effectively to the pedagogical challenges presented by the requirements of the external accrediting body, in this case, SAICA. As mentioned earlier, UKZN, to its credit, has recently made it mandatory for new appointees as well as current faculty at or below lecturer level to attend the following teaching and learning induction modules: Designing and evaluating curricula in Higher Education (HE), Teaching and learning in HE, Assessing learning in HE and Supervising research in HE. While this training should better equip accounting lecturers to make appropriate pedagogical decisions generally within the constraints imposed by SAICA's requirements, introducing accounting-specific CPD may be expected to further enhance their ability to implement a suitable pedagogy. In this regard, SAICA itself could play a more active role by devising CPD programmes that focus on appropriate pedagogy for accounting education.

As mentioned earlier, the impact that SAICA's content intensive and technically orientated curriculum has on accounting education needs further consideration. The findings suggest that the scope, breadth and depth, of the curriculum impose significant time pressures on accounting lecturers and, as

reported in Coetzee & Schmulian (2012) and Venter and de Villiers (2013), this limits the extent to which more conceptual and research related issues can be introduced into the curriculum. Consequently, students may well be technically competent but lack a deeper understanding of the accounting disciplines and their philosophical underpinnings. Rossouw (2006: 3), cited by van der Schyf (2008a), made the following comment in this regard: whenever *'the cultivation of the philosophical mind is neglected, the disciplines are likely to produce technocrats with knowledge and skills of limited shelf-life'*. Thus equipping students to become life-long learners, as required by SAICA (2011), is unlikely to be achieved if the scope and nature of the curriculum does not include more theoretical disciplinary considerations.

While this study and others locally (Coetzee & Schmulian 2012; Venter & de Villiers 2013) have identified a 'teaching to the test' culture among accounting faculty, arising from the high-stakes character of SAICA's qualifying examinations, the extent and ramifications of this culture require further study before firm conclusions can be drawn. Nevertheless, the South African accounting education fraternity needs to be cognisant of the constraining effect such a culture can exercise, and should bear in mind that too close a link between university accounting education and external professional organisations has long been discouraged abroad (American Accounting Association (AAA), 1986; Arthur Andersen & Co. *et al.* 1986; Cooper *et al.* 2005; Evans 2008).

To conclude: despite the professional association, SAICA's, implied recommendation to accounting lecturers to adopt a learner-centred pedagogy, the actual teaching practice of the participants in this study was found to be teacher-centred and content-intensive. This finding is not surprising given their restricted pedagogical 'upbringing', which encouraged them to believe that teaching as they themselves were taught was the right approach to adopt, and given also their limited pedagogical knowledge arising from inadequate teacher education and a lack of CPD. The VSR process was however found to be a powerful means of prompting critical reflection on their praxis, enabling inadequacies to be diagnosed and in that way identifying the specific needs to be addressed and goals to be met in a targeted CPD intervention. In the case of the present study, it would seem that the collegial non-evaluative context within which the VSR was conducted contributed importantly to the open and honest reflection that occurred.

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Improving Quality in Higher Education: A Reflection on External and Internal Programme Reviews

Zilungile Sosibo

Abstract

'Improvement' and 'maintenance' of quality in higher education are buzzwords in the discourse on higher education in both emerging and mature economies. Globally, schools and universities make efforts to produce students of high calibre who will excel as citizens and active participants in the global marketplace. At the institutional and national level, these attempts include internal and external quality assurance of education programmes and institutions. In South Africa, the Higher Education Qualifications Committee of the Council on Higher Education assures the quality of higher education programmes through a system of external programme reviews. This process often leads to institutions and education programmes acquiring or losing their accreditation status. Programme reviews are also undertaken internally in institutions. Although internal and external review systems have been in place in South Africa for a number of years, not many institutions have reflected on how they impact on the quality of education. In this study, eight academics reflected on these reviews, with the goal of determining which review had more impact than the other in maintaining quality in education. Because there were a greater number of limitations identified in external reviews than there were in internal reviews, it could be inferred that academics supported the latter. Hence, in this study, it is recommended that internal reviews should be strengthened and conducted regularly in order to raise quality in higher education.

Keywords: quality assurance, quality, impact, internal, external, programme review, higher education

Introduction

In both emerging and mature economies, ensuring high quality education through external programme reviews or quality assurance of education programmes offered by higher education institutions (HEIs) is receiving substantial emphasis. Part of the reason for this is that higher education is regarded as a viable means of enabling every country and its citizens to become members of the emerging knowledge society (Sanyal & Martin 2007). It equips individuals with skills and knowledge that guarantee them better employment in the market economy of the globalised world (Naidoo 2003). International interest in quality education is encapsulated in international organisations such as the 2008 UNESCO Global Forum on International Quality Assurance, Accreditation and the Recognition of Qualifications; the 2007 Global University Network for Innovation; the 1999 Bologna Declaration of Italy; the Quality Assurance Agency for Higher Education in the United Kingdom; the Australian Universities Quality Agency (AUQA) and the National Assessment and Accreditation Council in India.

Both nationally and internationally, the twenty-first century has experienced an explosion in the number of students entering higher education, paralleled with an increasingly growing demand for access to higher education. Massification of higher education has inevitably led to a proliferation of diverse and unscrupulous fly-by-night, unaccredited private education providers that promise to offer high quality distance, online and on-site education programmes to potential students (Council on Higher Education (CHE) 2004; Department of Higher Education & Training 2012; Thobega 2010). Thobega (2010) warns against private institutions: some of them offer virtual programmes in which students enrol privately online so that it is difficult to guarantee the quality of their programmes. Consequently, there is a high possibility of their programmes being substandard (Thobega 2010). Owing to this, the demand for quality assurance and accreditation of HEIs and the programmes offered in them has intensified as a means of protecting the demands and interests of consumers (students, prospective employers, societies and institutions themselves) and of ensuring high quality in standards and excellence in higher education (Sanyal & Martin 2007). Referring to the assurance that can be given to an institution to prove that it is not fraudulent and that the degree it awards is credible, Sanyal and Martin (2007: 6) claim that ‘accreditation is one way of providing that guarantee’.

South Africa is not immune to the demands for high quality education that are made by multiple stakeholders. According to Singh (2004):

> *[South African] stakeholders also require that higher education institutions are able to provide the public with comprehensive information on the manner in which they maintain quality and standards of their core academic activities, and to demonstrate sustained improvement in this regard. Institutional audits serve to address both sets of issues.*

In the context of South Africa, the Preamble to the Higher Education Act 1997 (Act No. 101 of 1997) emphasises the desirability of pursuing excellence in higher education. To realise this ideal, the Higher Education Act of 1997 assigned the responsibility of quality assurance and accreditation in South African higher education to the Council on Higher Education (CHE), which was launched in May 2001. The CHE discharges its mandate through its permanent sub-committee called the Higher Education Quality Committee (HEQC). The HEQC, like other quality assurers internationally, conducts audits and accreditation of education programmes offered in HEIs, with the purpose of improving and maintaining sustainable quality. In the document entitled 'Institutional Audit Framework' (CHE 2004), the functions of the HEQC are spelled out: first, to promote quality assurance in higher education, second, to audit quality assurance mechanisms of institutions of higher education and third, to accredit programmes of higher education. The HEQC has added quality development workshops for staff from HEIs to these functions. What sets the CHE/HEQC apart from other international quality-assurance agencies is that it functions in a previously racially divided South Africa that is recovering from inequalities of opportunity, access to higher education and the scars left by the apartheid system. Therefore, it is mindful of discharging its quality-assurance mandate in line with the transformation objectives of higher education institutions.

Research Problem

External and internal reviews or quality assurance of programmes, as commonly referred to in South Africa, and accreditation, have been

extensively researched and critiqued in South Africa and beyond (Motala 2001; Borman 2004; Fourie 2000; Mhlanga 2008; Carrim 2013). Not many studies have been conducted in which HEIs or their constituencies reflect on these processes. In a country such as South Africa with students from vastly different backgrounds, there is a need for institutions to engage in robust reflections on these processes. Reflection leads to improvement. By engaging in reflection, HEIs may be able to determine the efficacy of programme reviews and identify gaps in these processes that can potentially compromise the quality in education. The only reflection on the external programme review and accreditation processes was undertaken by the CHE (CHE 2010).

Purpose

This study involved eight academics at a particular HEI in an emerging economy who reflected on two programme reviews conducted in their faculty: one external and the other internal. The external review and accreditation of the programme had been conducted by the HEQC and its team of reviewers in 2007, while the internal review of the other programme had been conducted in 2013 by a mixed panel of reviewers from both inside and outside the institution's Faculty of Education. The purpose of this study was to give academics an opportunity to reflect on their actions and those of the review panel that had occurred before, during and after the reviews. The objective was to establish whether actions had been carried out well and to identify lacunae that could compromise or negatively impact on the quality of our education programmes. The other objective was to determine which, between internal and external programme reviews, had more impact on improving quality in education than the other. As the author of this paper, I was one of the eight academics who engaged in reflective action.

During reflection, we looked back, compared and contrasted phenomena as they had unfolded in the two programme reviews in which we had participated. The research questions were: (from the perspective of the academics) (i) what is the scale of the impact of external and internal review processes on the quality of educational programmes offered by HEIs, and (ii) which of the two programme reviews (internal and external) has more impact on improving the quality of education programmes than the other?

The first thesis of this study was that vital as external programme

reviews and accreditation are, unless institutions and organisms within them (such as academic and support staff, students and tutors) internalise standards and commit to continuous improvement, or adopt an 'internal culture of quality' (Grossman, Sands & Brittingham 2010: 104), high quality in HEI educational programmes will remain elusive. Therefore, emphasis on continuing internal quality assurance of educational programmes should be placed primarily on the academics and HEIs themselves and to a lesser degree on external systems. Therefore, in the current study, internal quality assurance measures take centre stage. The second thesis was that reflection should be an integral component that is incorporated in all internal and external quality-assurance related processes because it may enhance the quality of education programmes, regardless of whether they are offered in emerging or mature economies. The hypothesis of this study was that emerging economies face more dilemmas related to underdevelopment with regard to external programme reviews and accreditation than their counterparts in mature economies.

Context of the Study

Having an integrated quality assurance system that operates outside institutions is not unique to South Africa but is a common global trend. In line with trends in the developed world, education programmes offered in emerging economies, such as South Africa, undergo quality assurance through internal and external reviews. During the period 2005-2007, the HEQC conducted its first 81 programme reviews and accreditation in the country's 21 public HEIs. The four programmes subjected to this process were located within the Faculties of Education of these institutions. They included the Advanced Certificate in Education (ACE), Bachelor of Education (B. Ed), Master of Education (M. Ed) and Postgraduate Certificate in Education (PGCE). Our University of Technology (UoT) was among those institutions whose education programmes were reviewed. During the 2007 external programme reviews I coordinated seven programmes, one of which had been selected for the review and accreditation process. This programme was one of the 23 programmes reviewed in this category in 2007. The internal review was conducted in 2013 on two education programmes, one for which I was acting as head of department (HoD) in the Faculty of Education at the time. External reviews included the accreditation component whereas

internal reviews did not. These external and internal programme reviews form the basis of this study.

Theoretical Framework

As stated earlier, this study involved an intentional reflection on the external and internal reviews of two educational programmes offered in a Faculty of Education located within a UoT in South Africa. In the light of the reflective actions and processes undertaken, reflection theory informed this study. Dewey (1933) is widely recognised as the founder of the concept of reflection in the twentieth century. He regarded reflection as a way of thinking about or solving a problem, which involved action chaining. Thus, according to him, reflection is an active and deliberative cognitive process which involves reflective thinking and reflective action. Similarly, educators involved in this study made a deliberate effort to think back (or reflect) on the external and internal programme reviews that had been undertaken in 2007 and 2013, with the goal of identifying what had worked or not worked in their actions and those of the review panel in relation to improving the quality of education.

Schön (1983; 1987) presents two forms of reflection: reflection-in-action, which he describes as reflection that happens while action is still occurring; and reflection-on-action, which he defines as reflection that occurs after the event. Two types of reflection apply in this study; they both involve meta-cognition or thinking about thinking. In other words, educators involved in this study thought about what had happened before, during and after reviews of their educational programmes. The reflection process included not only the phenomena that occurred before the reviews began, but what happened during and after the reviews had been completed.

According to Schön (1983; 1987), through reflection and action, professionals are bound to make rational judgements about how to modify their actions and find new ways of doing them while in action (reflection-in-action) or after the action has occurred (reflection-on-action). Clearly, the reflective action undertaken in this study helped academics who had been involved in the review of the said programmes to make rational judgements about how they would modify and improve their educational practices in order to improve the quality of their education programmes.

Literature Review

Conceptual Definition of Quality

At the heart of quality assurance and accreditation is the concept of quality. The term 'quality' is used loosely in the education arena without any consensus on what it exactly means. Part of the reason is that there are multiple stakeholders in education with diverse understandings of the meaning of quality (Borman 2004). Borman asserts that 'all these actors have their own, sometimes conflicting interpretations of quality, with the result that it becomes more difficult to arrive at a standard definition' (p.374). Hindle (2013: 346) holds the same view, that 'definitions of quality education are not as self-evident as some would believe. Instead, they may well be a point of contestation and debate, as different constituencies express their views on the purpose of education, and on what quality education would mean in respect of these views'.

Hindle raises an important point, that while quality must relate to the context in which it is applied, it is important to keep cognisance of the globalising world and hence, of a search for a universal definition of quality. Carrim (2013: 39) concurs with Borman and Hindle, that there is no consensus on the definition of the concept of quality in South Africa and the world over. He contends that defining the concept of 'quality' and 'education quality' 'is by no means straightforward': as questions such as 'quality for what?', 'quality for whom?' or 'quality in relation to what?' need to be asked because the meaning of the concept of quality is elusive. Since there is no universally accepted definition of quality, it stands to reason that it cannot be measured with certainty either. Towards this end, Carrim (2013: 40) concludes that 'quality is not a clear-cut issue and measuring it is not straightforward either', a fact supported by Meyer and Hofmeyr (1995). It makes sense, therefore, to conclude that measurement of education quality is fraught with challenges (Sanyal & Martin 2007) and that the process of quality assurance and improvement can be a difficult undertaking.

Internal and External Reviews

Sanyal and Martin (2007) distinguish between internal and external quality assurance. Internal quality assurance is provided by an institution auditing itself or its programmes whereas external quality assurance is that which is undertaken by an organization external to the institution. In the South African

context, the quality assurance and accreditation system serves as a means of determining whether, in the case of internal quality assurance, programmes or institutions meet their own objectives and standards as determined by their mission and vision. In the case of external reviews, the system determines whether programmes or institutions meet a set of standards or criteria against which they are measured, as predetermined and evaluated by the HEQC.

In measuring education quality, the HEQC adopts three principles, that is: fitness of purpose, fitness for purpose (CHE 2010; Fourie, van der Westhuizen, Alt & Holtzhausen 2010; Sanyal & Martin 2007; Thobega 2010; Grossman *et al.* 2010) and transformation (CHE 2010). According to the CHE (2010:3), the principle of fitness of purpose determines 'whether the training offered by the reviewed programmes is appropriate to the specific conditions of teaching and learning in South Africa'. The principle of fitness for purpose determines whether the programmes are offered at the appropriate level with corresponding support, resources and organisation. This principle addresses the fitness of institutions/departments/faculties for offering respective programmes (CHE 2010; Sanyal & Martin 2007). Lastly, the principle of transformation is subsumed under the two (CHE 2010). As mentioned earlier, South Africa serves students, the majority of whom during the apartheid era, had limited or no access to higher education. The principle of transformation helps to determine whether the programmes offered by South African HEIs match the country's context and whether the challenges of transformation are met (CHE 2010; Sanyal & Martin 2007).

Methodology

After the external and internal reviews of our educational programmes had passed, I invited seven colleagues who had been involved in both these processes during 2007 and 2013 to engage in a reflective action. During the reflection, we had to think back on the phenomena that had occurred during the two reviews to which our two education programmes had been subjected. The reflection process was based on the three main HEQC quality-assurance stages that we used as our guiding principle during the brainstorming and reflective processes. These stages included developing a desktop self-evaluation report; the quality-assurance and validation process and outcomes of the review. We brainstormed ideas step by step, beginning with reflecting on how we had addressed each quality-assurance stage vis-à-vis the actions

of the review panel, as well as how we felt about how the panel had judged us at each stage. We reflected on the review process in relation to how we thought it had impacted on the review outcomes, as well as ways in which we, as agents of change, could improve on these processes. During the reflection, we jotted down ideas on a flipchart.

After we had exhausted the ideas, I collated them and used a mind-map to compare, contrast and categorise them. This was the first phase of data analysis. I analysed data using deductive qualitative analysis (DQA) (Gilgun 2011; Acock, van Dulmen, Allen & Piercy 2005 in Bengtson, Acock, Allen, Dilworth-Anderson & Klein 2005). In DQA, researchers employ a theoretical framework to structure their research. The three quality-assurance stages mentioned earlier became *a priori* codes that guided the analysis of this research.

Axial coding helped refine common emergent themes from the categories I had developed. I colour-coded the themes, re-categorised, re-grouped them and placed them under the *a priori* codes. Gilgun describes negative case analysis (NCA) as a procedure which helps researchers to look for data that does not fit the theory. During data collection and analysis, I conducted NCA to check for data that did not fit the three HEQC quality-assurance stages. I could not find any data that was not commensurate with these *a priori* codes. Using DQA helped me to focus my research question. I used member checking to enhance the validity and credibility of my data analysis.

Before the reflection process began, I had made ethical considerations of obtaining permission from my colleagues to develop this reflection process into research. After they had granted me permission to proceed, and before the reflection commenced, they signed the consent forms. I explained the anonymity clause to them and informed them that during the course of the study, I would store data in a safe place and destroy it after the study had been published. I obtained ethical clearance from the Ethics Committee of the Faculty of Education in which this study was based.

Results

This section includes an analytical discussion of the outcomes of the reflection process that took place on the external and internal programme

reviews. As stated earlier, the analysis was conducted using the three HEQC stages mentioned in the methodology. These stages became *a priori* codes on which the study results were hinged. In this section, it is important to provide a concise definition of each *a priori* code, followed by an analytical summary of results related to each code.

Development of the Desktop Self-evaluation Report

Akin to the requirements of accreditation in both emerging and mature economies, a programme or institution under review develops a review or audit portfolio which it uses to evaluate itself. The evidence contained in the portfolio is validated by the external review panel to determine if the target areas of the programme reviewed meet predetermined quality standards. Oosthuizen (2003: 4) argues that 'the heart of the [quality assurance] process is self-evaluation'. The HEQC emphasises that self-evaluation should be credible and reflect the true status of the quality of the programmes undergoing quality assurance and accreditation; its outcomes should strive to match those of the review panel. Singh (2004: Foreword), on the one hand, states that 'Institutional responsibility for credible self-evaluation and sustained improvement remains at the heart of the HEQC's institutional audit system'. Woodhouse (2001: 23), on the other hand, advocates that 'meaningful institutional self-evaluation assessment depends on openness, truthfulness and risk-taking if problems are to be identified and solved'.

Upon reflection, all of us all felt that, during both reviews, we had striven to be as honest as we possibly could in the self-evaluation reports. However, having recently written a self-evaluation report for internal review of our programme, we realised that it was easier to be more candid when conducting self-evaluation for internal, as opposed to external, programme review. For some reason, we realised that the pressure of being judged negatively in internal review was lighter than when the programme had been reviewed externally.

The other issue relates to inclusiveness and ownership of the programme review process. We all noted that when preparations for external programme review were made, the responsibility had appeared to fall heavily on the shoulders of the heads of departments, programme coordinators and the Dean; less so on the lecturers, students and other stakeholders. Arguing

for inclusion of lecturers in the review process, Borman (2004: 382) states that 'Staff plays a decisive role in quality assurance and should receive adequate recognition for their contributions to efficient teaching'. During preparation for our external programme review, we noticed that the majority of lecturers had been minimally involved, such as when they had to collate and submit evidence, which is another requirement of the accreditation process. We believed that some of the lecturers had not been aware of the contents of the self-evaluation report before the review process had begun. Nonetheless, they had been interviewed by the HEQC panel of reviewers.

In contrast, we recognised that the self-evaluation report we had recently prepared for the internal programme review had been more inclusive. Before the report was written, the academic staff in our programme had held a two-day workshop in which they brainstormed each criterion and compiled ideas. Similarly, the report-writing process involved all those who had been interested in participating in this activity. Since the process was democratic and lecturers had been made part of the whole process, we acknowledged that they were more likely to sense ownership of the internal review process than the external review in which they had played no part. As a group, we decided that in the next series of reviews, it would be important to repeat the bottom-up approach we had employed in the internal review.

Other stakeholders included in the external programme reviews had been students and their leaders, as it related to participating in the interviews held by the review panel. Other than this involvement, we recognised that they had not been invited to make any input in the writing of the self-evaluation report. Borman (2004: 377) cites Strydom and Lategan who emphasise the input of students, because they are beneficiaries of the reviews. Reiterating this point, Borman (2004: 382) contends that 'Student input ought to be considered as a very important aspect of programme reviewing. Students themselves are the best authorities on their own local environments and are therefore the most obvious people to participate in successful programme reviewing'. In addition, we conceded that stakeholders such as alumni, school principals and advisory committees had participated minimally in the interviews due to other commitments.

Our reflection led us to conclude that, during the internal programme reviews, we had democratised the process by having the academic staff, students and other stakeholders participate fully and actively. Students had been involved in making inputs during brainstorming sessions. They had

been requested to read the self-evaluation report and make contributions before it was submitted to the review panel, as well as before the actual review process had commenced. We had invited stakeholders such as members of the advisory committee, alumni and current students to participate in the interviews set up for internal reviews. We felt that no-one had been neglected: the internal review process had been highly inclusive.

The Quality-assurance and Validation Process

The external review and validation process by a panel of experts includes site visitation by a panel of peers and experts. Although the HEQC is a permanent committee of the CHE, it does not have a permanent staff but operates with its committee members who are either affiliated with other institutions or retired professionals. With the exception of the CHE permanent staff, the peers and experts who serve on the review panels are HEQC members and volunteers employed by different institutions. Before the programme review panel is selected, potential reviewers submit CVs which help in determining their credentials and expertise. The limitation of the CV is that, in the interest of serving on the HEQC, candidates can inflate and overestimate their levels of expertise.

In line with the standards of external programme reviews and accreditation processes and practices globally, the HEQC followed the procedures that were, to a large extent, similar to the international quality assurance systems. Before the 2007 programme reviews commenced, the HEQC provided academics from various institutions with capacity-building workshops on the processes related to external programme reviews and accreditation. The panel briefed us on the three main review and accreditation steps, namely, preparation of a self-evaluation report, visit by the panel, and review/accreditation outcomes. As participants in these workshops, we felt that we were equipped with essential skills that empowered us to face the unfamiliar external review processes.

Similarly, before the 2013 internal programme review took place, we had a four-day training workshop on this process, which we acknowledged had strengthened us. The difference was that in the latter, we went through all the categories of the evaluation process together as staff. We brainstormed ideas on how to address each of them, whereas in the former, only those who

were going to be involved in the review process attended the workshops: some academics needed these skills but were excluded. In the latter case, we had a scribe to compile the ideas we had brainstormed collectively. Upon reflection, we found that these activities had facilitated the writing of the desktop evaluation report and had made the internal programme review democratic, leading to a buy-in, ownership and support for the review process. We appreciated the fact that academics who had been involved in the 2007 reviews were willing to offer assistance and to take on the leading role in this process, such as writing the desktop evaluation report and coordinating collection of evidence.

In hindsight, we realised that on both occasions, not having a unified understanding of the meaning of quality had not become a challenge for us. We had not even collectively engaged with the meaning of this concept as in both instances, time was against us. Our main concern and priority had been to write and finish the self-evaluation reports while simultaneously collecting evidence. Rather than focussing on the definitions, we had instead used our general understanding of the concept. We understood that we had relied heavily on the minimum standards set out in the HEQC documents for each criterion to guide our understanding of the meaning of this concept. As a reflection group, we highlighted the importance of having a common and collective definition and understanding of this concept: doing so can help us to work towards a common goal with a clear vision of what we want to achieve.

In the case of external programme reviews, before the process began, we had received the schedule of the review process which included a list of reviewers. This process had given us a chance to scrutinise the reviewers so that we could indicate to the HEQC if there were potential conflicts of interest. Basically, this process facilitated transparency and allowed us to indicate if there was a reviewer or reviewers whom we felt should be excluded from reviewing our programme; obviously based on solid reasons, the main of which was conflict of interest. Upon reflecting on the internal reviews, we noted that we had obtained the list of the names of external reviewers but not of the internal reviewers.

The external review process lasted for four days, including the arrival and departure days. CHE/HEQC states that it can last for two or three days. Considering the large scope of the external programme review, we argued that the panel of six members was relatively small; compared with twelve in

the internal review. During our reflection, we questioned both the limited duration and the panel size of the external review process. In essence, these issues raised serious concerns and questions to us about the credibility of external reviews. One question that came to mind was: how was it possible to do justice to the quality assurance of a programme within such a limited period of time and with such a small panel making quality-related judgements of our programme against so many criteria? Consequently, we were led to conclude that this process relies heavily on the self-evaluation report, evidence sources and short interviews without making an in-depth and well-informed analysis of each programme. We contended that reliance on these information sources, and making judgements based on such data within such a limited period of time weakens the external review process and subjects it to doubt and mistrust. Our concern was that this situation can potentially lead institutions that feel unfairly judged to take legal action against the HEQC, especially if they feel strongly about the credibility of their programmes in terms of quality.

Legally, HEIs have inalienable rights to dispute the outcome of the review process and to file a lawsuit against the review agency, as has been the case with one South African HEI. Consequently, we came to the realisation that external programme reviews and accreditation are political and legal processes that need to be handled professionally and with immense care. During our reflection, we held that the internal reviews, although they had been much better than external reviews with regard to the size of the panel, were, however, equally limited regarding the duration of two days. We questioned the involvement of a former colleague who had been teaching in our programme a few months before the internal review process. We felt that his inclusion had presented a high conflict of interest and in our view, jeopardised the transparency and objectivity of the review process.

We also raised the point that the external programme reviews had been too formal for our liking. We understood that access to the review panel had to be strictly controlled in order to avoid interference with the review process. However, we unanimously felt that some review panel members had been aloof and lacked collegiality, while others had been intimidating, confrontational and antagonistic in their interview approach. This could be a reflection of the power dynamics that prevail in the quality assurance and accreditation of programmes. During the reflection, we agreed that the bureaucratic approach to programme reviews had made it difficult for us to

think logically during the interviews. In contrast, we concurred that during the internal reviews, although the panel had asked equally difficult questions, their approach had been collegial, which we believed had made us feel valued for the contributions we had made to the institution and had helped us to grow as individuals.

With regard to diversity, our observation was that the internal review panel had been more diverse than the external one, consisting of reviewers from other HEIs, representatives from the Department of Basic Education involved with the senior phase that is part of our programme, and staff from our Learning Centre. Even though we had learnt a great deal from both instances, as a collective group, we felt that had the conditions been similar, we would not have been as sceptical about external programme reviews as we were during our reflection. The opposite was true about internal reviews. As a group we felt empowered by internal reviews and agreed that we would welcome them even if they were conducted annually. The conclusion one can infer is that the academics involved in this study advocated for internal reviews.

During the reflection, we noticed that the last external reviews had been undertaken in 2007, which had been six years earlier. This lack of frequency raised our concerns about the effectiveness of these reviews. Our argument was founded on the fact that the HEQC was failing to monitor what was happening in the HEIs that had obtained accreditation before. We concurred that relying on external reviews as quality-assurance measures can be risky. Therefore, we came to a conclusion that since we could not rely on external programme reviews as tools for improving quality, our faculty should conduct internal reviews at least every three years because, unlike external reviews, conducting them apparently costs less than conducting the latter.

Outcome of the Review

During HEQC programme reviews and accreditation, education programmes are evaluated against 19 criteria with which they have to comply. These criteria include aspects such as programme design, staffing, teaching and learning, recruitment of staff and students, resources and assessment. During reflection, we acknowledged that in our self-evaluation, we had addressed

these criteria individually in the report. The review panel used the same criteria to make decisions on whether our programme complied with the set criteria. The HEQC accreditation process is based on four assessment criteria which yield four different outcomes, depending on the extent to which the programmes have met minimum standards of quality (CHE 2010). Two of the assessment criteria are 'exceeds minimum standards' and 'complies with minimum standards', the outcome of which is accreditation of programmes. The other criterion 'needs improvement' leads to accreditation with conditions while 'does not meet minimum standards' leads to withdrawal of accreditation.

After the review has been completed, the HEQC issues a panel review report which spells out the accreditation status the programme has received. Programmes that obtain accreditation with conditions have to develop a quality improvement action plan of how they are going to improve the target areas in which they failed to meet the set standards. Ideally, the HEQC is supposed to provide continued monitoring and evaluation of the quality of the programmes that have obtained this status. The withdrawal of programme accreditation means that those programmes cannot continue to be offered and have to be terminated. According to the HEQC, programmes with full accreditation can apply for, and be granted, self-accreditation status for a period of six years (CHE 2004). However, self-accreditation can be controversial sometimes and can create suspicion among those institutions that do not qualify for it.

The outcome of the 2007 external reviews of our education programme was 'needs improvement'. This meant that we had to develop a quality improvement action plan based on the conditions set out by the HEQC. We did not dispute the judgement made by the review panel, implying that we considered the judgement fair. After submitting the quality improvement action plan after six months, our programme received full accreditation. Since there was no accreditation status attached to the internal review process, we received only a lengthy report from the review panel via our Learning Centre. The report specified the outcome of the reviews, highlighting the criteria we had or had not met. We were required to write an improvement action report on how we were going to improve the areas in which we had not met the minimum criteria. Seeing that it was close to the end of the year, we planned to write the report in 2014.

Upon reflecting on the outcomes of the two reviews, we all agreed

that not obtaining full accreditation the first time had brought a lot of stress to the academic staff involved in the programme, but especially to the Programme Coordinator who had to deal with all the work related to that process. Nonetheless, we acknowledged that having gone through the review and accreditation processes full circle no longer felt like a burden. Instead, we admitted that it became as attractive as the accreditation status we had earned. Grossman *et al.* (2010: 104) confirm this view, stating that 'when the standards appear high in line with the institution's mission, and the process promises [positive] feedback from respected peers, actually going through accreditation can be as attractive as the status to be earned'. With regard to the outcome of the internal review, we expressed the feeling that some omissions had been made, just as it had been the case with the external reviews. Hence, before embarking on writing the action plan, we believed omissions had to be addressed by the panel. Although we believed that the internal review report on outcomes had to be taken seriously, we acknowledgeed that we were not feeling as stressed as we had been with the outcomes of the external review. In hindsight, we believed we should have written the action plan before the same year (2013), as the following year (2014) in which we had planned to complete it was quickly swamped by new challenges.

Conclusion

This study comprises a reflection of academic staff on the external and internal programme reviews that had been conducted in 2007 and 2013 into the two education programmes in which they taught. The goal was to examine the impact of these reviews on the quality of education. The reflection was used as a tool for identifying what had been done well or not well in both processes so as to find improvement solutions and to determine which of the two reviews had more impact on improving quality of education. Judging by the positive remarks the academics expressed about internal programme reviews and the number of limitations they identified in external reviews, it is safe to conclude that they advocated internal reviews. The concerns about external reviews raised by the academics in this study could justify the new direction or approach that the CHE is taking; the Quality Enhancement Project (QEP) that will be employed in the HEQC Second Quality Assurance cycle (CHE 2013). This Project appears to be non-

invasive and non-threatening: it emphasises the supportive rather than evaluative role of programme reviews. If used together with internal reviews, this Project has a potential for improving quality in higher education. Nonetheless, it does require HEIs to conduct regular internal reviews so that they can identify gaps on which interventions through the QEP could be made. There is a need for HEIs to reflect constantly on their processes and strengthen the internal reviews.

The hypothesis of this study was that quality assurance systems in emerging economies present more challenges than in emerging economies. Although this study could not confirm or refute this hypothesis, judging from the results of this study, there are signs that fault-lines exist in the quality assurance and accreditation systems of South Africa. This situation is confirmed by Sanyal and Martin who claim that developing countries lack capable human resources and financial resources to conduct or sustain efficient quality assurance processes. Although the sample was small, this study presents important policy issues that need to be addressed with more elaborate samples.

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New Academics in the South African Research-oriented Academy: A Critical Review of Challenges and Support Structures

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Abstract

An explicit drive to increase research production at South African universities is apparent, but this drive also calls for the emergence of researchers who have traditionally been marginalised and underrepresented in the academy. Developing a new generation of productive researchers and intellectuals in South Africa, particularly those who are underrepresented in academia and who come from historically marginalised groups, is not only a pressing national concern, it is also an endeavour that is taken seriously by universities that value research production, transformation, and diversity. This paper is specifically concerned with the challenges faced by new academics who come from historically marginalised groups and groups which are underrepresented in academia, and thus particular attention is paid to black academics, academics from working-class backgrounds, and women in the academy. We specifically focus on concerns surrounding their success in the academy and in research production by addressing the transition from student to academic staff member, and the appropriation of the language of the academy. We argue that fundamental changes are necessary to address the specified challenges, and thus call for adequate support structures that promote intentional socialisation into the academy; supportive networking practices, and non-hierarchical mentoring models.

Keywords: university, new academics, research production, transformation

Introduction

In the global South, the university of the future needs to become more inclusive and critically consider issues concerning knowledge production (Morley 2012). An explicit drive to increase research production has been apparent, but this drive also calls for the emergence of researchers who have traditionally been marginalised and underrepresented in the academy. Indeed, South Africa has embarked on a journey to transform its universities into more research-intensive and demographically diverse institutions. These goals have been outlined in various government documents that have urged universities to produce high-calibre researchers. For example, the *National Plan for Higher Education* has argued that 'higher education must make a lasting contribution toward building the future generations of critical black intellectuals and researchers' (Department of Education 2001: 2). Additionally, the National Planning Commission's report-in-progress has called for cogent improvements with respect to race and gender representation among researchers in higher education (Carrim & Wangenge-Ouma 2012). This is warranted given that in South Africa academic staff members across higher education, particularly at research universities, continue to be predominantly white and women are under-represented in high-ranking positions (Department of Education 2008; Metcalfe & Cock 2010). The racial and gendered inequities in staff composition indicate that structural obstacles continue to exist for those who have traditionally been marginalised and underrepresented in higher education institutions (Department of Education 2008).

Recruiting cutting-edge researchers in general is particularly difficult given the paucity of postgraduate students (and particularly doctoral students) in the pipeline (Herman 2011). Most PhD programmes struggle to find suitable students (Herman 2009). This lack of suitable students amounts to a small pool of qualified potential cutting-edge researchers and intellectuals. Indeed, there is a dearth of highly educated academic staff members. In 2008, only 34% of permanently employed university staff members held a doctorate (Carrim & Wangenge-Ouma 2012). In 2007, the number of white doctoral degree graduates was more than double that of the combined figure for African, Coloured and Indian doctoral degree graduates (Department of Education 2008). The dearth of qualified black South Africans has meant that universities appoint non-

South African Africans to take-up academic posts (Department of Education 2008). Unfortunately, this move has not come without xenophobic sentiments and tensions between South Africans and non-South Africans within the academy (Department of Education 2008).

Developing a new generation of productive researchers and intellectuals in South Africa, particularly those who are underrepresented in academia and who come from historically marginalised groups, is not only a pressing national concern, it is also an endeavour that is taken seriously by universities that value research production, transformation, and diversity (see, for example, Rhodes University 2014). This undertaking benefits not only up-and-coming intellectuals who stand to gain from their employment at research oriented universities, but also benefits these universities. Diversity among academic staff members has positive implications for the development of a diverse university curriculum (Davis 2008: 278). In particular, it has been noted that black academics make use of more active pedagogical techniques and encourage students to interact with peers from different backgrounds (Knowles & Harleston 1997). A critical mass of Black intellectuals can contribute not only in terms of research production and academic 'publications but can also speak forcefully in the public arena about matters of national or public concern' (Bitzer 2008: 277). Supporting and nurturing new academics, particularly those from marginalised groups means that individuals from different 'settings and life experiences' have opportunities to make contributions to the academic project (Barton & Armstrong 2008: 5). When academics from different backgrounds and life experiences work together, issues can be examined from different perspectives, thus contributing to a more rigorous intellectual milieu (Barton & Armstrong 2008).

While governing documents and universities have engaged in the rhetoric of 'new researchers and intellectuals' in general (Department of Education 2001: 2), this paper is specifically concerned with new academics within the South African context who come from historically marginalised groups and groups that are underrepresented in academia. In particular, we focus on concerns surrounding their success in the academy and in research production. First, we outline the barriers and challenges that exist for new academics by focusing on the transition that must be made from student to academic staff. We also address how appropriating the language of the academy can be problematic for new academics. Secondly, we present a

cursory review of some of the challenges facing new academics that are underrepresented in academia and who come from historically marginalised groups. We particularly focus on black academics, academics from working-class backgrounds, and women in the academy. Lastly, we review some of the implicit and entrenched institutional practices that serve to undermine or disadvantage new academics, and call for adequate support structures that promote intentional socialisation into the academy; supportive networking practices, and non-hierarchical mentoring models.

Making the Transition: From Student to Academic

In understanding the challenges facing new academics who come from historically marginalized groups, it is imperative to discuss the transition that must be made when their roles shift from being postgraduate students to being full-time academic staff members[1]. We argue that this transition process is significant for promoting the success of new academics from historically marginalised groups and groups that are underrepresented in academia. The following discussion addresses some of the general difficulties related to making the transition from student to academic staff member, and then proceeds to discuss this transition within the specific context of South Africa. New academic staff members may have not been prepared during their postgraduate studies to enter into their new career. The postgraduate training received by students prepares them to conduct original research, but does not necessarily prepare students for a career that requires them to simultaneously undertake the three cornerstones of academia: research, teaching, and service (Reybold 2003; Speck2003; Gaff 2002; Golde & Dore 2001; Gaff & Pruitt-Logan 1998; Frongia 1995; Randall 1993; Huber 1992). In documenting the shortcomings of postgraduate training with respect to preparing future academics, Speck refers to a 'fallacy of adequate preparation' and notes that there is a false assumption that postgraduate programmes train future academics for professional life in

[1] While we acknowledge that historically, academic staff members in South Africa have held full-time posts while they undertake their postgraduate studies, this is now changing, with many universities seeking new staff members who have already earned their doctorates.

academia (2003: 42). It is difficult to conceive that the various responsibilities of an academic and what it means to be an academic can be articulated and clearly unpacked during the postgraduate training process. Given that this is the case, scholars such as Gaff, have called 'for a bridge between doctoral study and the work expected of new faculty' (2002: 66).

The transitional challenges faced may manifest themselves during the job search process, even before taking-up a position as a new academic. In particular, evidence suggests that postgraduate programmes fail to adequately professionalise students and do not prepare them to enter the academic job market (Nerad & Cerny 1999; NAGPS 2001). More specifically, new academics in South Africa find it difficult to make the transition from student to academic staff, struggle to launch their research careers, and experience difficulties establishing a publication record (Geber 2009). These barriers appear to be interrelated and can be viewed as stemming from a lack of support during the postgraduate years as well as during the early phase of an academic career. Similarly, Nkomo (2007) argues that there is insufficient preparation for those interested in pursuing academic positions and insinuates that this is not unrelated to the paucity of black intellectuals. It has also been suggested that the problem of underprepared postgraduate students is related to overburdened inexperienced supervisors (Mouton 2007). Mouton proposes a programme that has the potential to assist postgraduate students in transitioning into professional academics. He argues:

> We should seriously consider launching a national doctoral or post-graduate academy to provide prospective doctoral candidates with a better foundation in research methodology and thesis management and also provide high-quality seminars and workshops to build the capacity of our supervisors (2007: 1090).

Such an academy could serve to intentionally help new academics make the transition between postgraduate studies and a career in academia. Facilitating the transition between student and academic is a key factor that needs to be addressed in order to determinedly and intentionally produce a new generation of researchers that reflect individuals from various backgrounds.

The Language of the Academy

New academics who have traditionally been marginalised or underrepresented in the academy may also struggle to firmly entrench themselves in the language of the academy. The language of the academy, being considerably different from that of colloquial-speak, is used not merely to communicate, but also to wield power (Bourdieu & Passeron 2011). Indeed, university idiom exudes authority and is inscribed in the institution of the university. As noted by Bourdieu and Passeron:

> Magisterial language a status attribute which owes most of its effects to the institution, since it can never be dissociated from the relation of the academic authority in which it is manifested, is able to appear as an intrinsic quality of the person when it merely diverts an advantage of office onto the office-holder (2011:110).

As such, those who gain a firm command of the language of the academy are viewed as inherently gifted, and not necessarily as conforming to, and reproducing institutionally sanctioned language and culture. The language of the academy can be viewed as inextricably tied to the culture of the academy, and the authority it represents, thus compelling new academics to conform to the 'dominant model of the relation to language and culture' (Bourdieu & Passeron 2011:122). New academics are not only compelled to conform to, and affirm themselves pedagogically by appropriating, the language of the university, but they are also compelled to display their command of the language of the academy through their general comportment and in their research production endeavors. It thus follows that the new academics' command of the language of the academy, is as critical as the significance of their research. Those who struggle to gain a firm command of university-speak stand to lose institutionally sanctioned accolades.

While Bourdieu and Passeron argue that the language of the academy is no one's mother tongue, it is 'unequally removed from the languages actually spoken by the different classes' (2011:115). Language is seen to provide a system of categories, ranging from complex to less complex. The ability to decipher and manipulate complex language is contingent on 'the complexity of the language transmitted by the family'

(2011:73). In making the distinction between different forms of language, Bourdieu and Passeron (2011) note that bourgeois language tends to be characterised as embodying 'formalism intellectualism, and euphemistic moderation' whereas, working-class speak 'manifests itself in the tendency to…shun the bombast of fine words and the turgidity of grand emotions through banter, rudeness, and ribaldry' (2011: 116). Bourdieu and Passeron's critical insights have implications for a South African society which has historically conflated race and class. This also points to the arbitrary and advantaged position that the historically elite predominantly white community has had in terms of appropriating the language of the academy. The observation must also be made that while South African society is rapidly changing, the values, culture, and language of the academy remain virtually unaltered and continue to privilege those from the dominant group.

Marginalised and Underrepresented in Academia

In South Africa, as in many parts of the world, the quintessential academic has predominantly been, and continues to be middle-class, white, and male. Given South Africa's socio-political history, this has been the case despite the fact that only a small minority fit the bill. This is not to say that South Africa has not produced first-rate academics that do not meet the aforementioned description. However, it is befitting to acknowledge the barriers faced by those who have been traditionally underrepresented and marginalised in the academy. With this in mind, we outline some of the barriers faced by black academics and academics that come from a working class background. Additionally, we discuss some of the barriers that women in the academy continue to face. Our aim here is not to provide an exhaustive account of the literature on black academics, working-class academics, and women in the academy, nor to portray race, class, and gender as existing independently from each other. We also do not claim that race, class, and gender are the only relevant categories that exist when addressing issues of marginalisation in the academy, however these are issues that continue to be prevalent in the discourse on university transformation. Thus, we discuss the marginalisation and underrepresentation of black, working-class, and women academics in South Africa by looking at structural and

institutional factors. Our focus on race, class, and gender is informed by the nation's socio-historical past. We also acknowledge that individuals are not unidimensional and can identify in a myriad of socially relevant ways that evoke the intersection of race, class, and gender.

Black Academics[2]

The not so distant apartheid past and the resulting inequalities that were generated and perpetuated in South Africa underscore the relevance of acknowledging the struggles, difficulties, and barriers faced by new black academics. The alienation of black academics poses a major problem in South Africa (Thaver 2003). White, Riordan, Özkanli, and Neale have noted that race and gender manifest themselves in university management structures, with one of their participants noting that the university is characterised 'predominantly [by] a white male culture with an overwhelming white male professoriate' (2010: 653). This poses a major problem for those who do not conform to the overriding culture. As Thaver has noted,

> if an institution's culture reflects the hegemony of a single group, it signals a message that only persons from the hegemonic group can be academics, sending out a negative message to those outside of the specific group' (2003: 146).

It is therefore not surprising that black academics identify alienating cultures as one of the main reasons black individuals leave academia (Metcalfe & Cock 2010). Black academics' departure from the university raises concerns with respect to the lack of role models for black students (Davis 2008: 279). A need exists to fundamentally transform the system, and support and promote academics situated outside of the hegemonic group. In particular,

[2] We use an inclusive definition of black that includes Indians, Coloureds, and Africans. While we acknowledge that race is a social construct and that individuals do not necessarily fit into these categories, and can resist them, they have also been entrenched in South African society and point to social inequalities and disparities.

black female academics experience isolation and a need for training and mentorship in relation to conducting research and producing publications (Schulze 2005; Maürtin-Cairncross 2005).

The recent *Report of the Ministerial Committee on Transformation and Social Cohesion and the Elimination of Discrimination in the Public Higher Education Institutions* (also known as the Soudien Report), found that racism and sexism are pervasive in public institutions of higher education (Department of Education 2008). Among a plethora of problems, the report noted that universities are experiencing difficulties with respect to retaining black and female staff members (both academic and non-academic). These difficulties include problems of harassment of black staff members by white students in some institutions (Department of Education 2008). Similar findings have been previously documented by Schulze (2005).

The aforementioned discussion has focused on the South African context, however, it is noteworthy that the marginalisation of black academics and academics of colour has been well researched across different contexts (see, for example, Delgado-Romero, Nichols Manlove, Manlove & Hernandez 2007; Abercrumbie 2002; Alfred 2001; Turner & Myers 2000; Johnsrud & Sadao 1998; Keith & Moore 1995, Sorcinelli 1994; McKay 1983). Academics of colour experience discrimination and stereotypes within higher education institutions that have traditionally been centres of white hegemony (Allison 2008; Hendrix 1997; Weitz & Gordon 1993). However, Delgado-Romero *et al.* (2007) suggest that discrimination against academics and aspiring academics of colour is not often examined systematically, and is instead discussed anecdotally, thus creating the perception that discrimination on the basis of race and colour is not problematic within the academy. It is thus important to address the racial background of new academics vis-a-vis the institutional practices of the university, particularly those practices related to research and research productivity.

Working-class Academics

Within the context of South Africa, race and class have historically been

conflated, due to the institutionalised discrimination that was faced by black communities during apartheid. Thus, while a black middle-class has emerged and a black political power block exists, the majority of people living in abject poverty in South Africa continue to be black. This is exacerbated by the country's growing inequality (Bhorat, van der Westhuizen & Jacobs 2009). The widening gap between rich and poor must be taken into consideration, and universities must be cognisant of the struggles of new academics from working class backgrounds, who have traditionally not enjoyed the same benefits as their middle-class (or wealthy) counterparts. Moreover, the assumption cannot be made that all academics have had similar home and schooling experiences.

Academics who come from working-class or low-income backgrounds have expressed the difficulties they face in the academy (see, for example, Brook & Mitchell 2010; Ryan & Sackrey 1995; Langston 1993; Tokarczyk & Fay 1993; Rendón 1992). They deal with feelings of loss, longing, guilt, courage, and perseverance (see for example, Dews & Law 1995). Brook and Mitchell have noted that, 'over and over, in sometimes subtle, sometimes conspicuous ways, working-class sensibilities are assumed to be antithetical to intellectual life' (2010: 369). These assumptions are not only present in the academy, but can also be taken up by kin of academics from working class backgrounds (see, for example, Rendón 1992; Borkowski 2004), thus discouraging promising potential intellectuals from entering the academy. Attempting to reconcile the world of academia with working-class culture can be a difficult feat. It is no wonder that some intellectuals from working class backgrounds disconnect from their working class roots (see, for example, Dews & Law 1995; Brodkey 1994; Rodriguez 1982). The problems and difficulties faced by working class academics, at least in part, can be attributed to a 'professoriate [that] does not expect to find colleagues who were themselves first-generation students from working-class backgrounds among its ranks' (Brook & Mitchell 2010: 370). Furthermore, the argument has been made that the university can be a confusing space for individuals who have grown up in working class communities where 'straight talking is valued [as] the exigencies of daily life leave little space for either flattery or conceit' (Reay 2004: 36). This again highlights that the language of the academy can be used to marginalise new academics from working class backgrounds.

Women in the Academy

On the surface it appears that women in academia have made significant strides in South Africa. Between 1992 and 2001 the proportion of women increased from 30% to approximately 40% (Boshoff 2005). More recent figures indicate that women make up approximately 43% of academic staff (Department of Education 2008). However, they continue to be concentrated at lower levels, with few of them holding upper management or professor positions (Department of Education 1997; Koen 2003; Department of Education 2008). Women's concentration in lower level positions can at least in part be attributed to universities failing to consider women's role in the family and having few or no systems in place to cope with specific circumstances of women's career trajectories (cf. Department of Education 2008). In addition, women academics carry heavier administrative and teaching workloads, which tend to be undervalued and less prestigious than engaging in research activities (Perumal 2003; Garnett & Mahomed 2012).

Unfortunately, there is ample evidence that gender discrimination, sexism, and patriarchy have, and continue to be prevalent in institutions of higher education (see, for example, Bagilhole 1993; Carr, Szalacha, Barnett, Caswell & Inui 2003; Menges and Exum 1983; Shollen, Bland, Finstad & Taylor 2009; Stout, Staiger & Jennings 2007; Toutkoushian & Conley 2005; West 2007). However, it is also noteworthy that in South Africa women in the academy have reported experiencing some favourable conditions, such as flexible working hours and less visible blatant discrimination (Petersen & Gravett 2000). Nonetheless, their reports of subtle discrimination, male-dominated networks that exclude women, and unfair promotion practices, among other complaints, appear to overshadow favourable reports (Petersen & Gravett 2000). It should be noted that black women find themselves in particularly precarious positions (Department of Education 2008). For instance, the Soudien Report documents the response of an interviewed staff member, who notes that, 'Structural sexism also exists. If you are black and a woman it is doubly painful ... it is equally marginalising and stifling' (Department of Education 2008: 45). Black women in the academy face racism, sexism, confront stereotypes, and are expected to succeed in an environment that is perceived and experienced as hostile (for an-indepth discussion of the challenges faced, see, Gregory 2001; Patitu & Hinton 2003; Thomas & Hollenshead 2001; Mabokela &

Magubane 2004). Given South Africa's recent grim racial past and entrenched patriarchal practices and sentiments, it is necessary to critically question and challenge sexist and racist practices that are increasingly becoming more inconspicuous.

Developing Adequate Support Structures for New Academics

Our focus now turns to a discussion of the resources, information, and support that may facilitate success for new academics within the research orientated academy. Providing adequate support structures for new academics in general, is a strategy that could help promote the success of new academics from historically marginalised groups and groups that are underrepresented in academia. In focusing on support structures, we also examine the significance of presumed norms, values, rules, and ways of operating; socialisation into the academy; networking; and mentoring.

According to Barkhuizen (2010), new academics need to be inducted into academic life; they need to be provided with 'maps'. These maps refer to a set of guidelines which can be issued, explained and practiced during a university induction course. Furthermore, these guidelines should be clearly defined and elaborated for new academics. This would allow for a smoother transition between the postgraduate student role and the academic role that academics are required to assume. It is however noteworthy that these 'maps' would provide little use if they are generic formulations that do not take into consideration the specific university and the specific discipline of the new academic staff member.

The academy, similar to virtually any other institution, is bound by prescribed norms, rules, values, and traditions and new academics may not necessarily be familiar with the tacit ways in which universities operate. Shulman and Silver (2003) discuss the significance of informal norms that are rarely articulated within academia. Caplan suggests that the 'real rules' of the academic world may not be recorded in official university documents (1995: 92). Moreover, it is not uncommon for these real rules to be assumed and taken for granted, and thus they may go unspoken. For instance, it has been noted that teaching, research, and service (indicators of performance within academia) are not clearly articulated, openly discussed, or adequately evaluated (see, for example, Jackson 2004; Mullen & Forbes 2000; Tierney

1997). Programmes that intentionally prepare new academics for a career in the ivory tower can discuss and elaborate upon these unspoken rules and the *modus operandi* of universities. In this way, the academy can be demystified.

The significance of the socialisation process for new academics should not be overlooked or underestimated, it has been noted that socialisation into the profession assists individuals in successfully transitioning into a career in academia (see, for example, Price & Cotten 2006; Jackson 2004; Tierney 1997; Keith & Moore 1995; Tierney & Rhoads 1994). Socialisation into the academy must take into consideration disciplinary contexts (Austin 1990; Tierney 1990; Clark 1987). According to Tierney and Rhoads (1994), socialisation occurs both during postgraduate studies and in the profession (with more critical socialisation taking place after assuming an academic position); however, they argue that socialisation occurs in an isolated, indirect, and ambiguous manner. Many institutions of higher education do not specifically outline how academics will engage in their wide-ranging duties, thus rendering the socialisation process even more crucial (Austin 2002). With this in mind, a need exists for well-structured programmes that intentionally aim to socialise new academics, and thus assist them in entering and successfully navigating the academy.

Within the South African context a limited number of such programmes have been implemented. For example, the Research Success and Structured Support programme was instituted at the University of the Witwatersrand to support new academics. The programme assisted eight new academics in attaining higher degrees and producing publications, and consisted of courses, workshops and coaching (Geber 2009). Given the following (aggregate) tangible outputs, the programme achieved a fair amount of success particularly in terms of research production, this included ten publications, four papers under review, one M.Sc. completed, three promotions, five conference presentations, two NRF (National Research Foundation) grants, and one international grant. This programme demonstrates that these types of endeavours 'can have a dramatic effect in getting young researchers in a position where they are able to perform well and view themselves as successful and independent researchers' (Geber 2009: 688). Additionally, other similar programmes such as the Emerging Research Programme and the New Academic Practitioners Programme, both based at the University of Cape Town also serve to assist new academics

with their research, writing, and publication goals (Mohamed 2007). Thus, evidence exists that the implementation of programmes that intentionally assist new academics in becoming research active and successfully navigating the academy can be fruitful.

Networks and connections can be powerful factors with respect to gaining entry into or succeeding in academia. In his work on apprenticeship in the postgraduate student context in South Africa, Hugo notes that:

> Successful intellectuals are engaged with life, implicated into vital networks and lineages, and work within a community of teachers and students, peers, subordinates, superiors, colleagues, friends and partners, full of emotional energy and cultural capital (2009: 719).

In other words, networks can be viewed as resources for new academics within South Africa, since they can potentially facilitate successful engagement with the intellectual community. Thus, cultural and academic capital should not be underestimated. It must be acknowledged that one way in which new academics are inducted into academia and become established intellectuals, is via accessing the connections, contacts, and resources that are available to them; and it is not uncommon for mentors, supervisors, and senior professors to serve as gateways to these types of academic networks. If we are serious about supporting new academics from marginalised and underrepresented backgrounds these types of collaborations and networks must cut across race, class, and gender boundaries.

Mentorship is perhaps one of the most researched areas of study in the literature on preparing new academics (see, for example, Zellers, Howard & Barcic 2008; Geber 2006; Bell 1999; Caplan 1995; Keith & More 1995; Smith & Davidson 1992; Sands, Parson, & Duane 1991; Blackburn, Chapman & Cameron 1981; Reskin 1979). The benefits of mentoring new academics have been well documented (see, for example, Savage, Karp & Logue 2004; Gaia, Corts, Tatum & Allen 2003; Gaff & Pruitt-Logan 1998). However, some scholars (see, for example, van Louw & Waghid 2008; McGuire & Reger 2003, Johnson & Nelson 1999) have also warned about some of the pitfalls of traditional mentoring paradigms (i.e., hierarchical relationships, unequal power dynamics, and exploitation). Therefore, mentoring matches should take into consideration common

interests, compatible personalities, mutual respect, and a willingness by parties to enter into these relationships (Wilson, Pereira & Valentine 2002). Nonetheless, mentorship partnerships that are free from rigid hierarchical relationships and exploitation have the potential to make a significant positive impact on new academics. For example, mentorship between novice and seasoned academics facilitates cultural knowledge and role expectations; contributes to professional visibility within the academic community (Alfred 2001); increases confidence and activity; eases the transition into the chosen discipline (Price & Cotton 2006); decreases social isolation; and increases job satisfaction, morale and retention (Wilson, Pereira & Valentine 2002).

The significance of developing carefully structured mentoring programmes that can potentially maximise the benefits for new academics cannot be underestimated. Price and Cotten (2006) point to the importance of optimal matches between mentor and mentee. They go as far as to suggest that a single senior faculty member with robust mentoring skills can work with a group of new academics. This is model can potentially be applied at research universities in South Africa, given the shortage of senior academics (cf. Mabokela 2000). Moreover, some scholars (see, for example, Price & Cotton 2006; McGuire & Reger 2003) suggest that new academics can also mentor each other, since it is sometimes the case that new academics receive more mentoring from their peers than they do from senior academics. This peer approach to mentoring may be suitable for research universities in the South African context. It offers an alternative to the traditional expert-novice mentoring paradigm, and as such is consistent with fundamentally transforming universities to more egalitarian universities that are no longer restricted by entrenched hierarchies that have previously served to stifle growth and development.

Concluding Remarks

In order to transform research oriented universities in South Africa and provide opportunities and spaces for researchers who have been historically underrepresented in academia to succeed, fundamental system changes must be considered. These changes should include acknowledging the implicit and entrenched institutional practices that continue to undermine or

disadvantage new academics, particularly those who come from marginalised or underrepresented backgrounds. However, it is not sufficient to acknowledge these noxious practices. It is also imperative for universities to work towards creating new cultures and practices that intentionally assist new academics. More so, adequate support structures that promote intentional socialisation into the academy; supportive networking practices, and non-hierarchical mentoring models, need to be instituted with the aim of benefitting new academics, and not solely as a mere means or institutional exercise.

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‘The forms of our knowing are “moving”’: A Reflexive Lens on the Self-study Supervision Relationship

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Abstract

Postgraduate supervision is a complex and demanding pedagogic practice, which goes beyond research and disciplinary expertise on the part of the supervisor. Considering that a limitation of traditional systems of doctoral research training is the master/apprentice supervisory model, we question whether different genres of research, such as self-study, add to the complexity of a supervision relationship, where the support process between supervisor and student changes the practitioner and her situation. By adopting a reflexive stance in a self-study supervision relationship, we engage in the process of self-scrutiny and tenuous knowing of our positions in this relationship as each of us came to know it, and the shifting nature of these positions as illuminated through particular moments in the self-study doctoral project. Drawing on excerpts from supervisory meeting conversations we write together about our struggles relating to our fixed positionings, dis-positionings, and repositionings necessary for reframing the supervision relationship as an ethically and aesthetically caring practice. We conclude that the mutually reflexive process undertaken through writing foregrounds powerful, complex moments that happen as spaces – potential, transitional, creative – in a dialogical self-study supervision relationship, which left unattended may have negative consequences for the self-study researcher and the self-study research project as a whole.

Keywords: Supervision relationship, co-writing, mutuality, reflexivity, self-study research, scholarly identity

Introduction

The excerpt below makes reference to two individuals Jane (doctoral student) and Elizabeth (supervisor), both relatively new to the self-study doctoral relationship. The email conversation offers a glimpse into an important learning space in the self-study doctoral journey, and the supervision relationship, developed over the past year between a novice self-study supervisor, and a novice self-study researcher. The excerpt is from an email sent from Jane to Elizabeth.

> Fri 11/2/2012 10:09 AM
> Dear Elizabeth
> … I have been reading a lot around the self and writing up a self-study and I am convinced it has value. I have done some writing and will continue to do so. Perhaps I could see you sometime later on next week. … If you send a message please use my phone because I don't have access at home to my university account
> Take care.
> Thanks.
> Jane

The communication above between self-study student and supervisor marks a relational moment in the early part of the supervision journey where exploration of the intellectual elements of the self-study supervision relationship have not yet emerged. Waghid (2012) and (Fataar 2012) both write about the supervision relationship as continually transforming, and the need for the supervisor and student to continue to negotiate this complex intellectual and relational journey. Ongoing personal and professional redefinition for intellectual and emotional growth places both the student and the supervisor in a vulnerable, discomfiting position. However, we recognise that vulnerability is an important ingredient for being reflexive, and that it has potential for productive knowing/unknowing.

Although we are aware that participation in a self-study supervisory relationship may involve complex relations of power shifts and entanglements, co-authoring an article presents us with conditions for mutual engagement, characterised by collaborative deliberations (Fataar 2012:24). This article opens up a space for our collaborative deliberations as

doctoral student and supervisor when we ask ourselves 'What is it that I am doing, and why?' Together we probe each of these experiences and sensations to ask 'Why? From where? Founded on what?' to theorise our supervision experiences as a scholarly practice.

Need for 'Stepping Back' in the Self-study Supervision Relationship

Stepping back is a necessary process for the self-study researcher (Pithouse, Mitchell & Weber 2009:45). However, we want to extend the position to include, and argue for the fact that 'stepping back' is necessary and critical for both the student self-study researcher and the supervisor. Stepping back allows for deeper understanding and interpreting in the self-study supervision relationship supporting the research process.

To engage in this process we found it useful and worthwhile to take on the personae of Jane and Elizabeth, using a third-person stance to accommodate a more objective stepping back. The third-person genre allows for a more reflexive stance that we are able to adopt in our analysis of the conversations that took place between Jane and Elizabeth during a data generation and collection 'phase' of Jane's doctoral self-study project. We are reminded by Bass, Anderson-Patton and Allender (2002:67) that 'Reflexivity can push reflection past defensiveness into transformative learning'.

The main idea that drives our argument in this article centres on the following questions:

- By mutually engaging in the reflexive process, what can Jane and Elizabeth learn about the self-study supervision relationship and its place, purpose and process for the self-study doctoral project?
- In what way does the self-study doctoral project inform what should/should not happen in the self-study supervision relationship?
- How should the self-study supervision relationship support the doctoral learning and development process as two interdependent and iterative processes?

We show how sustained attention to what Kirk (2005:233-234) reiterates in

her understanding of reflexivity become sources of insights and a springboard for further investigation. Kirk defines reflexivity as 'the continuities *and* discontinuities, the smooth linkages *and* the dissonances between periphery and center, between self and other, and between theory and practice'.

Supporting our 'stepping back' 'involves using methods that facilitate a stepping back, a reading of our situated selves as if it were a text to be critically interrogated and interpreted within the broader social, political and historical contexts that shape our thoughts, actions, and constitute our world' (Pithouse *et al*. 2009:45). We extend this view to critically read our 'situated selves' as supervisor and student in the self-study supervision relationship.

Co-writing an article helps us to think critically and openly and together we are able to read between our spoken lines about ourselves and each other. For Jane, giving up and stepping back from her authorial position as teacher-educator to self-study researcher-co-learner is to be able to 'provoke, challenge and illuminate rather than confirm and settle' (Bullough & Pinnegar, 2001:20) her ways of being, knowing, and doing research. For Elizabeth giving up her authorial position as intellectual-expert and supervisor to promoter and co-learner is to be able to understand how, as posited by Bitzer (2007:1012), 'Supervising as a scholarly practice might be effectively promoted where academics themselves are closely involved in research, but also when they reflect, write and publish on their supervisory experiences, seek student feedback and allow peers to critique their work'.

We argue that a dialogical self-study supervision relationship offers a fertile space for inventiveness and movement, propelling the self-study project. We show how it provides the means to question what our individual and collective responsibility is in the supervisory relationship, and to understand to what extent the relationship as lived and experienced informs the reflexive self-study project. Reflecting through co-writing on our supervisory relationship at a selected moment of the self-study project is not a confessional tale, but a mutually reflexive enactment.

The Research Supervision Landscape

Local and international research studies on postgraduate supervision help us to understand the nature of the supervisory relationship. According to Johnson, Lee and Green (2000:136) supervision as a postgraduate pedagogy

is typified by complexity, with autonomy holding a prominent place in several different models of supervisory relationships. Postgraduate supervision, according to Bitzer (2007:1010), is 'a process involving complex academic/intellectual and interpersonal skills' and the supervisory relationship as a challenging and complex space in which emotions and tensions may occur (Pillay & Balfour 2011).

While some research studies emphasise the intellectual dimension of the supervisory relationship (Connell 1985) for its potential to offer new perspectives, others argue for inclusion of the relational aspects (Fataar 2012; Waghid 2012). Waghid (2012:46) claims that a dialogical climate enables 'a correcting one another and learning from each other in an atmosphere of trust, goodwill and mutual benefit that holds much promise in reshaping teaching and learning beyond indoctrination and rote'. Nekhwevha (2002:135) maintains that it calls for both the supervisor and doctoral student to engage their roles 'actively and reflect critically, with curiosity and uneasiness'.

Although not previously documented, we believe that being reflexive of the self-study supervisory relationship would allow us to reflect critically on our roles. Hamilton and Pinnegar (1998) emphasise openness as an essential characteristic for those engaging in a self-study process. Despite self-study requiring courage and support (Pithouse *et al*. 2009:47), risk-taking should be another quality evident in a supervisory relationship based on mutual respect, trust and reciprocal responsibility (Waghid 2012). In this article we engage mutually through our writing to doubt and to know/unknow (Vinz 1997) our scholarly practices as supervisor and student, and question the conditions that enable the workings of the supervisory relationship.

Conceptual Framework

Collaboration through writing as a reflexive process is supported by Said (1994), who maintains that the role of the intellectual in making scholarship known may entail writing. Collaborative writing – or co-writing, as we come to name the process – about our relationship as self-study doctoral student and supervisor provides an alternate and critical space for us as Jane and Elizabeth. Examining our meaning-making of these critical moments to see possibilities for reframing what we are and do, and why, to make public our

gain in knowledge (Bitzer 2007; Connell 1985) is framed by two concepts: reflexivity and mutuality. Co-writing is a kind of mutuality (Waghid 2012:45) 'whereby one engages another and is engaged in return', benefitting the teaching and learning that happens in this space.

Focusing on our insights in the moment as they arise spontaneously in the actual dialogue process is necessary for the co-writing. The mutuality helps the self-scrutinising process (Chiseri-Strater 1996) of understanding and negotiating meanings (of self) and the authorial positions through which the power of self (Lather 1986) is exercised in the relationship. Lather (1986) argues that it is imperative to question meanings of self, where I question what I know, what I don't know, what I come with and how I am moving forward in understanding. However, '…to be reflexive demands both an 'other' and some self-conscious awareness of the process of self-scrutiny' (Chiseri-Strater 1996:130).

Vinz (1997:139) speaks of an interrogation of self that will 'unsettle each of us to examine our own 'becoming''. She maintains that there is a continuous learning to un-know and not know, and that the dispositions that are made explicit through the questions are really 'dis-positions'. She defines un-knowing as 'a giving up of present understandings (positions)' and not knowing 'as a way to acknowledge ambiguity and uncertainty – a dispositioning that admits vulnerability' (Vinz 1997:139).

Kirk (2005) offers us a way to work through the praxis of reflexivity 'in the field', and in this article our being 'in the supervision relationship' is a critical field for thinking together inventively and without closure – through sustained attention on the positions in which we place ourselves and are placed by each other. This, she argues, requires a 'listening to and acknowledging of inner voices, doubts, and concerns as well as pleasures and pride, and a sensing of what my body is feeling. It implies a constant questioning of what I am doing and why' (Kirk 2005:233).

Casting a mutually reflexive lens to frame our interrogation of our supervision relationship contributes to the joint meaning-making with and for others (Wells 1999), and for oneself, and in the process extends one's own understanding. It calls on us to make ourselves 'strange', to start listening to and acknowledging the inner voices, doubts and concerns as well as pleasures and pride (Kirk 2005). The 'utterance', Wells (1999) argues, viewed from the perspective of what is said, is a knowledge artefact that potentially contributes to the collaborative knowledge building of all those who are co-

participants in the activity. We draw on Wells (1999:108), Bolton (2010) and Kirk (2005) to develop a set of guiding questions for our collaborative reflexive stance:

- How are we, seemingly unwittingly, involved in reproducing social or professional structures in the supervision relationship that are counter to our espoused values?
- How are our utterances being made – what effect does this have on the other?
- What value does this position of 'making the self strange' have for our practices in the self-study supervision relationship?

These questions help us to frame our choices and selections in the research process and reflexively question these selected moments, to better understand what we experienced and how we experienced these moments of 'being', and how to recognise and acknowledge too that the forms of our knowing are 'moving' (Vinz 1997:137). In our joint meaning-making with and for others through our co-writing we are encouraged to make meaning of self and in the process to extend our own understanding.

Our Research Process

Much has been written about the supervisory relationship, but there is sparse literature on the value for both supervisor and doctoral student of engaging reflexively on the supervisory relationship. We draw on transcribed audio-recorded supervision meeting conversations as a stimulus recall to prompt dialogue. The conversations were then interrogated, using dialogue as an inquiry tool (East, Fitzgerald & Heston 2009) to unpack the utterances and what they revealed about the supervisory relationship.

The initial ideas that sparked this reflexive dialogical encounter were initiated in a writing project held as part of a self-study writing workshop that took place on 13–15 March 2013. One of the key foci of the workshop was to ask ourselves 'What are we learning about writing in self-study and about self-study through writing?' Jane and Elizabeth chose to work together on an abstract entitled *Reflexivity in writing* as part of their contribution to this

debate and as part of their learning and development as novice self-study researchers. On completion of the draft chapter sent for editorial review, one of the reviewer's comments stated '*This chapter would be more interesting and relevant if situated within the supervisory relationship'.* We considered this valuable comment and attempted to rework our focus. The revised version was presented as a paper at the 2013 Annual Teaching and learning Higher Education Conference entitled *Reflexive writing in a supervisory relationship.*

Elizabeth and Jane considered the following evaluation from the conference: *'The process of co-learning from supervisory discussions is rarely reported on – stopping to analyse and better understand the learning that occurs in this process is pushing writing, for both, into a place where they continue to learn. Very interesting'* This comment would help us to respond to the question about what we are both learning, what we do and why. Drawing on excerpts of the supervisory meeting conversations that took place over a six-month period from February to July 2012, and using them as a recall stimulus to prompt dialogue, we engaged critically with the conversations to explore our meaning-making in the supervisory relationship. Wells (1999:108) states that:

> ... by contributing to the joint meaning making with and for others, one also makes meaning for oneself and, in the process, extends one's own understanding. At the same time, the 'utterance' viewed from the perspective of what is said, is a knowledge artefact that potentially contributes to the collaborative knowledge building of all those who are co-participants in the activity.

This writing opportunity to see how self-study research impacts on the supervisory relationship, and vice versa, encapsulates the simultaneous, consecutive movement of the dialogical nature of the self-study supervision relationship and the self-study doctoral project.

Data Analysis

We have created three different thematic ensembles (meeting moments) to discuss our reflexive, momentary glimpses of our self-study supervision

relationship. While these are very loosely organised groupings intending to give temporary coherence, they serve to emphasise selected opportunities that are made available for supervisor and doctoral student to exercise agency.

These fragile but explosive momentary opportunities are moments to reflect on what is, to examine our own complicity in the maintenance of the normative, the social order, as well as those threatening, disruptive moments when alternatives to the stereotypical, linear and singular are possible.

Meeting Moment One: 'It's your story …' – The Supervision Moment as a Potential Space

In the knowledge that there is a 'comfort' in remaining entrenched in particular positions (Pillow 2003) as supervisor and student in a supervision relationship, our reflexive gaze on the struggle to give up these positions (Vinz 1997:139) is best illustrated in the excerpt presented below. Jane and Elizabeth make meaning of their complacency and the familiar in their respective positions in which they come to place themselves and each other within the supervision relationship.

After six months of fieldwork, engaging with data collection and generation for the self-study doctoral project, Jane and Elizabeth meet to discuss Jane's work in progress. This comprised videotaped footage of lessons carried out in undergraduate communication classes. An excerpt of and audio-recorded conversation from a supervision meeting held on 27 February 2012 is presented below for discussion.

Dialogue:

J: I have interesting data of my students in my undergraduate communication class, that I have videotaped, and feel I have enough to proceed with my research.

E: Jane, first you need to write up your story. In self-study the process of data generation starts with self. You will need that data, but initially you need to write up your story, which will reveal your underlying assumptions of communication, and how your experiences have shaped your beliefs about teaching and learning. How do these data about students talk back to you – the teacher self?

J: But I need data of my students to provide validation for the study and to explore the 'other'.

E: Videotaping your students will not provide the *full* picture of you as communication lecturer, and it won't reveal to you the reasons for doing what you do in your communication classes. Do you think the problems in your practice lie elsewhere, or in the teacher self? You have to put self under the microscope.

J: So, I am the researcher and the researched. Is that possible?

E: Yes, I can see you are struggling with that position. You should go away somewhere and just write up your life story. Just write up your story!

J: But Elizabeth, my life isn't interesting or dramatic – it's so ordinary!

E: It's your story and your truth.

Analysis of Moment One

In the conversation excerpt both Jane and Elizabeth enter from positions of authority. Jane, in the opening line, takes the position as the author of her script and situates herself as one in control of the research process. As the self-study researcher, her use of the phrase 'I have enough' alludes to a measure of certainty and authority in deciding on her readiness to proceed to the next step in the research process. Evident in this statement is also the inversion of the promoter/student relationship. In Elizabeth's opening line to Jane, 'to write up your story ... data generation starts with self', she takes up an oppositional stance (not listening to Jane), rather than a more probing and inquiring one. This creates dissonance and reveals her struggle to give up her role as 'the one in control' of the research process as traditional supervisor.

However, in a slight moment of stepping back Elizabeth's prompt: 'How do these data about students talk back to you – the teacher self?' opens up a moment of scepticism in Jane's position as a higher education practitioner. It pushes her to re-think her stance despite her discomfort to do so as a self-study researcher. Elizabeth's attention to how she positions Jane as the researcher is evident in her consideration: 'Videotaping … will not provide the *full* picture of you as communication lecturer and it won't reveal to you the reasons for doing what you do in your communication classes'.

Elizabeth's ability to suspend her professional certainty and draw on Jane's ideas does signal the potential for movement – for Jane to see herself as the centre and for Elizabeth to move to the periphery as supervisor. Resisting the inclination to impose (Cissna & Anderson 2002), Elizabeth opens up the climate for dialogue. With some uneasiness, Jane asks 'So, I am the researcher and the researched. Is that possible?' Jane's response in this climate of openness assists her to become sceptical of how she needs to position herself in order to proceed with the self-study project.

An enabling dialogical climate presents itself in this supervisory moment, where questioning and clarifying challenge preconceived ideas (Pillow 2003). Elizabeth's words 'I see you are struggling with that position' reveals her acknowledgement of Jane's discomfort (Pillow 2003), while concealing her complacency as the traditional supervisor. 'You should go away somewhere and just write up your life story' further exemplifies her misrecognition of the critical role of the relational self-study supervision relationship for generating self-knowledge in self-study research. Both Elizabeth and Jane's reductionist view of self as data is indicative of a disconnect between supervisor and doctoral student on one level, and at another level of a disconnect between the self-study doctoral project and the supervision relationship. Moving in opposing directions is unhelpful for Jane, whose doubtful response (Dadds 1993) is '… my life isn't interesting or dramatic – it's so ordinary!'

Elizabeth and Jane's misrecognition and misunderstanding of the commitment and consideration of self, self – other, and the research project, is salvaged in a small but potential space in this disembodied encounter, when Elizabeth displaces herself and draws on the microscope as an analogy to help and affirm Jane's repositioning (Vinz 1997): 'It's your story, your truth'. In this respectful space, dispositioning (Vinz 1997) and repositioning from centre to periphery, however small, is illuminating of the ethical care that is necessary to sustain this shifting, tenuous form in the self-study supervision relationship. Dismissing the ethical responsibility to keep open this fluid shift has the potential to close down the reflexivity necessary for the self-study project.

This selected meeting moment is illustrative of how, when made from a position of closure and inflexibility, our utterances affect the other. Through our mutual reflexive stance that we adopt in the co-writing, we recognise the need for continued commitment of self to ongoing relational

shifts and openness to redefinition of self in these relational shifts, as articulated by Jane's question 'Is that possible?' There is hope in suspending certainty and the power of doubt for self-knowledge (Dadds 1993) in the tenuous quality of Elizabeth and Jane's responsibility in the relationship for generating reflexive, self-study research.

This conversation highlights the supervision meeting moment as a containing and potential space for a dialogical climate. The potential for mutual dispositioning in a dialogical climate is critical for disrupting our singular reality and for a readiness to 'contest our ideas' of autonomy (Pinnegar & Hamilton 2009:168) as we enter into the unsettling spaces of diverse realities (Vinz 1997).

Meeting Moment Two: 'Perhaps memory work will help…' – The Supervision Meeting Moment as a Transitional Space

With the understanding that there is a 'comfort' in remaining entrenched in particular conceptions of self as a neat, coherent package (Bloom, Munro & Pagano 1993), both Elizabeth and Jane cast a reflexive glance to understand their struggles to give up the comforting meanings of the 'narrative of self by ourselves' (Sparkes 1994). Furthermore they want to underrstand the conditions created and means made available in the self-study supervision relationship to enable such a transition. In the selected excerpt of the interactive supervision moment, or calibration point (East, Fitzgerald & Heston 2011: 60), that took place between Elizabeth and Jane on 7 March 2012, we focus on how our utterances are being made and the effect this has on the other in making the transition from singular, essentialising meaning-making to the adoption and negotiating of discomfiting shifts necessary for the self-study supervision relationship to represent lived experience.

Dialogue:

J: Elizabeth, What do you think of *my life history account*? It *took a long time* and a lot of thought to capture in *18 pages* my most significant personal and professional life experiences.

E: Yes, I read it *but it's more like a report*. It isn't a lived account.

J: *What do you mean?* Isn't the writing of the story *sufficient*? I've described nodal moments in my personal and professional life.

E: Yes, but the personal narrative is *more than just words*. *Personal life history requires telling,* not *explaining. Perhaps memory work will help to elicit more about life as experienced*.

J: *I'll have to think about what objects elicit memories* of critical moments in my life.

Analysis of Moment Two

Adopting a reflexive stance allows Jane and Elizabeth the space to scrutinise their respective roles in the supervision relationship. This dialogue is opened up by Jane, who takes up the position as autobiographer in the self-study project. In this authoritative role she describes her personal narrative-writing process as one that is lengthy, time-consuming and complex.

Elizabeth in her position as 'supervisor' fails to attend to the pleasures and pride that Jane expresses in being able to generate data of self (autobiographer), by the self (as researcher). Elizabeth's response instead is a challenge to Jane's singular understanding of what constitutes a personal life history. The moment that Elizabeth utters the words 'Yes, I read it *but it's more like a report*' has a 'shutting down' effect on Jane. This telling rather than mutually negotiating this sense-making by Jane is unhelpful. Despite showing a measure of expertise on the personal life history account, this statement does little to move Jane from this unitary subjective stance.

Jane's questioning '*What do you mean?*' signals uncertainty and reveals her discomfort in being challenged as the author of her own autobiography which charts 'the life' as simple, logical and manageable. La Boskey (2004:858) reminds us that 'it takes courage to expose our shortcomings, to make ourselves vulnerable'. Jane's questioning, however, signals an opening for a dialogical, non-hierarchical supervisory relationship to move the dialogue and for Elizabeth to adopt a more considered position as a professional friend (Waghid & Davids 2013) in the self-study supervision relationship. Samaras and Freese (2009), maintain that critical friends help to validate the quality and legitimacy of each other's claims in the research. We see too how Elizabeth, as supervisor, takes on the ethical responsibility as one of correcting (Waghid 2012) as part of learning, illustrated by the words 'Yes, but the personal narrative is *more than just words'.*

Our understanding here and use of ethical is adapted from Barad

(2007: 393), which relates to 'responsibility and accountability for the lived relationalities of becoming'. This phrase alludes to a more empowering shift that goes beyond the individual in the relationship – a move from *telling* to *acknowledging* and extending – a transition moment for both. For Jane leaving the meeting with some tentativeness about her self-study project makes this a meaningful shift in her meaning-making, when she utters the words *'I'll have to think about what objects elicit memories of critical moments in my life'.* Her scepticism, evoked in the dialogue with Elizabeth, foregrounds the meeting moment as a transitional space, where new ways are introduced for different meanings of thinking and writing about self. Elizabeth illustrates commitment to her responsibility to enable conditions for Jane's self-empowerment (Waghid & Davids 2013). For Elizabeth, adopting a less authoritative role as promoter, rather than supervisor as expert, offers the opportunity for her to be a critical friend (Dadds 1993).

This mutual, reflexive glance at the supervision relationship provides an opportunity for us to understand every supervision meeting moment as a contained, non-linear, complex experience – with the potential to block or to open up agentic shifts and changing roles for intellectual and interpersonal growth (Bitzer 2007). We learn from this reflexive writing moment that adopting less authoritative roles allows for mutual benefit (Waghid 2012).The presence of questioning, acknowledging and correcting in the conversation builds up an atmosphere of trust and respect (Waghid 2012) for self and self–other in the supervision relationship, that cultivates and prepares the site for 'an uncomfortable reflexivity' (Pillow 2003) in the self-study research process.

Meeting Moment Three: 'I began to liken my life to that bench' – The Supervision Relationship as a Complex, Creative Space

In the selected excerpt of the supervision meeting conversation that took place on 23 June 2012, Elizabeth and Jane gaze reflexively on the interactive dialogue evoked between themselves and the photograph of an artefact. Elizabeth and Jane look at the photograph of the *trencadis* bench by artist Antonio Gaudi that Jane offers as her selected artefact that has cultural, symbolic and historical significance for her and her life as a teacher.

Dialogue:

E: *Why did you choose this photograph of yourself on the trencadis bench?*

J: It represents a turning point in my life when I saw a link between my personal and professional self.

E: Where's the bench located and what is the occasion?

J: After attending a language conference in Barcelona, I visited Parc Guell. Here I am sitting on this beautiful bench admiring the artistry of Gaudi's work.

E: After our discussion about the benefits of using metaphor, *have your meanings* of that critical moment on the bench changed?

J: Well, *in reflecting on the bench, I began to see that the bench could be interpreted on a different level. I began to liken my life to that bench* and question the multiple roles that I play as a woman, mother, and a higher education educator. The trencadis bench encapsulates a colourful picture of who I am and what I do.

E: *The photograph seems to have helped you* connect your personal life experiences with your professional practices.

J: Yes, just like the multifaceted mosaic pieces that form the bench, *I see there are pieces of different shapes and sizes that form who I am and help me to understand my multiple selves.*

E: Now you are using the metaphor as *a heuristic device*. This tool has opened up a space for you to see the self as multiple.

Analysis of Moment Three

In the excerpt above, the photograph of the *trencadis* bench becomes the focus of the conversation between Jane and Elizabeth. Different from the previous two meeting moments discussed, this excerpt highlights Elizabeth's role as Jane's promoter – a position different from one in which her interest was mostly on the intellectual project that she is responsible for in this supervision relationship. In prompting and probing Jane through questions, her authority is productively reconfigured by her acknowledgement that knowledge rests elsewhere – with Jane. Each questioning moment in this meaning-making space provides them with new choices and the potential for creative risk-taking, which La Boskey (2004) contends is possible within a

dialogical climate. It also allows a shift to a more scholarly stance (Fataar 2012).

Elizabeth and Jane draw on a combination of 'research expertise' and 'relational and personal dynamics' (Fataar 2012:34) for delving deeper into an inquiry into situations. The question '*Why did you choose this photograph of yourself on the trencadis bench?'* allows for a deepening of inquiry into Jane's choice of the artefact, and recognises the inherent complexity and plurality of voices that are always somehow present in every situation. In a moment of transition Jane's response, '*I began to liken my life to that bench*' demonstrates a reworking of her meanings of her initial response to the photograph of herself on the bench. '*I see there are … multiple selves',* is indicative of a powerful opening up of Jane's confidence and trust in the value of her personal life history for the self-study doctoral project.

This dialogical encounter – enlivened by a 'wide-awakeness' (Greene 1997: 121) in the supervisory meeting, offers significant contact points during the research process to provide an aesthetic opportunity to suspend certainty, to 'define our positions, and embrace imagination, which may allow space for creative change' (McNamee & Shotter 2004: 103). Bass *et al.* (2002:67) remind us that 'Reflexivity can push reflection past defensiveness into transformative learning'. It is, as Vinz (1997:139) describes an unknowing, 'to scratch at the marrow of understanding to discover a multiplicity of meanings'. It allows Elizabeth and Jane 'to bring into question existing understandings, and produce different meanings perhaps not thought of before' (Waghid 2012:47).

Elizabeth's affirming words, '*the photograph seems to have helped you*', are demonstrative of care and acknowledgement of Jane's choice. The words '*Now you are using the metaphor as a heuristic device*' simultaneously illustrate Elizabeth's prompting to shift this inventive moment to a scholarly discourse. Elizabeth's comment '*After our discussion about the benefits of using metaphor…*' reveals 'an encouraging, collaborative climate with accompanying respect and emotional support' (La Bosky 2004:829) that sows the seeds for scholarly growth.

These slight moments of connecting and commitment are not about 'othering or separating' (Barad 2007: 391-392), but illustrate that the act of reflexivity requires an 'other' (Chiseri-Strater 1996). Elizabeth's means of provoking and encouraging Jane's reframing, using the *trencadis* as metaphor simultaneously calls for her to shift from thinking *for* Jane to thinking *with*

Jane, a necessary move past reflection to a more reflexive stance – a necessary stance for Jane's self-study doctoral project (Calma 2007). Drawing on her methodological expertise, she makes a teachable moment possible, as described by Barad (2007), 'not about a right response but rather a fundamental responsibility and accountability for the lively material-discursive becoming of which they are part' (ibid: 393).This aesthetically and ethically caring meeting moment propels 'the necessary academic and intellectual repertoires' (Fataar 2012:34) relevant to Jane's self-study project.

Elizabeth's 'growing awareness of the personal and intellectual basis on which she has to manage and negotiate her authority as promoter, critical friend and supervisor' (Fataar 2007:34) is heightened. Elizabeth's responsibility as a promoter of Jane's deeper learning to shift from a 'normative stance' to an appropriate 'analytical stance' is a lively moment (Fataar 2012:15), and creative risk-taking is made possible. In this lived, meeting moment, aesthetic care for new ideas, trust and mutual respect (Waghid 2007; Bitzer 2007) in and for each other, work in entangled ways.

Mutual reflexivity for the supervisor and doctoral student makes available the subtle moves necessary for the critical process of redefinition of self as supervisor and doctoral student in a dialogical climate (Waghid 2012:46). Elizabeth's shifting from supervisor to critical friend and promoter, and Jane's movement from practitioner to autobiographer to researcher-scholar, is made possible in a climate of ethical and aesthetic care – when the supervisory relationship offers significant contact points during the research process. This provides an aesthetic opportunity to 'suspend certainty, define our positions and embrace imagination, which may allow space for creative change' (McNamee & Shotter 2004:103). It allows for what Vinz (1997:146) describes as 'moving beyond the familiar boundary of what seems clear and known to look as if for the first time so that we might see more and see differently'.

Discussion

According to an Academy of Science of South Africa report (2010:40) one of the major limitations (amongst others) of traditional systems of doctoral research training is the idea that 'supervision modes are often limited to a master/apprentice model'. By making available the local knowledge of our self-study supervisory experience we hope to 'raise new questions, stimulate

debate, and suggest other possibilities' (La Boskey 2004:858). Mutual reflexivity through our co-writing process makes available the subtle, yet risk-taking moments of doubting our fixedness, heightening our awareness of our discomfort as productive and redefining self – other in a dialogical climate.

Importantly, we see mutual reflexivity as a new way of working with self-study research and supervision relationship development. It is a way in which our intra-relationality with each other, with objects and spaces that are made available, is emphasised. Each supervision meeting is an entanglement of connections and considerations – and embodiment of an ethical and aesthetic commitment to the reflexive self-study project.

In our reflexive account we engage in counteracting our totalising positions as supervisor and doctoral student. Mutual recognition of the complexity rather than the singularity of the encounter for meaning-making in the supervision relationship are acknowledged. The responsibility of both student and supervisor is expanded from one's own perspective and ideas to a willingness to commit to embracing and risking change (Wood 2004). In the self-study supervisory relationship mutual reflexivity is a necessary and critical process for simultaneous and sequential shifts in the self-study research project. Casting the reflexive lens on our supervision relationship has challenged and changed our narrow and traditional conception of this one-dimensional, hierarchical connection. The self-study supervision relationship is a dialogical space that is complex, contained and creative.

Mutual reflexivity allows us to see each supervision meeting moment in the self-study supervisory relationship as a complex space – constituted of and constituted by potential, transitional, creative spaces. As a potential space, the supervision relationship enables us to 'stay with personal uncertainty, critically informed curiosity, and flexibility – an ethical way of changing deeply held ways of being' (Bolton 2010: xix). As a transitional space the dialogue, prompted by the conversations in an embodied atmosphere of trust and respect (Waghid 2012), makes the self-study supervision relationship a fertile site for 'an uncomfortable reflexivity' (Pillow 2003). As a complex, creative space, this dialogical supervision encounter is enlivened by curiosity, care and creativity for becoming.

The dialogical supervision relationship is a contained space. Attending to each meeting that works in different ways, with different meaning flows, and calling for ongoing identity shifts from both doctoral

student and 'supervisor-promoter-critical friend' makes the dialogical supervision relationship a dynamic and lived space. We became aware that in a reflexive supervision relationship there is no stable or static centre or periphery, and that the shifting positions necessitate a giving up of positions to allow for a move to the periphery. For example, Jane had to learn that whilst authoring the script of her self-study, the ideas and perceptions that she took to the supervisory meetings were tenuous. We experienced what McNamee and Shotter (2004:103) speak of as a need to 'avoid certainty' because this 'closes us to alternative views'.

The points of connectedness are small, almost unnoticeable moments of ethical and aesthetic caring. These powerful disrupting moments we have come to recognise and acknowledge as spaces for further exploration of what Kirk (2005:233-234) speaks of as 'the continuities *and* dis-continuities, the smooth linkages *and* the dissonances between periphery and centre, self and other, and between theory and practice'. These become sources of insight and a springboard for further investigation of different perspectives to facilitate 'the necessary academic and intellectual repertoires' (Fataar 2012:34) for the self-study research project.

Conclusion

This article has drawn attention to reflexive practices of the self by both the 'supervisor' and doctoral student to foreground those powerful, complex moments that happen as spaces – potential, transitional and creative – in a dialogical self-study supervision relationship. These are mobile, transitory moments (they materialise as quickly as they disappear), crucial to the agenda of a reflexive self-study doctoral project. These ethical and aesthetic investments by both the self-study doctoral student and 'self-study doctoral 'supervisor' reflect the interplay of forces (identities, meanings, practices) which provide the codes through which both make meaning of their existing ways of thinking, relating (what is) and acting (what could be). We define ourselves by means of the dialogical supervision relationship, and that shift 'toward wide-awakeness' (Greene 1977:119) contributes to the making of the self. Opening up our other identity categories through particular reflexive stances encourages us to continue in our transformation and redefinition as ethical and aesthetic beings in a dialogical self-study relationship.

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The Self-study Supervision Relationship

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Do Grade 12 Life Sciences' Results Predict Competence with Regard to Knowledge and Skills Required in First Year Biology Education?

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Abstract

Higher Education Institutions (HEIs) view the National Senior Certificate results as important indicators for entry into such institutions. In the light of the improved Grade 12 results the purpose of the research was to compare first year students' Grade 12 performance with their results obtained in a first biology module at a tertiary institution. We used a number of strategies to determine if there was a significant difference in performance. One strategy was to compare student competences with competences stipulated in the Department of Education National Curriculum Statement for Life Sciences. We also explored students' experiences of learning biology. Grade 12 results as well as results obtained in the first biology module provided data to make comparisons. The results show that the significant difference between Grade 12 results and the performance in the first biology module may be explained by the fact that students demonstrate knowledge and skills that are below those stipulated in the policy documents. Furthermore students' experience of learning at a tertiary institution are significantly different to their schooling experience. This has implications for HEIs and requires interventions by such institutions to ensure a smooth transition from school to tertiary education.

Keywords: Biology education; Grade 12 results; First year experience; Institution expectations; Student expectations.

Introduction and Background

With the demise of apartheid, a common education system was introduced for all learners and the infamous Bantu education system which had wreaked havoc amongst those who were subjected to this system was eradicated. The introduction of an outcomes-based education system was one way of transforming education. As the effect of a transformed education system would only be visible after a number of years, there was a need to demonstrate significant change in the short term. The South African matriculation (Grade 12) examination results was one way of demonstrating this change.

The consistent improvement of the matriculation results, including the Life Sciences' results, has been under scrutiny for a number of years (Nel & Kistner 2009). As far back as 2001, Jansen (2001) was extremely critical of the matriculation results because he believed the results were politicised. This has led to debates in many circles with a number of stakeholders questioning the validity of the results (Ramphele 2009). The Department of Education contends that the numerous intervention programmes initiated by the department are working and this has resulted in the improved pass rates for Grade 12 learners. However, research has shown that interventions appear to have little effect on the education system (Taylor, Muller & Vinjevold 2003; Taylor 2010).

The 2010 Grade 12 results once again showed an improvement over previous years despite the problems that the learners had encountered, which prompted an intense debate that resulted in a report by Umalusi in which they attempted to explain how the matric standardisation decisions were made (Umalusi 2011). With regard to Life Sciences the explanation was that the raw mean score of the 2010 result was in line with the raw mean score of 2009 as the difference was very slight. The 2010 cohort performed slightly better than the 2009 cohort (Umalusi 2011) and according to Umalusi, the Life Sciences' marks were not adjusted. The improved matriculation pass rate assumes improvement in the lower grades as well, although this is not evident from the poor performance of South African learners in the Third International Mathematics and Science Study (TIMSS) (Reddy 2006). Even South African studies show that learners are performing below the requirements of the curriculum (Sikhwari & Pillay 2012).

It is against this background that, HEIs, enrol first year students. The

university at which this research was conducted has no access/foundation programmes, thus student preparation for tertiary study was not available. Students who enrolled for their first year of study were expected to register for their chosen major subjects in that year. Anecdotal evidence during registration over the period 2009 to 2011 seemed to suggest that first year students who registered for the first module in Biological Science Education had better Grade 12 results than in previous years. What was significant was the fact that the three cohorts, from 2009-2011, were the products of Curriculum 2005. This prompted the question whether these students, who had been exposed to an outcomes-based education system, were more competent than those who had experienced the traditional education system that was in place before the introduction of C2005.

The discrepancy between school performance and university performance is a well-known phenomenon and has generated much research (Baron & Norman 1992; Nel & Kistner 2009; Govender & Moodley 2012). We were therefore not expecting students to perform at the same level as they did in Grade 12. However we were interested to find out if the learners who were exposed to C2005 throughout their school careers, had improved knowledge and skills compared to previous cohorts.

The purpose of the study is threefold: firstly we wanted to compare the Grade 12 results for Life Sciences of three cohorts (2009-2011) with their results for the first biology module to determine their levels of competence in the subject; secondly we wanted to determine what competences first year students bring to biology courses and thirdly to explore their experiences of teaching and learning at a tertiary level. This study was conceptualised when the 2011 cohort registered and their high marks in Life Sciences were noted. The critical questions that guided the research are:

- How do first year Biological Science Education students' Grade 12 marks for Life Sciences compare with their performance in a first year biology module?

- How do the knowledge and skills of first year Biological Science Education students compare with the knowledge and skills stipulated in the National Curriculum Statement (Life Sciences)?

- How do students experience the learning of Biology during their first year of study?

Literature Review

The research described here raises the question of the relationship between school exit examinations and acceptance of students at HEIs. Of the many questions surrounding exit examinations such as the South African senior certificate examination, one enduring question is whether these results actually matter. This question is especially important in the context of higher education as HEIs expect a certain level of competence on which they build. The senior certificate examination is a high stakes examination in South Africa. High marks are prerequisites for entry into many courses and often marks are the only criterion for entrance into such courses. While schools and communities place a high premium on good performance in these examinations, HEIs are more concerned with the competences learners acquire during their years of schooling (Pike & Saupe 2002).

Nel and Kistner (2009) proposed a benchmarking test for HEIs to give a more realistic assessment of student competence as the National Senior Certificate (NSC) tends to inflate the lower grades, allowing learners into the system who may not be able to cope with the increasing demands of tertiary education. Furthermore, with the increasing diversity of students entering universities worldwide, it has become necessary to develop predictors of academic performance in the first year (Mackenzie & Schweitzer 2001). Rankin, Schöer, Sebastiao and van Walbeek (2012) suggest that students' performance in both the NSC and the National Benchmark Tests [1](NBT) should be used to determine student success in the first year of tertiary study.

Baron and Norman (1992) found that scholastic performance was a better predictor of achievement than aptitude tests. As aptitude tests are supposedly indicators of potential, this is an interesting finding. In South Africa HEIs often place more emphasis on potential than on scholastic

[1] The National Benchmark Tests (NBTs) were commissioned by Higher Education South Africa (HESA) with the task of assessing academic readiness of first year university students as a supplement to secondary school reports on learning achieved in content specific courses.

achievement when admitting students into courses with limited access, as this is deemed a better predictor of success (Enslin, Button, Chakane, de Groot & Dison 2006). Aptitude tests such as the Differential Aptitude Test (DAT) commonly measures potential for verbal, numerical and abstract reasoning. Dynamic assessment as a method of measuring potential is also gaining momentum (Murphy & Maree 2006). To admit students into HEIs based purely on their scholastic performance is often regarded as a discriminating practice, considering our history of inequalities between different race groups where the education of these groups was, and currently still is, differently resourced and their teachers differently qualified (Keevy 2006).

The work of Evans and Fancy (1998) shows a strong relationship between prior academic achievement at secondary school and first year performance although this relationship varies, depending on the discipline. While the work of Cyrenne and Chan (2012) shows that high school results are indeed a predictor of university performance, other factors also play a significant role in predicting performance – they give examples such as socio-economic background, the financial position of the student at university, as well as the resources of the school from which the student comes.

Although Umalusi regularly reports on Grade 12 results and endeavours to make comparisons between cohorts from different years, very little research has been conducted to determine whether students who have been exposed to an outcomes-based education system such as C2005 perform better at university. Govender and Moodley (2012) found that the first cohort of physics students at their institution who had been exposed to C2005 throughout their school career, performed worse than those of previous years, while Engelbrecht and Harding (2008) found that first year students who had matriculated before 2008, but were exposed to OBE in the earlier years performed at the same level as earlier cohorts.

The transition from Grade 12 to tertiary education is difficult for most students, irrespective of whether they are products of an outcomes–based education system or not (Keke 2008). Most universities expect students to be capable of developing inquiry and problem solving skills. Students are encouraged to think critically and independently, rather than rely on external authoritative knowledge (Yang, Webster & Prosser 2011). This may be difficult for students who have not been exposed to this approach at school. A further factor that was found to influence students' performance at university

was that of workloads (Kember, Jamieson, Pomfret & Wong 1995). Students report that the amount of work covered at university is considerably more than that covered at school over the same period of time. This raises the question as to the ways in which students are inducted into particular disciplines at university.

The work of Parker, Summerfeldt, Hogan and Majeski (2003) adds another dimension in that their research examined the relationship between emotional intelligence (as measured through self-report questionnaires or tests) and academic achievement. Their study showed that emotional intelligence is a modest predictor of academic success; nevertheless it was a better predictor than high school achievement. This is in contrast to earlier studies that showed little association between academic success and emotional intelligence. This research points towards the importance of factors other than academic factors which may influence student achievement. Linked to this is the students' confidence in their own abilities, termed self-efficacy by Chemers, Litze and Garcia (2001). Their research has shown that self-efficacy has a major effect on academic performance. While most research shows that commitment is one of the strongest drivers of academic success, commitment and perseverance may be determined by both personal and environmental factors. Aptitudes and capabilities contribute to academic confidence/efficacy and this helps to determine goal commitment (Chemers *et al.* 2001). Lizzio, Wilson and Simons (2002) found that students' perception of their learning environment was a stronger predictor of achievement than school achievement. This has implications for HEIs as it questions the kinds of learning environment HEIs create that facilitate learning. Keke (2008) found that unrelated factors had a major impact on students' well-being and also influenced their academic performance. One such factor is parental role. Winter and Yaffe (2000) report that the role of parents provides a small, but significant contribution to their children's adjustment at university. This could be an important factor in a context where children are first generation students whose parents have little understanding of their university experiences. Another factor that has an effect on student performance was found to be a sense of belonging (Shook & Clay 2000).

In conclusion, the literature reveals a number of factors that impact on students' performance at university and while research points to school performance as an important indicator, a number of other non-academic factors may also have a significant effect on performance.

Methods

The method of data collection applied in this study is mainly quantitative because the data were obtained by analysing marks obtained by students in the first biology module for which they had registered, as well as their Grade 12 marks. The framework that guided the analysis of students' performance in activities was the Life Sciences Curriculum Statement (Department of Education 2008), which gives clear guidelines as to what outcomes learners should have achieved at the end of Grade 12, which served as the benchmark to be discussed later.

The first step that preceded data analysis was an analysis of the National Curriculum Statement (NCS) (Department of Education 2008) for Life Sciences. This was done in order to determine the range of skills students are expected to master by the end of Grade 12. These skills were used as a benchmark to measure the levels of skills students brought to the course. The NCS clearly states which skills are expected of learners at each level of performance, for example if all students attained a mark of 60% and above in the Grade 12 examination, as is the case in this study, the document clearly states what the competence level of such learners should be.

The second step involved the analysis of the Grade 12 marks for Life Sciences for those students who enrolled for their first year of study in the module Biological Science for Educators 210 in 2009 (30 students), 2010 (41 students) and 2011(68 students), respectively. The marks obtained by the three cohorts for the above named module were also analysed. Furthermore, the results for two tests and the university Biology examination of the 2011 cohort were also analysed.

A third step in analysis involved one activity where students' responses were analysed to determine their perceptions of learning in their first year of study of Biology at the HEI.

The National Curriculum Statement, NCS: Life Sciences

Three sections of the NCS document were used to determine the skills students were expected to have acquired at the end of Grade 12. The first was the introductory section; the second was the three learning outcomes and the third was the competence descriptions.

One of the pertinent statements in the introductory section is that the NCS: Life Sciences Grades 10 – 12 (General) aims to develop a high level of

knowledge and skills in learners' (Department of Education 2008: 1). It further presents this goal as extremely important because it strives to empower those sections of the population who were previously prevented from achieving high knowledge and skills.

The three learning outcomes of the subject Life Sciences are based on three competences i.e. scientific inquiry and problem-solving skills; construction and application of life sciences knowledge and an understanding of the interrelationship of Life Sciences, Technology, Environment and Society. For the purpose of this research we only focused on the first two competences because the third competence is covered in other modules of the B.Ed Biology Education curriculum.

Learning Outcome 1 states that: '*The learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills'.* The document elaborates on the statement by explaining that the above competences involve experimental and data handling skills, defining experimental skills as the ability to follow instructions, make observations, measure trends and record information. Data handling skills are described as skills involving identifying, selecting, organising, presenting, translating, and manipulating data, as well as making inferences, deductions and conclusions from the data gathered.

Learning Outcome 2 states that: '*The learner is able to access, interpret, construct and use Life Sciences concepts to explain phenomena relevant to Life Sciences'.* This means learners should be able to use their inquiry and thinking skills to interpret, apply and extend the understanding of concepts, principles, laws and theories. As all the members of the first year cohort in 2011 achieved a mark of 60% or above in the Grade 12 Examination, the outcomes they were expected to have achieved are described in table 1.

Table 1: Achievement descriptors for different levels (From NCS, DoE, 2008).

By the end of Grade 12 the learner with outstanding achievement (80-100%) can:	**By the end of Grade 12 the learner with meritorious achievement (60-79%) can:**
■ suggest specific changes to	■ analyse, reflect on, and evaluate

improve the experimental design as well as provide conclusions showing awareness of uncertainty in the data; ■ analyse problems and make solutions to problems brought by biotechnology; ■ evaluate the relevance of biotechnological applications to Life Sciences; ■ critically evaluate the application of scientific and indigenous knowledge in South Africa and elsewhere; ■ develop justifiable and responsible positions on the influences of different beliefs, attitudes and values in various communities; ■ evaluate and give ecommendations on the impact of scientific and technological processes and products on different communities.	findings of the investigation as well as identify and allow for irregular observations when displaying data; ■ debate and show how concepts, principles, laws, theories and models influence one's behaviour; ■ analyse the application of scientific and indigenous knowledge in the South African context as well as debate the influence of different beliefs, attitudes and values among different communities; ■ analyse and report on the impact of scientific and technological processes and products on different communities.

The expectation was that all students should therefore have the competences described in Table 1 to varying degrees.

Ethical clearance was obtained from the university where the research was conducted. The university assisted in making examination results available and students gave their consent for their tests and class work scores to be used. A limitation of the study is the fact that data on class activities and tests were only collected for the 2011 first year cohort. Consequently, only final marks for the 2009 and 2010 cohorts were available.

Results and Discussion

The results from the various data sources are discussed below.

Analysis of Grade 12 results

Table 2 shows the Grade 12 results for Life Sciences of students registered

for the Biological Science for Educators 210 (EDBS210) course from 2008 – 2010.

Table 2: Matriculation results of students registered for EDBS210 from 2008 – 2010

	YEAR MATRICULATED		
	2008	**2009**	**2010**
Number of students	30	41	68
80-100%	4 (13.3%)	3 (7.3%)	7 (10.3%)
70-79%	7 (23.3%)	15 (36.6%)	29 (42.6%)
60-69%	14 (46.7%)	20 (48.8%)	31 (45.6%)
50-59%	5 (16.7%)	3 (7.3%)	1 (1.5%)
Percentage of students achieving >70%	36,6%	43.9%	52.9%

The cohorts show a steady improvement of their Grade 12 results from 2008 to 2010 with percentages of students attaining >70% ranging from 36.6% to 52.9%. This means that more than 50% of the students who registered for the first module in Biology in 2011 obtained a mark of 70% or higher.

Table 3 shows the final results for the three cohorts registered for Biological Science for Educators 210 from 2009 to 2011.

Table 3: Final results for students registered for module EDBS210 over three years

	FIRST YEAR REGISTERED FOR EDBS210		
	2009	**2010**	**2011**
Number of students	30	41	68
>74% First	0 (0%)	1 (2.4%)	0 (0%)
69-74% Upper second	2 (6.6%)	2 (4.8%)	0 (0%)
60-68% Lower second	3 (10%)	5 (12.2%)	6 (8.8%)
50-59% Third	11 (36.7%)	26 (63.4%)	28 (41.2%)
40-49% Fail (qualifies for a supplementary examination)	11 (36.7%)	5 (12.2%)	26 (38.2%)

<49% Fail (Including students who did not qualify for a DP)	3 (10%)	2 (4.8%)	8 (11.7%)

The performance categories are slightly different from those of the Grade 12 results, but if the categories from 69-100% are analysed, the percentages are as follows: In 2009 only 6.6% of students scored above 69% in the module; in 2010 only 7.2% scored above 69% and in 2011 no student scored above 69% in the final examination. The 2011 cohort that matriculated in 2010 with 52.9% obtaining a pass above 70% preformed the worst in the biology module.

While lower scores for the biology module are not unexpected, the difference is significant. This does raise questions about the alignment between what is expected of Grade 12 learners and what is expected of first year university students in a module such as Biology.

Results of Selected Activities of the 2011 Cohort

A number of activities were selected that covered certain competences mentioned in Learning Outcomes 1 and 2 of the NCS: Life Sciences (Department of Education 2008).

Practical Activity

The first practical activity, completed by 68 students, consisted of a number of smaller tasks aimed at discovering what the level of basic process skills were. One of the activities required students to observe the object before them and to record what they observed. This activity served to gauge very basic skills and we were especially interested to see whether students, when operating in the context of learning Biology are focused on biological phenomena and whether they are able to observe keenly. This particular activity was set up in the garden outside the biology laboratory. This was an extremely simple activity and could be regarded as unsuitable at tertiary level, but we felt justified in including this as a starting point for first year students. All 68 students registered for the module participated in the activity.

Students were asked to say what the labelled structure was. The structure was a fern, a plant commonly found in the environment. The results in table four show that only 15 out of 68 students mentioned that they were observing a green plant. The remainder of the students mentioned other aspects that did not relate specifically to biological aspects of the fern. For instance, they would say things such as: *the sun is shining* or *the soil is dry*. It was as if they did not see the plant at all. When they were asked to specifically observe the fern, a relatively large number could make biological observations such as leaf shape and colour. However, the majority still made observations of the fern that did not indicate at all that these students possessed a degree of biological knowledge and explicit biological terms were not stated. While students' responses point to a lack of skills, the different pedagogical approach could also have had an effect on students as many of them were unaccustomed to answering open-ended questions. While Allen and Tanner (2005) are of the view that student-centred strategies promote learning, the students in this study did not benefit from this approach at the time the research was conducted, possibly because they found it too unfamiliar.

Table 4: Students' responses to a practical task

Practical Activity-Student responses	**Number of students giving correct answers**	**Percentage answers**
Object observed:		
Green plant	15	22.0
Other		78.0
Biological aspects of the object		
Observed biologically	27	39.7
Unable to observe biologically		60.3
What they thought they were expected to do		
Link between observation and expectation	31	45.5
No link between observation and expectation		54.5

The results of this activity were disappointing because it became clear that the level of skill development as envisaged in the NCS was lacking. Most students operated far below the competence level expected of students who had scored above 60 % in Grade 12 because they were unable to analyse the situation or apply biological knowledge.

Tests and Examination

During the course of the module EDBS210 students were exposed to a variety of teaching approaches. The focus was on the acquisition of knowledge as well as similar skills to those mentioned in the NCS (DoE 2008). A range of assessment strategies, both formative and summative, were employed to assess students. The most important summative assessments were two tests and the final examination. Table 5 shows the results of these three assessments.

Table 5: Breakdown of tests and examination results for the 2011 cohort

Test/Examination	**First >74%**	**Upper Second 69-74%**	**Lower second 60-68%**	**Third 50-59%**	**Fail**	**Total**
Test 1	0	0	4	7	57	68
Percentage			5.9	10.2	83.8	100%
Test 2	0	0	5	14	49	68
Percentage			7.3	20.5	72.0	100%
Examination	0	1	8	19	34	62 *
		1.6	12.9	30.6	54.8	100%

*6 students did not gain entry into the examination

While there is a slight improvement in the second test, the results are disappointing, considering the students' Grade 12 performance. As the first test was written halfway through the semester, the students had been exposed to teaching in this module for approximately 6 weeks (The semester is of 13 weeks duration). This appears to have had little impact on their performance.

By the time the end of semester examination was written, one student managed to obtain an upper second pass and a higher number of students (8) achieved lower second passes. It is disconcerting that more than half the class failed the examination.

The First Lecture in Biology Education

This lecture took place outside the lecture venue in an open area, a grassy area/field and used grass as a resource to make the link between grass and biology. While the aim of this lecture is usually to expose students to different approaches and contexts to teaching the Life Sciences, it served the purpose for this project to determine what students' experiences were of learning biology outside the classroom. Students were asked to reflect on their experience of this lecture. A variety of responses emerged from the reflections which were grouped into seven categories. Each category reflects different students' perceptions of what was conspicuous in the lecture. The categories are presented in Table 6.

Table 6: Students' reflections on their first lecture in Biology Education

Category	**Responses**	**Percentage**
1.Environmental component of Biology acknowledged	Link with biology and the environment Interact with the environment Experience learning outside [the] classroom was good Experienced the connection between the sun and plants (grass) Outdoor, wet grass, outdoor learning	21.7
2.Contributed to knowledge development	Understanding has increased, not the same Broaden scientific knowledge	8.7
3.Contribution to positive attitude development	I felt biology Love for biology was developed	8.7

4.Experienced this approach as difficult	Challenging Lecture was difficult	8.7
5.Experience framed in terms of the nature of the lecturer	Dedicated lecturer Unpredictable lecturer Feel the lecturer's passion for the subject Lecturer was full of surprises	17.3
6.Pedagogy	Lecturer encouraged us to think critically Learner (student) centred lecture Lesson was more practical	13.0
7.Acknowledgement of 'first time' experience	Lesson was refreshing Enjoyable lecture, was captivated Interesting New experience; Fun Lecture was unique The lecture venue was a great surprise to me	21.7

There were varied student responses to the lecture, but the common thread appears to be that students experienced something different. Most of them did not appear to have had experience of working outside the classroom to learn through direct observation, collecting data and drawing conclusions. This has implications for developing skills with regard to conducting investigations. While one could argue that investigations may be conducted inside the classroom, considering the lack of resources in most schools, this does not seem likely. While the percentage is quite low (8.7%) it is worth noting that some students experienced the approach as challenging. When students are not accustomed to such open-ended approaches where more than one answer is possible, they may find it quite threatening. While research has shown that students respond well to student centred-pedagogy and active learning (Armbruster, Patel, Johnson & Weiss 2009; Preszler, 2006) the students in this study found it difficult to adjust to teaching and learning strategies that they were unfamiliar with. Another significant response for us was the relatively large number of students (17, 3%) who define their learning during the lecture with regards to the lecturer and not the content.

Conclusion

First year students' poor performance at university is not a new phenomenon. We therefore did not expect the students to produce results comparable to their Grade 12 results. What was significant for us however was the fact that the cohort with the best Grade 12 results (the 2011 cohort), performed worse in their first year than the cohorts with poorer Grade 12 results. When this cohort's competences as demonstrated in activities in which they participated, were measured against the competences listed in Table 1, the findings show that the levels of competence in biology were much lower than cited in the policy document. As all students achieved a pass above 60% in Grade 12, it was expected that they would be able to make basic observations and analyse simple situations within the context of scientific investigations. In fact, the level of skill development demonstrated by the students did not come close to the competences listed in Table 1.

As the results show discrepancies between what students can do and what is expected of them in a university course; this raises the issue of students' performance in the Senior Certificate Examination. The fact that they arrive at university with good marks, but very low levels of skills, brings the criticism of the Grade 12 results to the fore (Jansen 2010; 2011; Ramphele 2009). While a considerable body of international research shows that final year school performance is a good predictor of first-year university performance (Baron & Norman; 1992; Evans & Fancy 1998), the results for students in this study do not support this and the question remains why first year students in Biological Science Education are so poorly prepared for tertiary education.

This state of affairs has serious implications for HEIs. They have no jurisdiction over the schooling sector, and are not in a position to ensure that students entering tertiary institutions have the necessary competences. Raising entrance requirements will exclude many more students, but this will not ensure improvement in the competences required for tertiary study. Therefore, while the schooling system produces matriculants, most of whom lack the necessary competences, it is incumbent upon HEIs to prepare students for tertiary education.

Furthermore, factors other than low levels of knowledge and poor skill development may also contribute to the fact that students are poorly prepared for tertiary education and HEIs need to be cognisant of this. The fact

that students are expected to learn differently, as illustrated by the first lecture in the course as well as the practical activity described, could be a contributing factor. Students in this course are encouraged to be critical and they find this very difficult. Learning outside the confines of the classroom was also a daunting experience for many. A significant percentage of students (17.3%) when asked to comment on the first lecture, referred to the nature of the lecturer and the fact that working outside the classroom was a new experience for them (21.7%). First year students' responses in university courses may therefore be influenced by the type of lecturer they have and this should be taken into consideration during the orientation of first year students.

The findings raise an important question with regard to students' expectations. They arrive at university with high marks and it is reasonable to assume that many of them are confident that they have the necessary competences to succeed in their studies, only to be disappointed when they perform poorly. This may have a debilitating effect on students as they lose confidence and this raises the question of whether a lower matric pass would have motivated them to work harder instead of relying on their abilities as perceived by themselves. While research points to multiple non-academic factors that may also influence student performance in the first year of university study (Keke, 2008; Shook & Clay, 2000; Winter & Yaffe, 2012) the discrepancy between school performance and first year university performance may have a negative effect on student motivation.

All the above factors need to be considered by HEIs if they wish to ensure a smooth transition from school to tertiary education. Access/foundation programmes are one way of assisting students with low level competences. Such programmes are dedicated to the development of the competences required for tertiary education. Furthermore, all students need to adapt to the tertiary environment and in this regard mentoring programmes may facilitate the transition from school to university.

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Making Sense of Mathematical Discourse: Implications for Success in the Learning of Differentiation in a University Classroom

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Abstract

This article reports part of a case study which investigated errors that occurred in a Mathematics classroom owing to poor conceptualisation of mathematical concepts and a lack of the required mathematical register among a group of thirty first year university students. The study focused on the critical issue of making sense of mathematical concepts and examined this issue by exploring students' interpretations and misinterpretations in their learning of mathematical differentiation. The students were registered for Mathematics 1 in Chemical Engineering. Data was derived from the students' written work, along with video-recorded material of their 'live' learning interactions. This data was then analysed within the framework of Sfard's (2007) Commognitive approach as a means of attempting to address errors that are displayed by students when learning differentiation. The students demonstrated different types of difficulties, namely, conceptual, interpretation, procedural, linear extrapolation and arbitrary errors. The application of the Commognitive approach to the identification and addressing of students' errors to advance their understanding of differentiation has proven to be positive in enhancing student learning and success.

Keywords: Commognitive framework; mathematical discourse; students' errors; students' understanding; success in mathematics

Introduction

Students' understanding of mathematics causes uneasiness among teachers, lecturers and other interested parties (Siyepu 2013a). It is somewhat difficult to predict the causes of difficulties that make several, primarily English Second Language (ESL) students, fail or not understand mathematics. Several researchers have devoted time to investigate issues that relate to poor performance of students in mathematics (for example, Vale, Murray & Brown 2012). Vale *et al.* (2012) point out that, 'English second language students face an additional challenge in their National Curriculum Vocational (NCV) studies, namely that of learning and being assessed in a language other than home language'. This problem is exacerbated by the fact that the majority of South African students study mathematics in English; and most institutions of higher learning have English as their medium of instruction.

Apart from the problem of English Second Language (ESL) impacting negatively on the general performance of students, the language of mathematics is also viewed as problematic for many. In line with this view, Dempster and Reddy (2007) advance a convincing argument when suggesting that, learning of scientific subjects (Mathematics included) requires students' proficiency in both (i) language of mathematics and the (ii) language of instruction. In this respect, Jawahar and Dempster (2013:1429) submit that ESL students tend to be faced by an additional challenge, as they tend not to be in a position to master both the former and the latter. Arguably, English as the medium of instruction (in this case) mediates the comprehension and comprehensibility of the language of mathematics and, as such, one senses that the language of mathematics and the language of instruction may not be mutually exclusive, particularly in an environment where English is the medium of instruction. Put differently, mastery of English is, in some sense, a prerequisite for understanding and making sense of the language of mathematics. Mathematical discourse is a concern of this paper. This discourse consists of rules, symbols and formulae, some of which are derived from foreign languages. As a result of that, students tend to demonstrate poor interpretation of symbols in their calculations of mathematical problems (Siyepu, 2013b). Cangelosi *et al.* (2013:71) point out that students memorise algebraic rules with no conceptual understanding attached to these concepts in a mathematics discourse. They (2013) also note that many students have difficulty keeping track of and applying the rules

appropriately; and they (2013) add that students often misinterpret -9^2 as equal $(-9)^2$ not $-(9)^2$. For example, some students interpret 2^{-3} as $2^{1/3}$ instead of $\frac{1}{2^3}$. The point being made is that an under-developed conception of additive and multiplicative inverse is at the root of these errors; and it is for that reason, among others, that the language used and the difficulty in interpreting notation and grouping may hinder students' progression *(ibid).*

The study of calculus, with its fundamental concepts, requires students to interpret mathematical signs, symbols and rules appropriately (Gray *et al.* 2009). Students' difficulties in the learning of calculus are well documented; but there seems to be scanty research (to the best of our knowledge) that focuses on making sense of symbols, rules and formulae in a calculus classroom. The inadequate interpretation, or misinterpretation, of symbols results in the failure of students to establish the interconnectedness of their existing mathematical knowledge with the new knowledge to be acquired; and this tends to have some negative implications for their success. This article explores students' interpretations of symbols, rules and formulae in a calculus classroom in their learning of differentiation in their first year in a university classroom. The primary purpose of this study was to explore and understand how students interpret symbols, rules and formulae as they attempt to attach meaning to and make sense of mathematical discourse. The intention was to gain this understanding through identifying students' errors in their written text and classroom interactions. Attention was also paid to addressing the identified errors in classroom discussion, with a view to improving students' understanding and, ultimately, their success.

This study sought to reveal errors displayed by students registered for mathematics in their learning of differentiation in their 1st year level in a university classroom. Explicitly, this study sought to answer questions such as:

1. What are errors displayed by students registered for mathematics in their learning of differentiation?

2. What strategies that are used by the lecturer to eliminate students' errors in their learning of differentiation?

3. How do these strategies improve learners' understanding of differentiation?

Theoretical Framework

This study is based on Sfard's (2007) Commognitive framework. Within this framework, *thinking* is defined as an individualisation of interpersonal communication, although not necessarily verbal. To emphasise the unity of cognitive processes and communication, the word *commognition*, a combination of the two (that is, cognitive processes and communication), is used to name the framework. The Commognitive framework is an analytical framework of the communicational approach to cognition, which could be perceived as including both cognitive and socio-cultural approaches. These approaches view learning as a process of becoming a participant in a certain distinct discourse. Discourse is considered a special type of communication, made distinct by its repertoire of admissible actions and the way these actions are paired with re-actions. Sfard (2001:28) asserts that the concept of discourse refers to any specific act of communication, 'whether diachronic or synchronic, whether with others or with oneself, whether predominantly verbal or with the help of other symbolic systems'. Sfard (2007:573) adds: '…the different types of communication that bring some people together while excluding some others are called discourses'. She further explains that a discourse counts as mathematical if it features mathematical words, such as those related to quantities and shapes. This study deals with calculus, focusing on students' interpretations of calculus concepts and their notations, symbols and rules.

Sfard (2007:568) makes the following claim:

> If an interpretive framework is to pass the test, studies guided by this framework must be able to cope with the following issues:
>
> (i) *Focus on the object of learning:* In the case under study, what kind of change is supposed to occur as a result of learning?
>
> (ii) *Focus on the process:* How do the students and the lecturer work towards this change?
>
> (iii) *Focus on the outcome:* Has the expected change occurred?

Due to the concern of educationists and researchers about students' difficulties learning mathematical concepts, a shift from acquisitionist to participationist emerged. Sfard (2007:570) asserts that 'the participationist account comes to the rescue not only by offering a different answer to the question of how humans develop, but also by altering the conception of what it is that develops'. In a Commognitive approach, Sfard (2007:573) states that, 'in any academic discipline such as mathematics a form of discourse made distinct by four characteristics may be considered'. These comprise (a) words and their uses; (b) visual mediators; (c) endorsed narratives; and (d) routines, as detailed below.

Words and their uses: In any professional discourse, there are words and their uses that comprise the unique vocabulary of that particular discipline. Mathematics has its own language. It shares words with ordinary English but these have a different meaning in the context of mathematics. Mathematics 'register' is defined as the meanings belonging to the natural language used in mathematics (Cuevas 1984). Halliday (1975) asserts that a mathematics register has the following components:

(i) Natural language words reinterpreted in the context of mathematics, such as functions, root, derivative, product, chain, composite and differentiation.
(ii) Locutions, such as the square on the hypotenuse and least common multiple.
(iii) Terms formed from the combining elements of Greek and Latin words, such as parabola, denominator, coefficient and asymptotic.

In addition to vocabulary, a mathematics register also includes styles of meaning and ways of presenting arguments within the context of mathematics. In a calculus classroom, special words or concepts with their notations or symbols should be introduced with care to distinguish between their meaning in everyday English and in a mathematics context.

Visual mediators are the means by which participants of discourses identify the object of their talk and coordinate their communication. Mathematical discourses often involve symbolic artefacts, created specifically for the sake of a particular form of communication. The most common examples include

mathematical notations, symbols, rules and formulae. In order to flesh out this notion, the following mathematical notations, symbols, rules and formulae are worthy of note.

(a) $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$

(b) Power Rule *is described by the equation below:* $\frac{d}{dx}(x^n) = nx^{n-1}$ *for* n *is equal to any constant.*

(c) Constant Rule: $\frac{d}{dx}(c) = 0$. *The derivative of a constant is zero.*

(d) Constant Multiple Rule: The derivative of a constant multiplied by a function is the constant multiplied by the derivative of the original function: $\frac{d}{dx}(a \cdot f(x)) = a \cdot \frac{d}{dx}(f(x))$

(e) Sum/Difference Rules: *The derivative of the sum of two functions is the sum of the derivatives of the two functions:* $\frac{d}{dx}[f(x) + g(x)] = \frac{d}{dx}[f(x)] + \frac{d}{dx}[g(x)]$

(f) Product Rule: *The derivative of the product of two functions is described by the equation here* $\frac{d}{dx}(f(x) \cdot g(x)) = f(x) \cdot \frac{d}{dx}(g(x)) + g(x) \cdot \frac{d}{dx}(f(x))$

(g) Quotient Rule: *The derivative of the quotient of two functions is described by the equation here* $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{\frac{d}{dx}(f(x)) \cdot g(x) - f(x)\frac{d}{dx}g(x)}{(g(x))^2}$

(h) Chain Rule: The chain rule is used to differentiate composite functions. As such, it is a vital tool for differentiating most functions of a certain complexity.

It states: $\frac{d}{dx}(f(g(x))) = f'(g(x)) \cdot g'(x)$.

(i) Differentiation of exponential functions: The derivative of $y = b^x$ is given by $\frac{d}{dx} = b^x \ln x$

(j) Logarithmic differentiation provides a way to differentiate functions such as $y = x^x$; $y = x^{(ex)}$; $y = (\sin x)^{x^3}$ and $y = x^{(x^{(x^4)})}$. These functions require expert algebra skills and careful use of the following unpopular, but well-known, properties of logarithms. Though the following properties and methods are true for a logarithm of any base, only the natural logarithm (base e, where $e \approx 2{,}718281828.....$) are considered. Notably, this study uses the natural logarithm $(\ln)$ and thus students' understanding of logarithmic differentiation requires them to master the following properties of natural logarithms.

(a) $\ln e = 1$
(b) $\ln e^x = x$
(c) $\ln y^x = x \ln y$
(d) $\ln(xy) = \ln x + \ln y$
(e) $\ln\left(\frac{x}{y}\right) = \ln x - \ln y$

All of the above mathematical formulae, rules, symbols and notations are the basic requirements for any student in order to develop interconnectedness of differentiation.

Endorsed narratives are facts and ideas that are true in conventional mathematical knowledge. These entail definitions, axioms, theorems and formulae. In the case of mathematical discourse, the consensually endorsed narratives are known as mathematical theories, which include the rules and

formulae discussed above in relation to visual mediation (Sfard 2007). Making sense of rules, notations and formulae that are applicable in a calculus classroom is considered part of this study.

Routines are procedures that are applied as repeated steps to reach a solution in a mathematical problem. Routines are helpful in learning a new discourse, as our ability to act in new situations often depends on recalling one's or others' past experiences (Tabach & Nachlieli 2011). An example of a routine in calculus is the application of the first principle of differentiation to find the derivative $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$.

Literature Review

Students' understanding of mathematics remains a problem, despite several attempts by teachers, lecturers and researchers to develop viable strategies that could be applied in the classroom to enable students to improve their performance. The language of mathematics is regarded as the main cause of this inadequate understanding. Students' tendency to make errors when learning mathematics seems to be related to their poor interpretation of concepts. Students' displayed errors are based on these factors: over-generalisation; ignorance of rule restrictions; incomplete application of rules; and misinterpretation of concepts (Cuevas 1984).

Mathematical Discourse

Adler (2001) outlines language scenarios that are relevant to the South African situation, with specific reference to the language culture in a Mathematics classroom. Firstly, in the urban-suburban areas where there is a strong English environment, many different main languages are found. Secondly, in urban or township contexts, there is less English in the environment, with the presence of a strong regional language and different indigenous languages. Thirdly, there are foreign language situations where the learners mainly hear English at school but most of the learners use the same main language, i.e. not English. The two latter scenarios seem to have a

direct bearing on the current study, because a reasonable number of students who participated in the study hail from the townships of the Western Cape, whereas all others originate from the deep rural areas of the Eastern Cape. As pointed out earlier in the discussion, in South Africa, English is used as the language of instruction from the middle level of schooling to tertiary level. Subjects such as Mathematics are taught to students, the majority of whom have limited English proficiency. These students struggle to understand Mathematics lessons owing to, amongst other factors, poor everyday English vocabulary and a poor understanding of mathematical discourse.

English language speakers select their vocabulary to convey meaning in a particular context. This also applies within the discourse of mathematics, where mathematical concepts have special meanings. Cuevas (1984:137) asserts that 'mathematical concepts are viewed as the result of the students' experience, with language facilitating the students' conceptual development through discussion and instruction'. He further elaborates that language is applied to the content of mathematics in the representation of experience through mathematical notation. The use of signs, symbols, rules and formulae in mathematics confuses students, as they struggle to access the meaning of this terminology.

The main task for Mathematics lecturers is to help students to make sense of all these mathematical statements. This may be done by means of semiotic activity. Semiotic activity is defined as the activity of investigating the relationship between sign and meaning, as well as improving the existing relationship between sign and meaning (Van Oers 1997). This suggests that lecturers should focus on making meaning of mathematical vocabulary and procedures in their teaching of mathematics.

Communication in a Mathematics Classroom

The poor performance of students in Mathematics is perhaps owing to lecturers' teaching approaches in Mathematics classrooms. Studies show that instruction remains lecturer-centred, with greater emphasis placed on lecturing than on helping students to think critically and apply their knowledge to real-world situations (Cobb *et al.* 1992). Several researchers propose the development of an inquiry-based form of mathematics

instruction. In an inquiry-based environment, learning is viewed as an active, constructive activity in which students are encouraged to explore, develop conjectures and solve problems (Wachira *et al.* 2013). Students are encouraged to discuss and communicate their ideas and results, often within small, cooperative groups, as well as with their lecturers. The National Council of Teachers of Mathematics (2000) suggests that instruction should provide students with opportunities to engage in mathematical inquiry and meaning-making through discourse; and lecturers should encourage this process by remaining flexible and responsive to students' response and feedback.

Wachira, Pourdavood & Skitzki (2013:2) claim that 'a crucial aspect of a classroom in which students are actively engaged, is to focus on classroom discourse'. They define discourse as purposeful talk on a mathematics subject in which there are contributions and interactions that unpack mathematical concepts among students. They elaborate that discourse does not only promote the development of shared understandings and new insights, but also contributes to deeper analyses of mathematics by the lecturers. They claim that a key element of discourse is the need to use mathematics language and articulate mathematics concepts in order to learn both the language and the concepts. This study employs high discourse classrooms. Imm and Stylianou (2012:131) relate to this notion when pointing out that in high discourse classrooms lecturers prioritise exchange of ideas among the students, and the exchange of ideas should be a purposeful mathematical conversation.

Communication is important in developing mathematical understanding (Steele 2001). Steele (2001) explains that, within a socio-cultural perspective, students exchange ideas with one another and listen actively to one another's views. This creates mutual understanding based on culturally established mathematical practices. Ryve, Nilsson and Pettersson (2013) suggest that students need to enter each other's universe of thought in classroom interaction. Communication should be effective: it is effective if it assists students to gain insight into what is being discussed about a particular topic being studied. In a high discourse Mathematics classroom, students are assigned tasks to calculate and communicate their thinking with others. In this way, students express their understanding and interpretation of their mathematical tasks. The next section discusses students' difficulties in learning calculus.

Students' Conceptual Difficulties in Understanding Calculus

Making sense of mathematics gives students pleasure, confidence and a willingness to tackle new problems (Tall, 2013). He (2013) also notes that the long-term growth of mathematical thinking is improved for those who have a 'sense of relationships' that guides their thinking. Additionally, for students to develop an understanding of mathematics, there should be a sensible approach that takes account of the structures and increasing levels of sophistication involved as learning progresses from sense through perception, then through the relationships of operations and a developing sense of reasoning (Tall, 2013). In other words, students should be able to connect meanings of symbols, rules and formulae in their learning of differential calculus.

Some students' understanding of calculus is hindered by their lack of ability to make sense of calculus concepts (White & Mitchelmore 1996). Sfard (2008:111) defines a concept as 'a symbol together with its uses'. White and Mitchelmore (1996) argue that the main inhibiting factor to success in calculus seems to be an underdeveloped concept of a variable. Consequently, students suffer from a *manipulation focus* where they base decisions about which procedures to apply to the given symbols and ignore the meaning behind the symbols. They (1996) argue that being able to symbolise derivatives involves forming relationships between concepts and should therefore be indicative of conceptual knowledge.

Tall (1993:2) claims that, 'whichever way the calculus is approached, there seem to be difficult concepts which seem to cause problems no matter how they are taught'. , He continues to argue that, 'when students meet difficulties, a dominant strategy for coping is to concentrate on the procedural aspects that are usually set in set examinations' (Tall 1993:4). He provides a list of examples of difficulties with calculus that are normally displayed by students (Tall 1993:6):

- Leibniz notation $\frac{dy}{dx}$ proves to be almost indispensable in calculus, yet it causes serious conceptual problems. Students fail to understand whether $\frac{dy}{dx}$ is a fraction or a single symbol. In the same vein, students fail to

understand the relationship between the dx in $\frac{dy}{dx}$ and the dx in $\int f(x)dx$. Another query he raises is, 'can the du be cancelled in the equation $\frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx}$?'

- Difficulties in selecting and using appropriate representations are known to be widespread.
- Algebraic manipulation is the preferred mode of operation for many students. Students who take calculus with little knowledge of manipulating polynomials and trigonometric formulae tend to experience difficulties in simplification processes in solutions of differentiation.

Research Design and Methodology

This is a qualitative case study located within the interpretive paradigm. Shank (2002:5) defines qualitative research as 'a form of organised empirical inquiry into meaning'. Denzin and Lincoln (2000:3) further maintain that qualitative research involves an *interpretive and naturalistic* approach and thus '…qualitative researchers study things in their natural settings, attempting to make sense of or to interpret, phenomena in terms of the meanings people bring to them'. This study focuses on making sense of mathematical discourse with the intention of developing meaning and understanding the concept of differentiation among the first year students. The purpose is to attempt to find viable solutions to student difficulties in learning of differentiation in a calculus classroom and improve their success. This study reports on implications of using mathematical classroom discourse during social interactions to unpack calculus concepts.

Case Study

This study adopts a case study design approach. A case study is an empirical inquiry that investigates a phenomenon within its real life context (Yin 2009).

Merriam (1988) defines a qualitative case study as an intensive, holistic description and analysis of a single entity. Case studies are particularistic, which means that a case study focuses on a particular situation. They rely heavily on inductive reasoning in handling multiple data sources.

Research Participants

The research participants were thirty students who enrolled for Chemical Engineering for first semester level in an Extended Curriculum Programme (ECP) during the 2009 academic year. They were borderline cases, meaning that they did not necessarily meet the minimum requirements for entry into the main engineering stream.

Data Collection

The data set for this study was collected from students' written work, and from audio and video recordings. The latter offer the advantage of dense, authentic data. In a case study approach, researchers seek to study participants in real situations, doing real activities. To substantiate this view, DuFon (2002:43) argues that: Audio and video recordings can provide researchers and other interested parties with more contextual data. Further they give a complete sense of who the participants are, and acquaint people with the setting in which the participants function and the type of activities they engage in, and the nature of these activities. Audio and video recordings are permanent; they allow researchers and other interested parties to experience an event repeatedly by listening to and viewing these recordings as many times as necessary. Replaying an event allows researchers more time to reflect on the data before drawing conclusions. The audio and video recordings supported the data collection process through bringing a high level of detail regarding the interactions between the researcher and students (Pelling & Renard 1999).

In this study, students and the researchers gathered in a lecture room so that the students could demonstrate their interpretations of calculus activities. They shared their understanding and interpretations to reach consensus about the correct interpretation of rules and symbols to make sense of their learning of differentiation. Figure 1 below shows activities which the participants discussed.

Question 1
Differentiate the following functions and leave your answer in simplest form.

1.1 $y = \dfrac{\sec^3 x^2}{\tan x}$

1.2 $y = 3^{2x+5} \ln(7x-9)$

Question 2
Differentiate the following functions implicitly and leave your answer in simplest form.

2.1 $x + y = \ln(x^2 + y^2)$

2.2 $e^{y+x} - e^x = e + e^y$

Question 3
Find the derivatives of the following functions and simplify where possible

3.1 $y = x^3 e^{2x+3} \sqrt{\cos x}$

3.2 $y = \sec^2 x e^{-\tan^2 x}$

Figure 1: The test given to the students

Data Analysis

Data analysis was conducted in multiple stages. Upon completion of marking students' written tests, the lecturer carried out item-by-item analysis by examining students' responses for each item. The students' scripts were sorted and the scripts that displayed similar errors were grouped.

Audio and video recordings from the classroom lessons were transcribed. The focus was on errors displayed by the students in their calculations on a whiteboard.

The data analysis also focused on the classroom interactions and exchange of ideas among the students and the lecturer. Data analysis revealed that some students misinterpret rules and symbols in their use of differentiation rules. During mathematical discourse in the classroom, this misinterpretation drew the attention of both the lecturer and the students.

Classroom interactions and exchange of ideas involves students and lecturers' evoking one another's understanding of differentiation concepts as students explain their thinking in the process of calculation.

Discussion of Results

This study considered student errors in line with the conceptual framework discussed below:

- Conceptual errors, according to Kiat (2005), are evident in a failure to grasp the concepts in a problem and a failure to appreciate the relationships in a problem. From a Commognitive stance, conceptual errors are connected with poor understanding of words and their uses.

- Interpretation errors, according to Olivier (1989), occur when students wrongly interpret a concept due to over-generalisation of the existing schema. From a Commognitive point, interpretation errors are interconnected with poor understanding of words and their uses. To be exact, students might know mathematical formulae but unable to apply them appropriately.

- Linear extrapolation errors occur when students over-generalise the property f (a + b) = f (a) + f (b), which applies only when f is a linear function, to the form f (a *b) = f (a) * f (b), where f is any function and * any operation (Matz, 1980). From a Commognitive standpoint, linear extrapolation errors are related narratives as students fail to understand the restrictions of the rules.

- Procedural errors, according to Kiat (2005), occur when students fail to carry out manipulations or algorithms, although concepts are understood. From a Commognitive position, procedural errors are related to routines where students fail to follow repetitive patterns in interlocutors' actions.

- Arbitrary errors, according to Orton (1983), occur when students behave illogically and fail to take account of the constraints laid down in what was given. A commognitive justification is where students have poor visual mediators. In the case of differentiation where students do not know the appropriate formulae to be applied.

The discussion of results is an attempt to reveal errors displayed by students in their written work. An explanation on how the errors displayed was addressed in classroom discussion. Of particular interest and importance was the students' improvement that seemed to take place as a result of this teaching and learning initiative.

Conceptual Errors Displayed by Students

Conceptual errors occur owing to a failure to grasp the concepts involved in the problem, or failure to appreciate the relationships involved in the problem.

Table 1 shows a conceptual error and its description in an exponential logarithmic function

Type of error	Description
Conceptual errors	Conceptual errors occur owing to a failure to grasp the concepts involved in the problem or failure to appreciate the relationships involved in the problem. For example, it did not occur to some students that $\ln e = 1$

In activities attempted by eight students, the students did not register that $\ln e = 1$, hence they applied the product rule to differentiate $\tan^2 x \ln e$. They also could not see the relationship of the concept of a natural logarithm ($\ln x$) and the cosine function given in the problem 3.1. Hence they differentiated $\frac{1}{2}\ln\cos x$ as $\frac{1}{2}\ln\cos x \cdot -\sin x + \frac{\frac{1}{2} - \sin x}{\cos x}$. One student could not see that $\sqrt{\cos x} = (\cos x)^{\frac{1}{2}} \neq \cos x^{\frac{1}{2}}$, and she differentiated $\ln\sqrt{\cos x}$ incorrectly. For example, her solution was as follows:

$$\frac{d}{dx}(\ln\sqrt{\cos x})$$

$= \frac{1}{\sqrt{\cos x}} \cdot (-\sin x).$

Two students showed errors of simplification of trigonometric functions, as they did not apply the Lowest Common Denominator (LCD) correctly.
One student showed errors in differentiation of trigonometric functions when incorporated with logarithmic functions. His solution indicated that he could not distinguish between the power rule and the logarithmic differentiation. He differentiated $\ln x^3$ as $3\ln x^2$ instead of $\frac{3}{x}$. He wrote that the derivative of $y = \ln e^{2x+3}$ is $\frac{dy}{dx} = 2x + 3\ln e \cdot 1.$

Students also differentiated $y = \ln\sqrt{\cos x}$ as $\frac{1}{2\sqrt{\cos x}} \cdot \frac{-\sin x}{1}$ instead of $\frac{1}{\sqrt{\cos x}} \frac{1}{2\sqrt{\cos x}} \cdot -\sin x$. One student did not substitute $\frac{-\sin x}{2\cos x}$ with $\frac{-\tan x}{2}$. This indicates poor understanding of trigonometric identities.

One student differentiated the following function as: $y = \ln\sec^2 x$ $= 2\ln\sec x \cdot \frac{1}{\sec x} \cdot \sec x \tan x = 2\ln\sec x \tan x$ instead of writing $\ln\sec^2 x$ as $2\ln\sec x$ first and then differentiating $2\ln\sec x$ as $2 \cdot \frac{1}{\sec x} \cdot \sec x \tan x = 2\tan x.$

Another student showed a poor understanding of the chain rule as she differentiated $\ln\sec^2 x$ as $\ln\sec^2 x \cdot 2\sec x \cdot \sec x \tan x$. She also differentiated $-\tan 2x$ as $\sec^2 x(-\tan 2x)$, instead of $-\sec^2 x \cdot 2 = -2\sec^2 x.$

Another student differentiated $\ln\sec^2 x + \ln e^{-\tan^2 x}$ incorrectly, as she

wrote that $\frac{y'}{y} = \frac{1}{\sec^2 x} \cdot 2\sec x \cdot \cos ecx \tan x + (-\tan^2 x)\ln e$ is the derivative of $\ln \sec^2 x + \ln e^{-\tan^2 x}$.

This solution indicated that this student did not know that the derivative of $\sec x$ is $\sec x \tan x$.

A student wrote $\frac{1}{\sin x}$ as the derivative of $\sec x$; another student wrote $\sec x$ as the derivative of $\tan x$, while yet another student differentiated $-\tan^2 x$ as $-2\tan x \cdot -\sec^2 x$. The error is to write a minus sign in front of $\sec^2 x$.

A student showed a poor understanding of the chain rule as they differentiated $-\tan^2 x$ as $-\tan^2 x \sec^2 x$ instead of $-2\tan x \sec^2 x$. Yet another student wrote that the derivative of $\sec^2 x$ is $-\cos ec^2 x$.

Another student wrote that the derivative of $-\tan^2 x$ is $-\tan^2 x \cdot 2\tan x \sec^2 x$. One student wrote that the derivative of $\tan x$ is $\cot x$. Two students wrote that the derivative of $-\tan^2 x$ is $\ln \sec x \cdot 0 - \sec^2 x$. Two students did not know how to differentiate a composite function from a trigonometric function such as $-\tan^2 x$. One of these two students wrote $-\sec x$ as the derivative of $-\tan^2 x$. The other wrote $-(\sec^2 x)^2 \sec^2 x$ as the derivative of $-\tan^2 x$, and also wrote that the derivative of $\sec^2 x$ is $(\sec x \tan x)^2$. This error originated from the algebraic over-generalisation that if $a = b$ then $a^2 = b^2$.

Interpretation Errors Displayed by Students

Interpretation errors arise when students fail to interpret the nature of the problem correctly owing to over-generalisation of certain mathematical rules involved in the problem.

Table 2 shows an interpretation error and its description in an exponential logarithmic function

Type of error	Description
Interpretation error	Students fail to interpret the nature of the problem correctly due to over-generalisation of certain mathematical rules. For example, some students wrote that the derivative of $y = \sec^2 x$ is $\frac{dy}{dx} = \tan x$.

Two students could not remember the appropriate procedure to differentiate $y = 3^{2x+5}$ in $y = 3^{2x+5}\ln(7x-9)$. One student applied the power rule instead of the exponential rule. He showed confusion in differentiation of the following functions, $y = a^x; y = x^n$ and the chain rule. Another student applied logarithmic differentiation to differentiate $y = 3^{2x+5}\ln(7x-9)$. Figure 2 shows an example of the kind of interpretation error that the students displayed in the differentiation of the function $y = 3^{2x+5}\ln(7x-9)$.

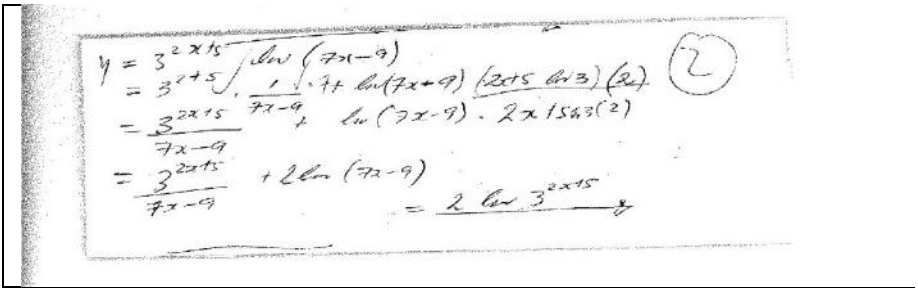

Figure 2: An interpretation error displayed in differentiation

Fourteen students fused two functions into one function in the differentiation of $y = x^3 e^{2x+3}\sqrt{\cos x}$. They treated $x^3 e^{2x+3}$ as the first

function and $\sqrt{\cos x}$ as the second function. One student could not remember the derivative of $y = \sec^2 x$ and, as a result, she wrote that the derivative of $y = \sec^2 x$ is $\frac{dy}{dx} = \tan x$. This error originated from over-generalisation of the symmetric property, which states that for any quantities a and b, if $a = b$, then $b = a$. This is not so in the case of derivatives.

One student wrote that the derivative of $y = -(\sec^2 x)^2 \sec^2 x$ is $\frac{dy}{dx} = -\tan^2 x$ and also wrote that the derivative of $y = \sec^2 x$ is $\frac{dy}{dx} = (\sec x \tan x)^2$. This originated from the algebraic over-generalisation, such as if $a = b$ then $a^2 = b^2$.

Procedural Errors Displayed by Students

Procedural errors occur when students fail to carry out manipulations or algorithms, although they understand concepts in the problem.

Table 3 shows a procedural error and its description in an algebraic function

Type of error	Description
Procedural error	Procedural errors arise when students fail to carry out manipulations or algorithms, although they understand concepts in the problem. For example, one student could not multiply $-\sec^2 x(\sec^3 x^2)$ correctly.

Ten students demonstrated difficulty in simplification of trigonometric functions. One student could not apply the appropriate procedure in differentiation of $y = \frac{\sec^3 x^2}{\tan x}$. He did not consider that he needed to apply

the quotient rule. Figure 3 below shows an example of a procedural error that the students displayed in the differentiation of a trigonometric function.

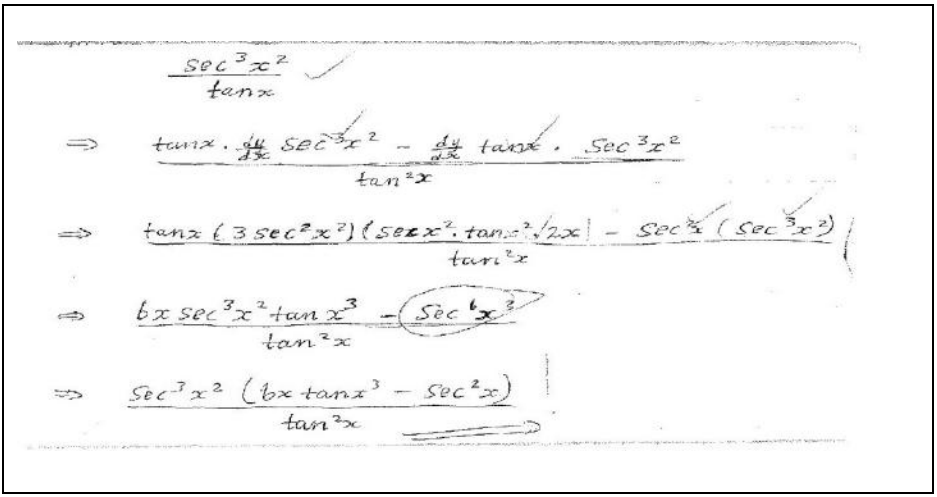

Figure 3: A procedural error displayed in differentiation of a trigonometric function

One student showed poor understanding of identities as he wrote $\cot\theta = \tan\theta$. As a result, he substituted $\cot\theta$ with $\tan\theta$. One student failed to multiply radical trigonometric functions correctly. He manipulated

$\frac{1}{\sqrt{\cos x}} \cdot \frac{1}{2\sqrt{\cos x}} \cdot \frac{-\sin x}{1}$ incorrectly. As a result, he obtained $\frac{-\sin x}{\sqrt{\cos x}}$

instead of $\frac{-\sin x}{2\cos x}$. One student failed to apply the LCD correctly in

$y = x^3 e^{2x+3}\sqrt{\cos x}$. Two students differentiated $y = 2x + 3\ln e$ incorrectly.

They did remember to apply the sum rule.

They also treated $y = 2x + 3\ln e$ as if it required the application of the product rule, treating $2x + 3$ as the first function and $\ln e$ as the second function. They wrote that the derivative of $(2x + 3)\ln e$ is $2\ln e$.

Linear Extrapolation Errors Displayed by the Students in the Three Tests

Linear extrapolation errors happen through an over-generalisation of the property $f(a+b) = f(a) + f(b)$, which applies only when f is a linear function. Linear extrapolation errors may be regarded as a subset of an interpretation error, as they occur due to poor interpretation of certain mathematical rules (Siyepu 2013b).

Table 4 shows a linear extrapolation error and its description in an implicit function

Type of error	Description
Linear extrapolation errors	Linear extrapolation errors happen through an over-generalisation of the property $f(a+b) = f(a) + f(b)$, which applies only when f is a linear function. For example, one student calculated $x + y = \ln(x^2 + y^2)$ as $\ln x + \ln y = \ln x^2 + \ln y^2$

Five students demonstrated linear extrapolation error as they multiplied an algebraic expression by the symbol of a natural logarithm $\ln$ and differentiated the expression by using the sum and difference rule. Their error shows an over-generalisation of the distributed property as they treated the logarithmic function $\ln x$ as an ordinary variable. Figure 4 below shows an example of a linear extrapolation error that the students displayed in the differentiation of an implicit function.

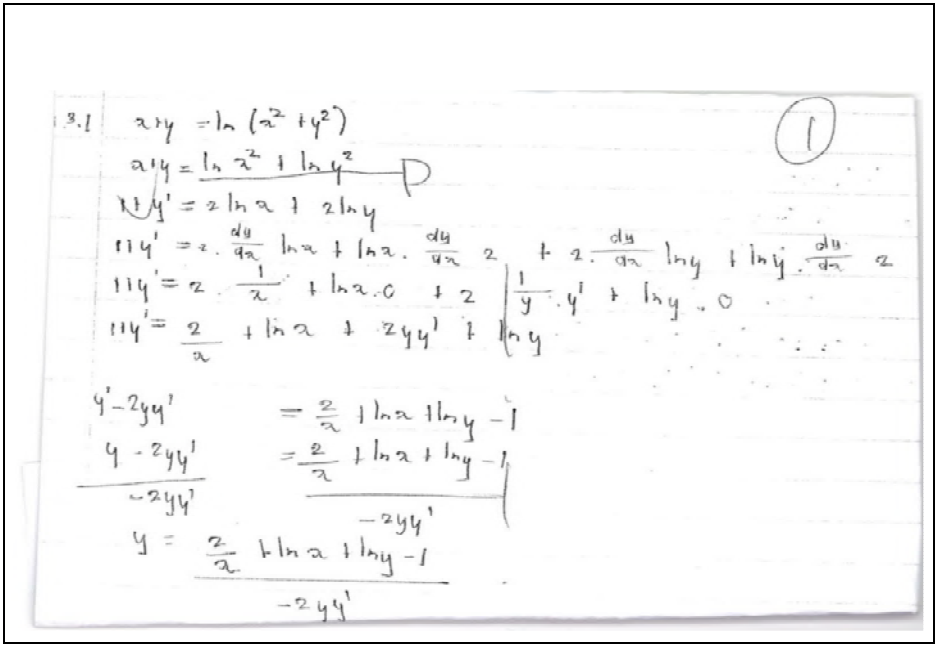

Figure 4: A linear extrapolation error displayed in implicit differentiation

Arbitrary Errors Displayed by Students

Arbitrary errors arise when students behave illogically and fail to take account of the constraints laid down in what is given.

Table 5 shows an arbitrary error and its description in a trigonometric function

Type of error	Description
Arbitrary error	Arbitrary errors arise when students behave arbitrarily and fail to take account of the constraints laid down in what is given. For example, one student rewrote $y = \cos^4(5x^2)$ as $y = \cos(5x^2)^4$.

Two students did not show any logic in their differentiation of $y = x^3.e^{2x+3}\sqrt{\cos x}$. They did not apply logarithmic differentiation correctly to obtain $\ln y = \ln x^3 + \ln e^{2x+3} + \ln\sqrt{\cos x}$. Two students only transcribed the problem without any attempt to do calculations.
Two other students transcribed the problem incorrectly and also showed illogical steps in their calculations of $y = \sec^2 xe^{-\tan^2 x}$. The first one transcribed the problem as $y = \sec^2 xe^{-\tan x}$ instead of $y = \sec^2 xe^{-\tan^2 x}$. The second one transcribed the problem as $y = \sec^2 xe^{-\tan 2x}$ instead of $y = \sec^2 xe^{-\tan^2 x}$. One student left $(2x+3)\ln e$ without differentiating it.

Students' Responses as Reflected in the Audio and Video Recordings

In the audio and video recordings, three students showed their solutions on a whiteboard, whilst representing their groups. The students demonstrated errors that had already been identified in their written work. The lecturer intervened by explaining appropriate procedures, describing concepts that had been interpreted incorrectly as the students were explaining their understanding of the derivatives of various functions.

One student argued that her understanding was that logarithmic differentiation is applied only when the base of the function is in the form of a variable, and that the index is also a variable. In the case of $y = x^3e^{2x+3}\sqrt{\cos x}$, all the terms are not in a transcendental form. This student's question indicated that she had confused the application of the chain rule with the application of the logarithmic differentiation rule. This problem contains three functions whilst the students were familiar with differentiation of two functions (the latter makes it easy for them to apply the product rule).

One student questioned why we do not apply the power rule to differentiate $y = \ln x^3$. His question might have been asked for purposes of clarity, or may show that he did not know the difference between the power

rule and logarithmic differentiation. This question may thus symbolise poor conceptualisation.

In response, the lecturer explained that, in the case of a natural logarithmic function, one does not apply the power rule. In the explanation, the lecturer used examples of x^3 and $\ln x^3$, showing techniques of differentiating these two different functions. He further explained that the first function x^3 requires the application of the power rule with its derivative equal to $3x^2$; and that the second function $\ln x^3$ requires the application of logarithmic differentiation to obtain its derivative, which is equal to $\frac{f'(x)}{f(x)} = \frac{3x^2}{x^3} = \frac{3}{x}$. This intervention assisted the student working on audio and video recordings to rectify her mistake. The lecturer also intervened by correcting errors as he explained the appropriate procedure involved in cancelling trigonometric functions that fall under addition.

One student raised a question, which reflected a conceptual error. He wanted to know whether it is appropriate to substitute $\sec^2 x$ with $\tan x$. This question showed that the student did not understand that, although the derivative of $y = \tan x$ is $\frac{dy}{dx} = \sec^2 x$, the derivative of $\sec^2 x$ is not $\tan x$

The lecturer explained the appropriate procedure of obtaining the derivative of $y = \sec^2 x$. One student suggested a further simplification of $y' = [2\tan x - 2\tan^2 x \sec x]\sec^2 x e^{-\tan^2 x}$ to $y' = 2\tan x[1 - \sec^2 x]\sec^2 x e^{-\tan^2 x}$.

The lecturer explained that to remove a common factor would be an undesirable closure, as it is the opposite of simplification.

A student requested the use of the product rule to differentiate this problem. The same student attempted to address the problem by using the product rule in audio and video recorded observations. The student showed that she had poor understanding of the standard derivatives.

Implications for Teaching and Learning

This section deals with implications of this study in the light of a Commognitive framework. The goal of any teaching is to develop understanding among the students in order to gain knowledge and insight on the topic being studied.

One student applied the power rule instead of exponential rule. In the case understudy the kind of change to occur as result of learning the students should be able to differentiate the differentiation problem that requires application of power rule and/or exponential function. He showed confusion in differentiation of the following functions $y = a^x; y = x^n$ and the chain rule. A commognitive justification is that in order for the teacher and students to focus on the process to occur to work towards a change, emphasis should be done in classroom activities and discussions to explain clearly the difference between power rule and exponential rule.

In the context of this study, we could confidently argue that 'understanding' has taken place, as Hiebert and Carpenter (1992:67) substantiate:

> A mathematical idea or procedure or fact is understood if it is part of an internal network. More specifically, the mathematics is understood if its mental representation is part of a network of representations. The degree of understanding is determined by the number and the strength of the connections. A mathematical idea, procedure, or fact is understood thoroughly if it is linked to existing networks with stronger or more numerous connections.

Firstly, the students' understanding of differentiation was determined by their ability to see the relationship of the concepts involved in the problem and apply appropriate procedures to obtain the solution. This was achieved not only through engaging students with learning activities of a mathematical nature, but also through the aid of the more competent students, along with the lecturer guidance.

Secondly, in terms of students who confused the product rule with the logarithmic rule, their solutions showed that they were not aware of $\ln x$ as a natural logarithm; they assumed that $\ln x$ was any other variable. As a result, they could not apply properties of a natural logarithm; instead they

applied the product rule. For these students, there seemed to be no difference between $\ln(\sin x+2)$ and $x(\sin x+2)$. This was also evident as the lecturer assigned the students with activities that elicited application of a natural logarithm ($\ln x$). It stands to reason therefore that the concept of a natural logarithm and its properties should be further demystified for students to comprehend. In addition, the difference between natural logarithmic functions and algebraic functions should be made explicit in the process of imparting knowledge.

The kind of change in endorsement routines to occur as a result of learning is that students should be able to know the nature of differentiation problem that requires application of a product rule. Specifically, knowing that a product rule is applied when two or more functions are joined by a multiplication sign(s). A commognitive justification is that students should be able to know that logarithmic differentiation is appropriate in the case of functions such as $y=x^x$ where the base is a variable as well as the exponent is also a variable.

Thirdly, it has become clear in this study that the process of engaging students with learning activities, along with tapping their independent thinking to some degree, reinforced their understanding. Their understanding became evident when they were assigned to solve mathematical problems independently. This was further demonstrated not only by being able to identify interrelationships between the concepts and appropriate procedures, but also through displaying confidence and working independently throughout the activity, without requiring any form of assistance from the lecturer or from their more capable peers.

Fourthly and finally, for the students who were not familiar with the differentiation of the function $y=a^x$ where a is a constant and x is a variable, the lecturer designed learning activities that would capitalise these errors so that students would be in a position to realise their errors and misconceptions without the lecturer's intervention. As a result, they became independent in terms of their thinking, such that it did occur to them that the two functions $y=x^n$ and $y=a^x$ are different. It also transpired that these students could remember the restriction of the rule $\frac{dy}{dx}=nx^{n-1}$, that is n is

strictly a constant. At the same time, they were able to remember that the derivative of the function $y = a^x$ is $\frac{dy}{dx} = a^x \ln a$.

A commognitive justification is that students should understand the words and their uses to solve any mathematical problem correctly. Once students understand the use of appropriate rules and procedures then they will be able to master differentiation.

Conclusion

The results of this study suggest that lecturers should identify students' errors in order to be able to design learning activities that may enhance students' understanding of derivatives of various functions. Errors displayed by students in this study mostly originated from their prior learning of mathematics and over-generalisation of certain mathematical rules. The students' prior learning had been dominated by rote learning of routines or procedures without their having made sense or meaning of these. As a result, they tended to apply rules hastily.

The use of the Commognitive framework is a utility and, as such, it emphasises individual attention to obtain students' explanations, discussions and elicit debates. This is an important spinoff as it also provides a sense of how and why students perform to reach their full potential, and what form of assistance they require to be in a position to devise viable solutions to their assigned mathematical problems. This, without doubt, requires investment in time and patience, if we are seriously concerned about enhancing the understanding and comprehension of students in as far mathematics is concerned, particularly when dealing with students enrolled in the Extended Curriculum Programme (ECP) and for whom English is an additional language.

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Making Sense of Mathematical Discourse

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Re-envisioning Pedagogy for African Higher Education: Students' Status of Science and IKS via Argumentation Discourses

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Abstract

The study explored the effects of an intervention strategy underpinned by the Contiguity Argumentation Theory (CAT) and Ogunniyi's Practical Argumentation Course (PAC) designed to shift students' perceptions towards science-IKS being equipollent (equal cognitive status) in a module that focused on re-envisioning African Higher Education. Eighty-five (85) primary science preservice students in a Natural Science Method module took part in the study. The module exposed students to the Nature of Science and IKS including the indigenous practices of African communities. Students' status of science-IKS from pre- and post-questionnaire were compared and validated by individual interviews where they deliberated the status of indigenous and scientific knowledge. During focus-group interviews, students argued whether classroom implementation of IKS has value or not in achieving the goals of science education. The analysis of data indicates that students' CAT status, after PAC intervention, shifted from Dominant, Suppressed and Assimilated to more Assimilated, less Suppressed, some Emergent and a few Equipollent. The findings also suggest that students have a more nuanced understanding of the status of indigenous knowledge and its relationship to science that was developed through the dialogical argumentative discourse supported by curriculum resource materials. The findings imply that educators need to engage students explicitly in using instructional strategies like argumentation discourses for a sustainable duration while incorporating students' local, cultural and indigenous experiences in addressing the science and social-justice goals of education.

Keywords: Contiguity Argumentation Theory; equipollent; dialogical argumentative discourse

Introduction

There have been several studies both in Africa and worldwide calling for tertiary teaching institutions to develop culturally-sensitive strategies that interface science with the local knowledge and beliefs of their students (Aikenhead 2001; Brown, Muzirambi & Pabale 2006; le Grange 2008; Webb 2013). Often African students are taught science and other subjects in westernized classrooms in the absence or denial of their cultural and indigenous experiences. The lack of understanding and the exclusion of students' African knowledge pose learning difficulties for these students, as it is difficult for them to make sense of abstract science in the way it is taught currently. It is also an educationally complex process to integrate their scientific worldview in terms of their African cultural experiences when crossing cultural-borders. To surmount these difficulties, there is a growing call for pedagogic intervention and support to resolve conflicts arising between science and indigenous knowledge (IK), especially where science is recognised as the dominant knowledge that exerts a powerful, political and universal influence (Abrams, Charles & Guo 2013; Ogunniyi & Ogawa 2008; van Wyk 2002). In particular, in post-apartheid South Africa, there is also an urgent need to address social injustices.

In addressing the above issues and transforming the education curriculum after apartheid, the Department of Basic Education in South Africa (DOE 2011) has included indigenous knowledge systems (IKS) in the school curriculum which emphasises valuing and 'acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution…' (p. 5). While the Department of Science and Technology (2004) has policies regarding the promotion of IKS, and 'a strong drive towards recognizing and affirming the critical role of IK' (p. 18), there is little evidence that the goals of these policies are being achieved on a large scale in both school and tertiary education, except perhaps, at a few universities where IKS modules are offered.

With regard to the role of IKS in relation to science, instructional strategies such as argumentation serve as a critical dialogical teaching and

learning tool that has thus far been successful in engaging students and teachers in controversial and reflective issues (Erduran & Jim´enez-Aleixandre 2007; Msimanga & Lelliott 2012). Argumentation theory and discourses as espoused by Ogunniyi's (2006) Contiguity Argumentation Theory (CAT) and his Practical Argumentation Course (PAC) provide valuable theoretical underpinnings and successful instructional strategies from research for students coming from indigenous backgrounds. It was anticipated in this study that PAC as an instructional strategy can inform and enhance preservice students' critical and reflective understanding of the stature of science-IKS and shift their status of science-IKS towards equipollent status. There was also a possibility of transfer of argumentation skills developed in this course to other contexts (Ogunniyi 2007a; 2007b).

This study thus explored the effects of an intervention strategy via PAC argumentation discourses when students' engaged in science-IKS issues in a module that focused on re-envisioning education for African Higher Education. It also intended to conscientise students about the wealth of African culture, and to create opportunities in the tertiary classroom to deliberate and integrate scientific and African traditional world-views and practices. It was envisaged that an argumentative discourse that is culturally relevant would make students aware of their cultural heritage and generate a fresh perspective of knowledge systems that could legitimately be made part of their classroom knowledge and pedagogical skills. The study thus engaged students in a more practical pedagogical approach through a modified PAC designed argumentative discourse originally proposed and researched by an African scholar, Meshach Ogunniyi (2006). The modified PAC was underpinned by South African culturally-relevant experiences and contexts.

In addressing the kind of pedagogy that students in Africa should experience in science education, the following research questions are posed:

1) What are preservice students' statuses of science and indigenous knowledge prior to exposure to a Practical Argumentation Course?

2) What are preservice students' statuses of science and indigenous knowledge after engaging in a Practical Argumentation Course?

3) Why did the students change their minds, if they did, and how did they change their minds (in terms of CAT)?

4) How do preservice students respond to: How should IKS be included in science classrooms in re-envisioning education for African Higher Education?

Literature

The demise of racism in America in the 60s and apartheid in South Africa in the 90s has led to the transformation of the social justice agenda worldwide and this agenda includes the development of Indigenous Knowledge Systems (IKS) as a means to interrogate past colonial practices and philosophies. It has renewed efforts to re-install the confidence and knowledge base of Africans and other indigenous communities globally. This agenda has also led to educational institutions worldwide re-envisioning and transforming their curricula to meet their students' cultural needs. In this regard, the Department of Science and Technology-DST (DST 2004) has taken a lead to develop IKS and protect IKS intellectual property (DoTE 2004). DST (2004) describes IKS as:

> The Indigenous Knowledge Systems (IKS) developed and maintained by South Africa's indigenous peoples pervades the lives and the belief systems of a large proportion of the country's population. Such indigenous knowledge manifests itself in areas ranging from cultural and religious ceremonies to agricultural practices and health interventions. Indigenous knowledge (IK) is generally used synonymously with traditional and local knowledge to differentiate the knowledge developed by and within distinctive indigenous communities from the international knowledge system generated through universities, government research centres and private industry, … . (p. 10)

IKS is a theory of reality representing the way reality is experienced, interpreted and perceived by indigenous communities (Shumba 1995). Africans in Africa still practice their traditional culture consisting of art forms such as dance, rituals, healing and worship, and still employ survival strategies of traditional technology, medicine and health. They are also exposed to westernized cultures and science. Consequently, they hold aspects of both an indigenous and a scientific worldview, and are influenced by

colonial practices and philosophies. A typical indigenous world-view is the notion that certain local plants have significant roles to play in people's healing. For example, the plant Ginger Bush (*Iboza*) (SANBI n.d.) is still currently used to treat coughs and influenza, among others. Hence, their indigenous knowledge (IK) of plants is still valuable and even today, widely practiced in urban communities as the high costs of allopathic medicines make IK the basis for choices and survival strategies for the majority.

The loss of cultural heritages, languages and knowledge is of concern worldwide (Aikenhead & Ogawa 2007; Diamond 2012) and there is a need to preserve, protect, educate, research and promote African cultural heritage as a whole (Kurin 2004). Kwame Nkrumah, Ghana's first president and a Pan-Africanist, suggested that we create the space and time, and seek opportunities for a more inclusive education that embraces the linguistic, indigenous and cultural resources of the home and community in embracing the globalized world (Ajei 2007). Indigenous knowledge can offer a different perspective on human experience than that provided by western empirical science (Kincheloe & Steinberg 2008). Ajei (2007) argues that a successful framework, designed for Africa's development, needs to be founded on indigenous knowledge and values.

Indigenous knowledge is a valuable teaching resource for motivating young people in Africa to participate actively in the education process as well as to engage critically in science-IKS issues. Naidoo (2010) adds that for education to be of value and relevance, participation in learning and performance must go together. She explains that relevance in science encourages 'learners to participate in classroom processes more deeply, learning in their own ways and bringing together their ideas, interests and experiences' (p. 6). While Aikenhead and Ogawa (2007) make an appeal for acknowledging collective worldviews, while Fleer (1997) calls for the inclusion of multiple worldviews, Govender (2009) adds that a science curriculum that includes aspects of relevant indigenous knowledge that recognises students' preconceptions and worldviews, affords a platform for discussion of different ways of knowing and encourages critical thinking, can attract more students to science. Thus, a curriculum that offers a climate of questioning, argumentation, and questioning sources of knowledge will ensure that students do become active participants in creating and defending knowledge positions.

IKS and Science Debates

South African education institutions are located in multicultural communities and there are often competing accounts of natural phenomena. The question of which aspects of, for example, African traditional knowledge should be included in science education, such as traditional African knowledge of agriculture and environment, and insights into conflict-resolution, is debatable. A traditional healer's (*sangoma)* insight that one should only use a limited amount of bark from a given tree, or that one should harvest no more than one-tenth of a given natural resource, constitutes an insight that may not be shared by many, but it has universal value and application. The phenomenon of lightning, as another example, is viewed differently when rural communities are exposed to its destructive effects, whereas in science classes, it is understood in terms of electrostatics. There are also competing claims from science educators (Cobern & Loving 2001) and indigenous scholars (Aikenhead & Ogawa 2007; Snively & Corsiglia 2001) about the status of IKS. Cobern and Loving (2001) argue that good science explanations will always be universal even if indigenous knowledge is incorporated into scientific knowledge. They argue that indigenous knowledge is 'better off as a different kind of knowlege that can be valued for its own merits, play a vital role in science education, and maintain a position of independence from which it can critique the practices of science and the Standard Account' (Cobern & Loving 2001: 51).

Arguments about whether IKS and science should be separate or integrated in the curriculum remain largely in the domain of researchers (Green 2008; Higgs 2008; Naidoo 2010) and preservice science students rarely get opportunities to debate this issue (Duschl & Osborne 2002; Sampson & Blanchard 2006). le Grange (2008) cautions us that 'The challenges for enacting an indigenous science curriculum are complex and there are no easy answers' (p. 824). Research papers by Ogunniyi (2004; 2007a; 2007b) indicate that enhancing IKS in classrooms is a long term curriculum goal as he and his post-graduate students have begun several small-scale studies with science teachers integrating IKS in their science classes. Studies have pointed out that when new concepts and innovative teaching strategies are introduced during new curriculum implementation, teachers are hugely challenged to adapt and they lack confidence unless a well-planned and supportive programme is in place (Erduran, Simon &

Osborne 2004; Simon & Richardson 2009). However, studies have also shown that when teachers are trained to incorporate multi-interactional instructional tools such as cooperative learning, discussion, argumentation, dialogue, and reflection, among others, their pedagogy skills are more effective in promoting new themes such as the Nature of Science (NOS), IKS and the relationships between NOS and IKS (Abd-El-Khalick 2005; Aikenhead 1997; Osborne, Erduran & Simon 2004).

Researchers (Bricker & Bell 2008; Erduran *et al.* 2004) argue that argumentation is increasingly viewed as a leading instructional approach and educational goal for science education. Students discussing and arguing in a group contribute to developing their argument skills further as opportunities to propose claims and defend via warrants are necessary to convince others in the group of the 'reasonableness' of the argument. Design research has shown how social norms of collaborative debate can be cultivated in science classrooms (Bell & Linn 2000) and as evidenced by PAC modules by Ogunniyi (2007a) where argumentation underpinnings were focused in controversial topics. The South African Curriculum and Assessment Policy Statements–CAPS (DoBE 2011), include 'critical thinking' as one of its goals, and it can be highly beneficial to both teachers and learners to learn how to identify and evaluate scientific arguments, as well as craft them. Consequentially, preservice students need to be trained in argumentation processes and develop skills to nurture argumentation in science classes.

Argumentation as a Tool for Teaching and Learning

Argumentation is a statement or constellation of statements advanced by an individual or a group to justify or refute a claim in order to attain the approval of an audience (Van Eemeren, Grootendorst & Henkemans 2002) or to reach consensus on controversial subject matter such as 'Is Indigenous Knowledge science?' Argumentation is critical to producing, evaluating, and therefore, advancing knowledge and it should be an essential aspect of science education and as a way to help students engage with the social construction of scientific and indigenous knowledge ideas. It is also valuable as a method of learning. Toulmin (1958) wants us to be wary of the universality of an argument in that it ignores human shortcomings and changing contexts. It is importance to take into account the context in which argumentation is

occurring (Billig 1987). The issues of criticism and justification are central to argumentation. Perelman (1979) notes that both processes occur in social contexts and, therefore, are 'always 'situated'' (p. 117). Argumentation is understood only by examining both criticisms and justifications. In other words, 'one cannot properly understand an argument, if one fails to grasp what it is arguing against' (Perelman 1979: 121) and because both criticisms and justifications are situated, one has to understand the larger social milieu in which the argumentation is embedded.

Despite the importance of argumentation in scientific discourse, science educators have not, until recently, paid much attention to arguments advanced by teachers against curricular innovations such as science-IKS curricula (Ogunniyi 2007a). The limitation of space will not permit repeating several excellent reviews of studies that have employed explicitly reflective or argumentation-based approaches in the study of teachers' and preservice students' conceptual understanding of NOS, IKS, or both (Abd-El-Khalick & Akerson 2004; Hewson & Ogunniyi 2011; Ogunniyi 2007a; Simon & Richardson 2009). The findings emanating from these studies have not only highlighted the importance of arguments and dialogues in enhancing teachers', preservice students' and learners' conceptual understanding of the NOS and IKS, but also increased their awareness about the complementary nature of both systems of thought when presented in an inclusive instructional context. The issue now appears to be not one of abandonment and replacement, but one of addition, so that the earlier belief and the scientific belief co-exist. The learners' task is to learn the scientific and indigenous beliefs, and to become clear about when it is appropriate to apply one belief or the other. The issue of co-existence of the two thought-systems alluded to above should not be construed as confusion on the part of researchers or teachers to replace one thought system with another, but shows the reality in which teachers, preservice students and learners from indigenous communities find themselves (Ogunniyi 2007a). As Michie and Linkson (2005) have argued, a science-IKS curriculum that reflects valid images of both systems of thought provides indigenous and non-indigenous students access to different ways of knowing and interpreting experience. The prominence given to learner-centred activities such as dialogues, argumentations, discussions, and group activities in CAPS stand in sharp contrast to the use of a traditional instructional approach and rote learning associated with the previous apartheid curriculum. Also, these learner-centred

activities have tended to increase teachers' and learners' confidence in undertaking various tasks called for by the new curriculum (Ogunniyi 2004).

Theoretical Framework

In this study, students were exposed to an argumentation framework based on a socio-cultural context based theory, the Contiguity Argumentation Theory (CAT) as proposed by Ogunniyi (2004). When two cultures or systems of thought meet, co-existence can only be found through conceptual appropriation, accommodation, integrative reconciliation, and adaptability (Ogunniyi 2004). Essentially, the CAT explains possible ways in which conflicts arising from clashing ideas or cosmologies such as science and IKS are resolved. Further, CAT assumes that ideas that come together will interact, overlap, or conflict with each other. One way of integrating such conceptions is by finding a larger, synergistic conception (Ogunniyi 1997). This leads to a higher form of awareness and a consequent deeper level of understanding than was previously possible. In other words, when ideas clash, an internal dialogue occurs to find some meaningful form of co-existence. CAT recognizes five categories into which ideas can move within a students' mind when discussing issues of different thought systems such as IKS and science. These are: *Dominant* - a powerful idea explains and predicts facts and events effectively; *Suppressed* - an idea becomes suppressed in the face of more valid evidence; *Assimilated* - a less powerful idea might be consumed into a more powerful one in terms of the persuasiveness of the dominant idea to a given context; *Emergent* - there may be circumstances where no prior knowledge exists and new knowledge has to be acquired or developed; and *Equipollent* - when two competing ideas have comparably equal intellectual force, the ideas tend to co-exist without necessarily resulting in a conflict. CAT is contextually-based and it can be applied to two or more thought-systems, unlike Toulmin's (TAP) theory, and provides a dialogical framework for resolving the incongruities that normally arise in these cases, for example science and IKS.

Methodology

This is a qualitative case study of why and how 85 preservice students' views of science and IKS changed after engaging in a Practical Argumentation

Course as an intervention strategy in a second-level Natural Science method module. Of the 85 students, 54 students have been schooled in western mode and come from mixed urban-multicultural areas, and hence are more familiar with the scientific worldview, while 31 have been schooled in a Western-African context and come from largely rural and indigenous backgrounds. Not all students were exposed to the school CAPS curriculum that demands new instructional approaches and goals in terms of contextualisation and indigenisation of school subjects. Hence, their exposure to IKS was minimal. All students were also exposed to two or three Natural Science content modules at the university. Students were asked questions about their perceptions of science and IKS at the beginning and end of the PAC course using questionnaires and during random individual interviews conducted.

While the module was of five months duration, the PAC course was implemented for three months as other aspects of the module had to be taught. The modified PAC course (different approach from Ogunniyi's 2007 which was more philosophical and historical) included a discussion of Nature of Science (NOS) using Views of Nature of Science (VNOS) (Lederman, Schwartz, Abd-El-Khalick & Bell 2001) questionnaire as a key document for NOS discussion. This was followed by the introduction of two argumentation patterns, TAP (Erduran *et al.* 2004) and CAT (Ogunniyi 2007a) and students' discussions of an article on Science across Cultures that highlighted African contributions to science (Selin 1993). Here, a number of scientific and medical accomplishments of African and Native American cultures were discussed such as early agricultural schemes, metallurgy, mining and smelting of copper, hieroglyphic writing and use of papyrus, mathematical and astronomical knowledge necessary to build the pyramids, a calendar and numeration system, and a carefully defined medical system, among others (Selin 1993). This was followed by the identification and uses of local indigenous knowledge of plants where students did research on the internet and submitted an assignment based on local indigenous plants and their uses, for example, Aloe Ferox, and how it is currently used in the pharmaceutical industry.

Students also conducted interviews with elders in their communities on the identification and uses of indigenous medicinal plants to verify the data obtained from internet sources. African cultural astronomy was then discussed (Govender 2011). Students then prepared for a debate on whether IKS is to be raised to the same level of science. A class debate was held and

the audience then raised questions for the group to answer. Erduran *et al.* (2004) have argued that interactive classroom arguments and dialogues have tended to encourage students to externalise their viewpoints on any subject matter, hence as part of their PAC, students in this study were free to ask and raise questions, argue, dispute and express their views. The students were encouraged to see argumentation not as a means to denigrate other people's opinions or beliefs, but as an expressed social, democratic, and intellectual activity aimed at justifying or refuting a claim or as a means for attaining acceptance by their peers. Creating trust and freedom of expression amongst diverse cultural and racial groups of students encouraged an atmosphere where ideas were raised and contradicted by evidence and by the arguments of others.

Three purposefully chosen focus group interviews were also conducted towards the end of the PAC course (the end of the 3rd month) to determine if, why and how students changed their minds, on the status of science–IKS relationship, and on how they perceived the inclusion of IKS in the science curriculum in envisioning science education in Africa.

The data was analysed as follows: Data for questions 1 and 2 was obtained from 85 pre- and post-questionnaires and pre- and post-interviews conducted with ten randomly selected individuals to gain a deeper understanding and to clarify students' views of science-IKS. A simple random sampling was chosen as it provided an equal probability of selection of students for interviews and so minimised bias in the sampling and it also avoided human (lecturer) bias in selecting a particular category of students, either in terms of race or test performance. Students are wary and do question the criteria for their selection. All 85 student numbers were placed in a container for random draws done transparently in a classroom setting. In addition, a random sample of students' assignment-projects was chosen by selecting the work of ten students from a batch for analysis. Random sampling of individuals or units as a probabilistic technique is highly representative of the student population and allows us to make generalisations from the sample to the population and provides a measure of external validity. Individual pre- and post- interviews were carried out with the intention to verify the status of students' claims. All interviews were audiotaped and transcribed. The data was qualitatively interpreted by sorting and classifying the data. The data was eventually categorised into common themes after multiple readings and agreement with a co-researcher assistant

in confirming students' CAT status. We must admit that to distinguish between Suppressed and Assimilated statuses did create some uncertainty, as some students' answers in the questionnaire were difficult to analyse exactly, though interviews did help to clarify in some cases. This was a limitation of the study.

Data for questions 3 and 4 were obtained from three focus group interviews consisting of four to five individuals per group and conducted towards the end of the module. These focus groups were purposefully selected as data was required from students from rural, urban and semi-urban areas to obtain a variation of science-IKS experiences. Excerpts of focus group interviews are presented as evidence of the discussions. The students' assignments were analysed for how examples of IKS was incorporated and referenced. Students' permission was sought for the use of data and interviews conducted.

Data Analysis, Results and Discussion

The data is presented in terms of answers to the research questions posed in this study:

Research Question 1: What are preservice students' views of the status of science and indigenous knowledge prior to engaging in a Practical Argumentation Course (PAC)?

Analysis of the 85 pre-questionnaires for students' views and knowledge of science showed that most students hold adequate scientific knowledge and perceive that science is the dominant way of understanding and learning about the world. Students were asked to write about their perceptions and views about, What is science? Is IKS science or scientific? Can IKS be integrated with science? Is IKS just tradition or cultural knowledge or is there some science embedded in IKS practices? Students could easily define science, give examples of scientific achievements and state their processes. In Nature of Science (NOS) tasks, students discussed the scientific worldview that science is understandable and subject to change, scientific inquiry demands evidence, science explains and predicts phenomena, the scientific enterprise is a complex social activity, ethics in science is an important aspect, and that science cannot explain supernatural/spiritual things. After

applying CAT classification, the pre-questionnaires confirmed that the majority of students held a strongly positivistic view of science [Dominant] and the world, while some held views that science is not the only source of knowledge for people and that without formal knowledge, they still survived [Suppressed and Assimilated].
For example, students wrote:

> Science is finding out theories that we have about the world. It's about investigations, experiments and questions that we come up with. [Dominant]
>
> Science is about explaining things like lightning and how things work. [Dominant]
>
> People have survived many centuries ago in the wild and in jungles of Africa and Amazon. They did not do science but still lived okay. In fact there are some people still living like that today. I think they learnt useful ways to survive from experience and shared this with their children. [Assimilated]
>
> IKS is outdated and superstitious knowledge of healers like sangomas. [Suppressed]

In the pre-questionnaire, students also completed NOS tasks in identifying fifteen cognitive and process skills in selected content topics such as astronomy and photosynthesis. Students adequately identified the different process skills in the selected content. For example, for scientific processes, one can investigate, through experimentation, the relationship of mass to acceleration of a falling object to explore gravity; and investigate the role of the sun's energy on plant growth by carrying out a series of systematic experiments on plant growth. It was evident from the pre-questionnaire that students used the concepts and examples developed in their Natural Science content modules to reflect on their understanding of science as constituting processes such as conducting experiments and developing cognitive skills such as analysis and synthesis. It can be concluded that students had a good knowledge of science process skills and sufficient content and understanding of content examples for teaching Natural Sciences in Grades 7-9.

After sorting the CAT status from pre-questionnaires, 27 students reported they had no or little understanding of what is meant by IKS and thought that science was the only acceptable knowledge worldwide [Dominant] while 48 were of the view that science is universal knowledge and IKS is cultural knowledge and not scientific [Suppressed], and 10 students felt that IKS may include some aspects of science and technology [Assimilated].

A random sample of pre-interviews conducted to determine students' views of NOS and IKS confirmed the status assigned in the pre-questionnaires especially in the case of Suppressed and Assimilated categories. Students replied in their pre-interviews as follows:

> Indigenous knowledge … IKS? No… I don't know what that means … never heard of that before…IKS! [Suppressed]
>
> Indigenous knowledge is old and traditional knowledge; it's what witchdoctors and old people know. I don't believe in all those things, you know. [Suppressed]
>
> Indigenous knowledge…yes, there is knowledge of lightning but superstitious ideas, and when to plant seeds, mmm… what about knowledge of trees and wood to make huts and grass to make things…like mats and hats. [Assimilated]
> Science is experimental and factual and its knowledge is verified by the scientific process. [Dominant]
>
> Science is applied in medicines, take all the research and how this has helped us to get better. I trust the results of science. [Dominant]

All students regarded science as useful, valuable and esteemed knowledge verified by scientists, but students responded with limited views of IKS. One possible reason for students' limited knowledge of IKS is that students emerged from a school curriculum that did not include IKS explicitly, whereas science and its nature were taught explicitly in their science content curriculum at university. It seems that only a few students were interested in reading outside their science knowledge exposure at university or ask their parents about IKS.

Research Question 2: What are preservice students' views of the status of indigenous knowledge and science after engaging in argumentative discourse (PAC)?

Evidence from post-questionnaires showed that students revealed a more nuanced understanding of the Nature of Science (NOS), detailed knowledge of Natural Science teaching strategies and provided more, richer and relevant examples, together with their relevant applications of the relationship of science and NOS. Examples of scientific achievement that student cited in their post-questionnaires included examples and applications of scientific concepts of energy, electricity, and chemistry. They showed understanding that science is a process, it is a human activity and that consensus of knowledge is reached based on evidence and theories and that theory is based on argumentation, rationalisation and subject to change. Their views on IKS now referred explicitly to historical backgrounds, culture, religion and value systems and students could narrate specific local, African and international IKS examples.

The examples below from the *post-questionnaire* illustrate how students' views have progressed:

> Indigenous System teaches us about our history and backgrounds. IKS gives us the definition of one-self.

> Heritage can be passed from generation to generation through IKS. [Assimilated]

> We have adapted IKS knowledge from our forefathers to survive now. [Assimilated]

> IKS has formed the basis and acts as a stepping stone for modern science, IKS help scientists to understand the management of biodiversity. It also helps scientists to understand agriculture, for example, crop rotation, pest control, and soil management. [Equipollent]

> Science is not permanent knowledge but can change as new experiments and theories develop. [Emergent]
>
> Science is developed by scientists who are human beings and sometimes they do make mistakes, so science is not perfect knowledge. [Emergent]

Ten students were also interviewed to validate the data in their post-questionnaire. They reported as follows:

> Nosipho: I have gained much from the PAC course, now I know that some medicinal plants are used to make our tablets, take the Aloe plant… lots of things are now made from it and this knowledge must have been taken from the indigenous people. [Equipollent]
>
> Gloria: I learnt a lot about IKS from Africa and I think science is still needed and used daily but I am not sure that IKS medicines is safe to use unless we carry out some experiments. With IKS we can learn more about the seasons and agriculture and the weather. [Equipollent]
>
> Olivier: We, in the Afrikaner community also have some IKS experiences regarding agriculture and planting of crops using the phases of the Moon but nowadays we use scientific methods especially in the farms as our farmers are trained in Agricultural Sciences. I think we can value IKS but I need to find out more. [Assimilated]

The post-questionnaires were analysed and the CAT status that emerged after the PAC argumentation discourse with student numbers were: Science is verified and universal knowledge and IKS is not science (Suppressed - 14); IKS is local cultural knowledge that contains some science and technology (Assimilated - 45); IKS is the basis for scientific development (Emergent -

15); IKS progresses, when it is subjected to more rigorous research, towards scientific knowledge (Equipollent - 11).

Research Question 3: Why did the preservice science students change their minds, if they did and how did they change their minds (in terms of CAT)?

In comparing the change in students' views as the result of the PAC intervention, CAT's five categories were assigned (see theory) to students' responses of the status of science and IKS in their pre-and post-questionnaires. Prior to the PAC implementation, students' status were largely Dominant and Suppressed where science was considered superior and institutionalised knowledge, and valued more than IKS. Twenty-seven students in pre-PAC had no previous or very little idea of IKS and were from westernized-Christian cultures and were not familiar with other cultures. Classroom interactions with students confirmed that they were largely ignorant of indigenous knowledge and traditional knowledge of other groups but did enjoy learning about IKS.

After the PAC course, the Dominant (27), Suppressed (48), Assimilated (10) status of science-IKS shifted to Suppressed (14), Assimilated (45), Emergent (15) and Equipollent (11). In addition, two new categories emerged after PAC course. Why did these students change their views?

The examples below from *post-interviews* conducted with purposefully selected focus-groups illustrate how students' views progressed and provide evidence of change of their ideas:

> They both focus on the importance of whom we are and the environment we live in'. 'We are able to learn our history and society in which we interact with'. [Equipollent]

> Science has uplifted the world, made life convenient, safer and healthier-there would be no hospitals, healthy food and medicine. IKS provided the background knowledge for improvement and new inventions, scientists would be lost without it. An example of 'hoodia' plant used by the Khoisan has been developed by the

> pharmaceuticals. I feel the teaching and learning of science should promote the understanding of different cultural contexts in which IKS has developed. [Equipollent]

We see elements of IKS incorporated into science, for example, modern medicines use natural herbs as core ingredients. IKS can be tested through scientific method and at the same time science can form facts and explain IKS. For example, microbiology can explain how plants are used in IKS on a cellular level and how they affect us in the way they do. [Equipollent]

An analysis of assignment-project tasks revealed that students examined the uses of indigenous medicinal plants used in South Africa, from information obtained from books and the internet, including the plant's uses, history, chemical and side-effects. They also inquired and verified from their elders in their communities about the use of local plants. For example, medicinal plants such as Black Jack are used to treat wounds in circumcision and Helichrysum (*impepho*) as incense in rituals, Basil (*tulsi*) in Indian IKS is chewed to treat coughs and to remove toxins from the body. The African Ginger plant (*Iboza*) is used to treat the symptoms of influenza. This plant was obtained from the campus grounds and brought into the classroom by a student familiar with its uses. These examples supported interesting discussions and debates based on how IKS holders and scientists experimented and applied knowledge gained from exploring the environment.

All five CAT categories exist in a dynamic state of flux and transitional (Ogunniyi 2007a). I use 'transitional' as it quite complex to know for sure whether students really made significant changes in their viewpoints on a permanent basis or was it just for the duration of the module while their contextual experiences were still fresh. For example, students who were of Dominant status prior to the PAC intervention could revert later to this state in a different contextual situation. Some of their transitional changes may be attributed due to the PAC course where they acquired knowledge of IKS, their project experiences with their community and peers, from questions, argumentation and debates in class, their writing assignments and possibly reflecting from a few research papers on science and IKS. It seemed that a combination of the debates, lecturers' background knowledge of IKS and science, setting a classroom ambiance for discourse, and course materials may have had a strong impact on students' changes of their status of science-IKS. In the case of debates, students engaged actively in constructing and

creating their ideas about IKS and the trusting environment in the class encouraged questions without censure. It is very interesting to note that students raised questions and held perspectives during the PAC course that are also the current debates raging between philosophers, scientists, science educators and indigenous scholars. Ogunniyi (2007a) in a similar PAC study conducted with four in-service teachers also provided evidence of teachers' change of science-IKS views from science dominant and infallible and IKS as outmoded to where teachers narrated that they now value and perceive IKS in a positive mode, especially in view of the tribal communities from which they come and they motivated that they had shifted to a critical mode in analysing both systems of knowledge and seeing the status of science-IKS in the broader socio-cultural-constructivist milieu.

Research Question 4: Should IKS be included in science classrooms?

Students' views of the inclusion of IKS in science classes that emerged after the argumentation PAC module are: A little of IKS should be included and that IKS and science must be taught separately; IKS should be partially integrated with science with examples; IKS as cultural knowledge must be holistically integrated and included in science as it is a curriculum requirement for a learner-centred-approach. These views concur with a recent case study (Naidoo 2010) with practising teachers where the study found that the three teachers used three very different approaches through which IKS was brought in the science curriculum: 'an incorporationist approach, that brings IKS into science by seeking how—*best IKS fits into science*; a separatist approach that holds IKS —*side-by-side* with scientific knowledge; and an integrationist approach that —*links* and makes—*connections* between IKS and science. The approaches developed by the teachers were found to be informed by their biographies, values, cultural backgrounds and worldviews' (p. vi).

The derived categories above are supported by student interviews.

Separating IKS and Science

I see IKS as including morals and spirituality; it is more

cultural and intuitive rather than rational. Hence I will separate science and IKS in the class.

I will compare similarities and differences or use argumentation in class to get learners to see how each one stands up for itself and against one another.

I will teach IKS and science on their own', 'First, I will emphasize the survival of the forefathers', 'I will compare early African achievements using the article on Egyptians and use argumentation and then teach science.

Partial Integration with Examples

I will teach science as a systematic way of understanding and integrate natural phenomena like lightning. I will discuss agriculture, fishing, and food reproduction in science and IKS with examples. Sometimes I will link them.

Full Integration of IKS with Science

I will use IKS to teach conservation, to value the heritage, and science also has ethics of honesty and openness.

Both are useful strategies. It will enable other learners to get information, share and debate ideas, carry their own investigations, and learn from others cultures. Learners will think 'out of the box' and be more creative and understanding rather than be bias.

Reflections

The above data and analysis of the four research questions provide evidence of most students' willingness to engage in IKS and encompass it as an

alternative and culturally relevant way of knowing and acting in their classrooms. Students have acquired skills in argumentation and in the process acquired pedagogic skills to be implemented when they become teachers. They are cognisant of the macro-policies of IKS and how these can be implemented at a micro-level in classrooms. They are now familiar with policies of IKS with a view of re-visioning and Africanising the education curriculum that can be found in the South Africa National Curriculum Statement, the Revised National Curriculum Statement, and the Indigenous Knowledge Systems Policies. In addition, they are familiar with the relationship of African culture to education implementation. In this regard, the White Paper on Arts, Culture and Heritage view education as part of culture and acknowledges that culture itself is transmitted through education (DoAC 2013). Students are also aware that IKS creates a sense of wholeness and relatedness to human society and its survival. They have presented examples and situations where IKS is holistic. They have begun to perceive that IKS espouses a transcendental view of human experiences linked inextricably with the cosmos. They see some aspects of science emanating from IKS. In summary, most students now recognize IKS in terms of its plurality, diversity, and the holism of human experiences (Odora Hoppers 2002). Ogunniyi's (2007b) study confirms that teachers recognise the value of IKS to their sense of cultural identity and hence they support integration of IKS in the curriculum but they (preservice and inservice teachers) will need mentorship and training if it is to be successfully implemented.

There is now a growing body of research and policy that highlights the importance of incorporating indigenous knowledge into the curricula in Higher Education (Govender 2012; Green 2007; Ogunniyi 2004). The rationale is that it offers an additional way of processing information, making sense of the world in engaging in critical pedagogy and humanises the educative process rather than just accumulate information. The evidence from this study has shown that a curriculum that encourages discussion, argumentation, dialogue, and reflection is thus effective in promoting understanding of the relationship of science and IKS. Students in this study, while holding 'transitional and dynamic' views of science-IKS, see the value of introducing IKS with science after their exposure to the PAC design and some have acquired or are in a state of reaching equipollent status. The Practical Argumentation Course underpinned by Contiguity Argumentation Theory (CAT) provided a valuable instructional strategy and an epistemology

for developing a pedagogy of humanistic education and yet promoted critical views of science and IKS. The majority of students indicated that both systems of thought are relevant in education and that IKS should be pursued further, as IKS research along scientific lines can also be the impetus for 'shaping scientific attitudes and values' (Loubser 2005: 86) amongst the citizens.

Conclusion

The study explored how preservice students' science-IKS CAT status changed when a Practical Argumentation Course (PAC), as an intervention strategy, was introduced to stimulate a dialogical discourse. At the beginning of the module, prior to intervention, students were confident in their content knowledge of Natural Science and in the Nature of Science but lacked understanding of IKS; most students held dominant and suppressed views and a few assimilated views of science and IKS. Students also held vague ideas of science and technology contributions from Africa. After the PAC intervention, students' status of science-IKS changed to: a decrease in the suppressed status, more shifted towards assimilated status and a few were identified as attaining emergent and equipollent status. The modified PAC course design that included resource materials, argumentation patterns, debates, critical questions, internet research, community research and active involvement by students in a constructive classroom environment all contributed to students' change in status.

Although the intervention PAC strategy was successful to an extent, to attempt to get more students to reach equipollent CAT status is a complex task and will require a refined engagement with more researched materials on IKS, and more time to engage in critical discourses via argumentation.

Implications

The study provides cautionary evidence that curricula in Higher Education can be transformed in re-visioning African education to take into account African epistemologies including IKS. The study confirms that it is possible for students to be engaged actively in critical debates via argumentation in tertiary education, but resources and time will be needed. It suggests that

current research on IKS, textbook and people resources, artefacts and materials on IKS should be made easily accessible via an IKS databank to support IKS teaching. This access to data will make the incorporation of IKS easier for developing teaching and learning programmes in HE.

This study implies that transformative curricula at universities can be a platform for re-envisioning African education to meet the aspirations of African students. This goal can be achieved by the introduction of instructional strategies like argumentation discourses through similar PAC design, preferably designed collaboratively with Higher Education policies in mind and with involvement of stakeholder institutions like government, universities and communities.

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The Teaching of Sexual and Gender Diversity Issues to Pre-service Teachers at the University of KwaZulu-Natal: Lessons from Student Exam Responses

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Abstract

This paper uses Kumashiro's (2002) anti-oppressive education theory to explore the type of education offered in a module on sexual and gender diversity at a South African School of Education. This is done through analysing the responses of students in one exam question, focussed on sexual diversity, in a compulsory final year module offered to 661 pre-service teachers at the University of KwaZulu-Natal. Focussed on human rights education, ethics and teacher professionalism, the module is designed to assist pre-service teachers in the promotion of social justice in the classroom. The analysis not only shows a heightened awareness of same-sex terminology and issues among students, it also highlights the possibilities that anti-oppressive pedagogy offers to teacher educators in teaching for diversity and social change. Further, the analysis also demonstrates that while useful in heightening awareness among students and enabling change, anti-oppressive pedagogies should pay more attention to the interrogation of students' own sexualities in order to trouble the 'asexual teacher discourse'. Such teaching would require the creation of safe environments for students through the creation of smaller classes as well as offering more time on teaching related material. The paper offers possible implications for further work in this area.

Keywords: homophobia, heterosexism, anti-oppressive pedagogy, LGBTI, higher education; teaching

> … hope u watching SABC 2 … just the topic u brought in Ed 420. Wow since then l became a critical thinker and started to accept people as they are. Tune in into sabc 2 #so much hatred from these people my word ... am very open-minded now…meant what I wrote in my exam (STUDENT 1)
>
> … I'm so glad we did sexual orientation in Ed 420. I'm so grateful to you…I meant what I said about [the] workshops [for] 'We all count'. It was not only for marks Doc believe me! (STUDENT 2)

I begin this paper rather unconventionally by presenting extracts from a conversation I had with two students on Facebook, concerning a documentary on same-sex issues that was presented on SABC 2 in 2012. Mainly, the students were making links between what they were observing on television and what they had learnt in Education Studies 420, a final-year compulsory module offered to Bachelor of Education students with a focus on human rights, ethics and teacher professionalism. The students' comments surprised me as, very often, as teacher-educators committed to social justice, we are unaware of the impact that our work has in transforming the lives of our students. This is more so when one has had very limited time with the students and, as Malley, Hoty and Slattery (2009) observe, we often 'have little, if any, influence over [our students'] schools or school districts' (p. 96) or even their personal attitudes after they have finished studying our modules. I was additionally intrigued that the students noted the impact of the module and both made reference to reflecting this in their exam responses. This triggered an interest into exploring the type of anti-oppressive education we offered in the module, using student exam responses to the question on sexual diversity. In this paper, I seek to present findings of my analysis of the student exam papers.

Internationally, there is increased focus on the teaching of sexual diversity issues to pre-service and in-service teachers (Clark 2010; Molley *et al.* 2009; Ferfolja & Robinson 2004). This is mainly because 'curriculum intervention is [seen as] one possible strategy for the challenging of homophobia and heterosexism in schools' (Saunton 2013), and teachers are

often seen as important agents for changing school cultures. Given that schools are by their very nature heteronormative sites where sexuality becomes the primary structure for organising the experiences of teachers, learners and the school itself (Schmidt, Chang, Carolan-Silva, Lockart & Anagnostopoulos 2012; Ferfolja 2007; Athanases & Larrabee 2003), the schooling space is often heterosexualised. The effect of this heterosexualisation of space is often seen in the victimisation and bullying of students who claim non-normative sexual and gender identifications (Butler & Astbury 2004). Such bullying has prompted international bodies such as UNESCO, together with researchers in countries such as Australia, Ireland, United Kingdom, United States, Taiwan, New Zealand, France and South Africa, to seek strategies within teacher education to address the continued violence (see Schmidt *et al.* 2012; Clark 2010; Elia & Eliason 2010). However, even with all these efforts, Clark (2010: 711) notes that,

> teachers [continue to be] woefully ill prepared to teach LGBTQ and non-gender confirming youth and to work against heterosexism and homophobia in schools.

In South Africa, despite constitutional provisions, homophobia remains a major problem generally (Human Rights Watch 2011; Mkhize, Bennett, Reddy & Moletsane, 2010) including in schools (Polders & Wells, 2004). Hate crimes involving the rape and murder of African 'lesbian' women mainly from townships are not uncommon (Bhana 2012). The homophobia experienced in general society often finds expression in schools (Bhana 2012; Francis 2012; Msibi 2012; Butler, Alpasan, Stŕumpher & Astbury 2003; Richardson 2006). Msibi (2012) has, for instance, noted that learners who engage in same-sex relations in South Africa experience discrimination, exclusion, violence, marginalisation and name-calling from both teachers and their peers. Bhana more recently (2013; 2014a) has shown that while the Constitution affirms all citizens, and appears to guarantee rights to students who claim same-sex identifications, principals and teachers are often unable to protect and support such learners as they are also part of those enacting homophobia.

Currently, efforts are underway to explore the possibilities of introducing an anti-homophobic bullying curriculum in several countries in Southern Africa. In 2012 and 2013, the Gay and Lesbian Memory in Action

(GALA) led an initiative to bring together universities, educators, the government, funders and NGOs to engage on possible interventions to address homophobia in schools. This was mainly because both local and international literature suggests that educators are often hesitant to include same-sex issues in the curriculum, or deal with homophobia when it emerges in the classroom (Francis & Msibi 2011). This is in spite of the fact that many learners in fact do want to engage on non-normative sexual and gender diversity issues (Kirby & Michaelson 2008). Even in subjects like Life Orientation (LO) where there should be explicit teaching on these issues, teachers often avoid them or become very authoritarian and scripted when teaching them. In a study with 11 high school teachers from Durban for instance, Francis (2012) found that teachers avoided or ignored matters related to sexual diversity, often endorsing ideas of compulsory heterosexuality. The same was found by DePalma and Francis (2014a & b) in a study with 25 teachers from the Free State. These teachers, it was found, drew on religious ideals, policy, science and the Constitution, with an added emphasis on notions of culture, which wielded significant authority and was rigidly adopted when teaching about sexuality issues. Of course, this was not surprising. Francis (2012), citing Helleve *et al.* (2009: 598), notes that, 'teachers' cultural perceptions often mean that basic sexuality education content such as safe sex is not delivered effectively as teachers are more concerned that learners are sexually active ...' than teaching openly about sexuality.

Also of concern is that even textbooks which are meant to introduce sexual and gender diversity issues are often blind to such issues or present them in less than affirming ways. Potgieter and Reygan (2012) in their study on grade 7-12 LO textbooks from four South African publishers found that there were inconsistencies and omissions in the representations of same-sex identities, with 'gay' identities at times presented, while 'lesbian' and 'bisexual' identities were being rarely ever presented. Transgender and intersex identities did not feature at all in the textbooks surveyed. The same has been confirmed elsewhere (see Wilmot & Naidoo 2014).

In light of the failure for schools to protect and support learners who claim same-sex identifications, Rofes (2005) asks an important question: 'who is responsible for preparing teachers to respond to a fifteen-year-old lesbian who is harassed by peers?' (p. 665). This is an important question as, very often, teachers leave universities unprepared to confront homophobia in

schools. However, higher education institutions are often themselves unable to handle these issues. Msibi (2013), for instance, decries the transformation discourse in South Africa for its exclusionary focus on race (and to a lesser extent gender) and for failing to recognise the complexities presented by intersections of various forms of identification. As Bhana (2013:116) aptly notes

> Terrible acts of male violence and homophobia ... draw from longstanding notions of moral traditions premised upon heteropatriachy, religion and culture and are steeped in South Africa's historical trajectories.

These intersections are often ignored in higher education transformation discourse, and reactions of horror and disgust are often aired when homophobia occurs, without asking what it is that institutions have done to curb this.

The challenges facing higher education institutions in South Africa in relation to the teaching of same-sex issues, particularly within teacher education programmes, have been highlighted in three seminal studies that have informed the field on same-sex teaching. First, Richardson's (2004) seminal work with pre-service teachers at the University of Witwatersrand highlighted the potential that explicit teaching offers in transforming the minds of students. Second, Francis and Msibi's (2011) study demonstrated the importance of creative approaches when teaching these challenging, often personal, issues. Finally, Potgieter, Reygan and Msibi (2014) have recently completed a study at the University of KwaZulu-Natal focussed on more than 800 pre-service and in-service teachers. The study highlighted the importance of teaching about same-sex issues not only for the improvement of the school conditions for non-normative gender and sexual identifications, but also for consciousness building among the student teachers. While these various interventions have gone some way in challenging and educating about homophobia, the interventions have not been adequate.

In a study commissioned by GALA on the need to understand and combat homophobia among student teachers, Johnson (2014) found that only three institutions, out of all the institutions with teacher education programmes in the country, offer explicit teaching on same-sex issues, and that even in those institutions, the programmes offered are not sufficient to

enable student teachers to apply their learning in their future classroom situations. While Johnson's paper presents a more etic understanding of the pedagogic practices present in teacher preparation programmes, it is this paper's contention that a more emic analysis may be useful to respond to some of the issues presented in Johnson's paper. This paper uses students' examination responses to explore their (students') thought processes in relation to the module content and possible future action in relation to dealing with homophobia in the classroom. The paper accepts that the exam responses may not necessarily present an accurate account of students' thinking, especially given that the students were writing for marks. However, given that the students' anonymity was guaranteed during the examination process, the paper holds that while the students' aim may have been for marks, certain phrases, words, and statements may be useful in making an inference on understanding and (possible) actions. Of course, as work on HIV/AIDS has shown, there's often a disjuncture between knowledge about something and change of behaviour (see Reddy 2005). This paper is therefore careful of pre-empting the future behaviour of the student-teachers on the basis of their exam responses.

The next section presents a discussion on the theoretical framework and the methodology adopted in the study. Details of the module are also presented. This is followed by a discussion on findings. I conclude by highlighting the implications of this paper for future research and practice related to the teaching of same-sex issues to pre-service teachers.

Theoretical Framing

Research focussed on the teaching of same-sex and gender non-conforming youth issues in teacher education programmes has generally focussed on three paradigms: safety, equity and critical paradigms (Szalacha 2004). The safety paradigm is a pre-emptive approach focussed on addressing school violence. Here, the concern is with 'protection from homophobic verbal taunts and physical violence, suicide prevention and AIDS/HIV education' (ibid: 69). While useful in combatting homophobia, the approach tends to position same-sex identifying or gender non-conforming young people as victims of abuse. The approach therefore fails to consider agency. The equity paradigm on the other hand is concerned with providing knowledge and skills

to pre-service teachers to teach everyone with respect. Focus is on full inclusion and citizenship, with teachers prepared to integrate same-sex issues into the curriculum. The intention is to 'change, and not simply mirror, our society' (Casper & Schultz 1999: 15, see also Szalacha 2004). Lastly, the critical paradigm is primarily concerned with critically examining all sexualities. It problematizes the other two paradigms for their heteronormative positionings, arguing instead that education should break away from the 'normative' into the realm of discomfort. As Kumashiro (2002) observes,

> the desire to learn only what is comforting goes hand in hand with a resistance to learning what is discomforting, and this resistance often proves to be a formidable barrier to movements towards social justice (p. 4).

Education in this paradigm therefore asks educators 'to examine school curricula and policies that normalize heterosexuality' (Szalacha 2004).

Linked to the three paradigms is what Kumashiro (2002) refers to as the four approaches that researchers have used in conceptualising the nature of education and the curricula, pedagogies and policies needed for change. These approaches are *education for the other, education about the other, education that is critical of privileging and othering and education that changes students and society*. *Education for the other* focuses on improving the conditions and treatment of students who are 'othered'. The approach prioritises the provision of helpful, affirming, supportive and empowering spaces for 'othered' groups. The strength of this approach is that it calls educators to recognise the diversity which exists among students, and its limitation is that it constructs those who are marginalised as problems, therefore ultimately fixing identities. This approach is mainly related to the safety paradigm discussed above. The second approach, *education about the other,* is mainly concerned with providing complete knowledge about groups which are 'othered'. This is done through including specific units in the curriculum about the groups which are 'othered' and the integration of 'otherness' through the curriculum. The strength of this approach is that it calls educators to bring visibility to ignored issues, while the weaknesses include the essentialising of experience as shared by all those belonging to the group while constructing the 'other' as an expert. This approach is related

to the equity paradigm. The third approach, *education which is critical of othering*, focusses on how groups are marginalised and how some groups are normalised and privileged in society. It offers a critique and transformation of hegemonic structures and prioritises consciousness-raising and empowerment, leading to a process of unlearning. Its strength is that it calls educators, not just to teach about oppression, but to try and change society as well. Its weaknesses, on the other hand, include the fact that members of the same group do not all share the same experiences as the approach seems to claim. Additionally, it is important to note that awareness does not always lead to action (Kumashiro 2002). This approach therefore still relies on essentialised notions of identity construction. The last approach, *education that changes society*, acknowledges the discursive nature of oppression. It is built on the belief that discourse frames how people think, feel, act, and interact. It therefore appeals to marginalised theories like poststructuralism. It acknowledges that we are not only framed by what is said, but also what is not said. Therefore, it is important to labour to stop repetition and rework history and discourse (Kumashiro 2002).

For Kumashiro (2002), there is no one best approach to be followed. Rather, a combination of these approaches should be used by teacher educators to advance anti-oppressive education. Kumashiro (2002) acknowledges that oppression is multi-layered, multiple and situated. Therefore 'both students and educators need to 'look beyond' existing theories and practices' by going beyond the field into

> postructuralism, feminist and queer readings of psychoanalysis, and other theories that remain marginalised and unexplored in the field of educational research (Kumashiro 2002: 23).

In South Africa, interventions that have sought to address oppression related to sexuality and gender non-conformity have mainly adopted either the safety paradigm or the equity paradigm. In the module discussed in this paper however, an explicit and intentional approach to utilise Kumashiro's (2002) anti-oppressive pedagogy was followed. The educators in the module were mainly positioned as activists; this was, after all, the first time for an entire group of students to both be taught and examined on content explicitly focussed on same-sex issues. The education provided was therefore for those who are marginalised, about those who are marginalised, presented the

complexities of privilege and subordination, and prompted pre-service to change.

For this paper, I keep to the same approach followed in the class. I interrogate the students' responses on the basis of the type of pedagogy we presented in the classroom and ask whether the responses from the students reflect the complexity which our approach sought to prioritise, or whether they present elements of confusion which need to be addressed in the future designs of the module.

Module Structure

As already mentioned above, the module under exploration has, as its focus, the prioritisation of human rights, ethics and teacher professionalism. Three weeks were set aside to focus on key concepts in human rights education as well as human rights instruments. Here, the Universal Declaration on Human Rights, the African Charter on Human and People's Rights as well as the South African Bill of Rights were discussed. This was followed by four weeks on children's rights, with a focus on race, gender and sexual orientation. Finally, another four weeks focussed on teacher professionalism and ethical conduct. The approach was to draw on an eclectic list of readings depending on the nature of the discussion. For example, the human rights theoretical discussions drew from scholars such as Jack Donnelly and Bonny Ibhawoh while the anti-oppressive pedagogy espoused by Kumashiro (2002) formed the permeating approach to pedagogy. While this eclectic approach may be challenged given that human rights education approaches differ tremendously from social justice approaches espoused by Kumashiro, it is argued here that drawing from a mix of theoretical positions strengthened the module as the approach presented knowledge as complex and contested. In this way, students were not exposed to just one way of thinking, rather we sought to develop critical thinking by presenting various ways of thinking and presented knowledge dynamic. Kumashiro (2002:68) notes that

> The unknowability involved in teaching requires that even anti-oppressive educators must constantly trouble our own practices and look beyond what we already know.

We therefore worked on the basis that what might work for one student may not work for the other and opened ourselves up to be questioned and challenged to learn, just like our students (Jansen 2009).

In this paper, I particularly focus on the four weeks dedicated to children's rights. During these four weeks, the focus was on four different aspects. The first week was on providing theory on children's rights as well as related instruments. This was then followed by two (90 minute) sessions each on race, followed by another two on gender and finally another two on sexual orientation. We deliberately started with discussions on race, as very often our students find it easier to identify issues related to racism compared to sexual orientation. Discussions on race also offered the theoretical foundations needed for discussions of the more complex issues surrounding gender and sexuality. We also wanted to present oppression and identification as intersectional, therefore avoiding the victim/perpetrator discourse which often characterises teaching on these issues.

Given that all 661 students registered for the compulsory module had to learn the same material across all groups, designs explicitly explaining the outcomes for each section as well as the actions of teachers and approaches to be followed were given to each staff member. While some may view this as too rigid, I argue that it is very important for teachers teaching sensitive issues to be fully prepared as sensitive issues often yield unpredictable classrooms. While preparation may not guarantee flow and exactness, it does nevertheless assist teachers to deal competently with sensitive issues.

For the session on race, we presented introductory notes on race and its relevance to South Africa today. This was followed by a session focussed on Jonathan Jansen's article on post-conflict theory (2009). Here students were introduced to the idea of 'bitter knowledge'– problematic, stereotypical received knowledge that we carry about groups which are 'othered'. The session also explored current experiences of racism in South African schools and the responsibility of teachers in addressing racism.

The next week focussed on gender. Here, the first session focused on terminology. Using Judith Butler's (1990) work, differences between gender, sex and sexuality were discussed alongside the concepts of heteronormativity, homophobia, sexism and heterosexism. After troubling the students' received knowledge, the next session moved to a familiar discussion on the relevance of gender issues in South Africa today, especially given the notions of women empowerment espoused in the Constitution. A discussion on the

article by Nkosi (2009) on *ukuthwala* (bride abduction) was then presented.

The final two sessions centred on sexual orientation. Here, the first session presented a discussion on homophobia in SA, connecting to terms discussed in previous sessions and drawing links to the systemic nature of oppression while using examples from racism and sexism. In order to interrogate students' ideas about sexuality and their responsibility as future teachers in protecting all learners, the second session focusses on a DVD called 'We all count'. The DVD presents the voices of teachers, learners and university students on their experiences of homophobia in schools and the need to address such homophobia. Participants represent a range of sexualities, highlighting that one ought not be same-sex identifying to address homophobia and heterosexism. A pastor also features in the DVD, speaking about the need for Christianity to accept sexual and gender diversity. After the DVD, students were referred to an article by Msibi on the experiences of 'queer' youth in township schools for further reading.

The various aspects covered in the module were assessed during the semester through two assignments, and an exam at the end of the semester. The two assignments were related in that the first one was a minor assignment presenting a brief visual and conceptual understanding of a human rights issue chosen by individual students; after written feedback from lecturers, the minor assignment was developed into a full written paper for the major assignment. The focus of this paper is not on the assignments but exclusively on the exam written at the end of the semester.

Methodology

As stated above, 661 students were registered for the module. Of the 661 students, 464 (70.2%) were African, 148 (23.4%) were Indian, 24 (3.4%) were white, 24 (3.6%) were coloured and 1 identified him/herself as 'other'. The class was 67% female and 33% male. The students were predominantly from rural areas and were taught by eight lecturers of different races, genders and sexual orientations.

For the exam, the students were given six questions, with the expectation that they select one question for each aspect of the module (i.e. 3 questions were to be answered by each student in total). Question one and

two dealt with theories on human rights, questions three and four dealt with children's rights and questions five and six dealt with teacher professionalism and ethics. For this paper, I focus on the section on children's rights, in particular question 4, which dealt with sexual orientation. Given the fact that this was the first time ever, in the history of the module, that students were expected to choose a question focused on sexual orientation, I expected very few students to write on this question. It also did not help that the students knew that the module coordinator (the author) was an expert on same-sex issues, and would therefore be marking the question. I was therefore very surprised that 286 students (43%) had chosen this question over a less controversial question 3 on children's rights. On its own, this already suggested something about the improving attitudes of students when it comes to same-sex issues.

My analysis involved the collection and reading of all exam scripts responding to Question 4. In the question, students were required to identify factors which contribute to the continuation of homophobia in schools and to propose interventions that they would launch when in schools the following year to curb homophobia. After re-reading the scripts, key codes were identified related to students' independent thinking in response to the question. Key repeated codes were then clustered together to formulate categories. Categories that spoke to each other were grouped together, with themes emerging from the grouped categories. Arguments were then established on the basis of the identified themes. This approach was in line with Spencer, Ritchie and O'Corner's (2003) analytical hierarchy. Overall four themes were identified. I now present these in the findings below. The analysis presented here is purely qualitative and where direct quotations are used, students' seat numbers are presented.

Findings

Four main themes emerged from the analysis of examination scripts: importance of teaching appropriate terminologies and relevant content; students as activists: creative approaches for the classroom; role of teacher professionalism in intervening, and the asexual teacher discourse.

Importance of Teaching Appropriate Terminologies and Relevant Content

The importance of teaching terminologies in work related to same-sex issues is not something new. O'Malley *et al.* (2009) note that such an approach is mainly tied to the deconstruction and complication of

> simplistic and dualistic understanding of men and women, homosexuality and heterosexuality and thus intervenes in the discursive normalization of heterosexuality (p. 97).

This approach is aligned with Kumashiro's (2002) notion of education that is critical of 'othering' and is particularly important in the South African context where notions of 'our culture' take on rigid meanings (see DePalma & Francis, 2014b). In this study, it appeared from the students' responses that the explicit teaching on the various terminologies and associated complications worked to produce students who were informed about same-sex issues. For instance, most students sought to demonstrate understanding by drawing on, and correctly using, appropriate terminologies in their discussions, even though the question did not require the students to do this. Students used terms such as heterosexuality, sexual orientation, gay, lesbian, queer, transgender, social construction, masculinity, patriarchy, among others, with clarity and accuracy. Often, reference was made to the classroom discussions when such terminologies were used. Many students had sentences such as 'like we discussed in class…' or 'in the documentary we saw in class….' Such discussions were often detailed, demonstrating not only comprehension of what was discussed in class, but also independent thinking in the process of writing. Often, reference was made to the video watched in class as well as readings and debates. Examples of this are evident in the following captions:

> As a Christian I learnt from the DVD to respect gay and lesbian people because I now understand that sex, gender and sexuality are not the same. I thought gay people wanted to be like women .... (016)

> Like the DVD, I hope for my learners to also challenge homophobia and heterosexism in schools. (088)

From their responses, it becomes clear that students' effective use of terminologies was linked to the structure of the module as constant reference was being made to the learning and key activities undertaken in class. Such responses suggest that the use of creative strategies to teach about same-sex issues including lectures, visual media like DVDs and class debates had worked to concretise the learning of students and also aided their understanding of terminologies beyond the cultural and religious frames. Francis and Msibi (2011) note the importance of using creative participatory approaches in the facilitation of learning when dealing with controversial issues.

While many of the students were able to utilise the terminologies and concepts with great effect, it became clear that some students still did not have a full grasp of the complexity of sexuality, and were appealing to stereotypical constructions of sexuality. Some students, for instance, made statements such as 'gay people are smart' or 'gay people abuse drugs because of victimisation'. Note, for example, one of the responses from a student:

> most of them [gay individuals] are the drug users because of the money they have and sometimes they get into drugs because of the people around them for example when people violate them, they distress with alcohol and drugs in order to forget about the discrimination (239).

The response above demonstrates just how dangerous the safety discourse may be in essentialising behaviour while also pathologising same-sex identification. The student's assertions at a cursory level seek to highlight the challenges encountered by individuals who claim same-sex identification: that victimisation may result in substance abuse, as some suicide studies have shown (see Savin-Williams 1994). However, deeper scrutiny shows that this supposed concern clouds internalised homophobia from the student. Note for instance the reference to 'them' and the idea that this is not just a small group of people affected in this way, but rather, it is 'most of them'. The stereotype that gay individuals have money appears not complimentary, but rather hides deep-seated envy and problematic constructions of behaviours associated with same-sex sexuality. Of course the idea that same-sex identifying individuals have money circulates in much of the public discourse on same-

sex issues in South Africa (see Msibi 2013). The above declaration from the cited student demonstrates just how such notions work to reinforce homophobia instead of disrupting it. Empathy alone is not adequate to address discrimination as that empathy may actually be the base from which homophobia can emanate.

Apart from the stereotypical positioning, there appears to have been a number of language problems which prevented some students from understanding some of the key concepts. Given that the majority of students were second language speakers of English, it appeared that the language and terminology used in the module was restricting students' abilities to understand some of the concepts taught. For instance, statements such as these were not uncommon:

> Homophobia needs to be implemented in schools (209)
>
> Heterosexuality individuals believe in homophobic (306)
>
> Queer means strange. That means gay people are strange (153)
>
> … someone who is sexually oriented (257)

The above statements suggest that the English language, together with the Western nature of the theoretical concepts taught, may have prevented some students from understanding. This, of course, may not be surprising given that in a study involving more than 1000 individuals from South Africa including young people, police and general members of a community in Johannesburg, less than 5% of the individuals surveyed associated the concept of homosexuality with same-sex identification (Sigamoney & Epprecht 2013), pointing to the unworkability of Western concepts in South Africa. What was surprising in this study is that the individuals who wrote the exam were enrolled to become teachers and were in their final year of study, suggesting an established exposure to the English language. If some students who are exposed to the language struggle to understand important concepts associated with same-sex desire, one wonders how those outside the education fraternity are able to understand. This points therefore to the need to interrogate more substantially the concepts we teach our students so as to Africanise them. This is an important aspect which much of the literature has not seriously taken into account.

Students as Activists: Creative Approaches for the Classroom

In a recently-released study on teacher preparation modules that focussed on same-sex and gender non-conformity issues in South Africa, Johnson (2014) argues that while the programmes she surveyed were useful in providing an understanding of same-sex issues for students, these programmes did not appear to enable students to apply their knowledge in the classroom situation. Contrary to the findings by Johnson, the examination scripts, which required students to write critically about how they intend to challenge homophobia in their classrooms, demonstrated a heightened awareness of issues, together with an entrenched commitment to address homophobia in future classroom situations. While one may not be able to provide direct evidence of students' actions in relation to this, as one would need to visit the students in their classrooms to observe their future actions, the fact that students demonstrated such heightened awareness suggests that some students had the potential of becoming activists (Kumashiro 2002) and were demonstrating a keen interest in challenging homophobia in future. That students could, for instance, send me messages after seeing a television programme focused on homophobia, suggests that students had become adequately sensitised about these matters and were keenly hoping to change their social and potential schooling conditions. This was confirmed by what the student wrote in the examination.

Many students suggested the use of media (like Generations), videos and debates to promote inclusion of same-sex identifying learners in schools. Interestingly, Generations (a local soapie on SABC 1) was suggested by many students as a possible avenue to be used to challenge homophobia. This is because this programme had positive representation of the gay and bisexual characters in it. Other students highlighted the integration of same-sex issues beyond Life Orientation. One of the students, for example, noted that '*As a language educator I can use an exercise about marriage where learners summarise an article and use two people of the same-sex. Indirectly the learners would be exposed to information or incidences which queer people encounter on a daily basis.'* (244). Other students suggested a stand-alone subject, while others suggested a more constructive use of LO, given that many teachers avoided teaching same-sex sexuality issues appropriately (DePalma & Francis 2014; Francis 2012). Some students also highlighted the possibility of establishing support groups which include both same-sex identifying youth and 'heterosexual' youth as a possible strategy. These

suggestions by students demonstrate that they not only did not see the teaching about same-sex and gender non-conformity as being the sole responsibility of LO teachers, but rather that they could locate themselves within this expectation. This suggests that these teachers no longer saw matters related to sexuality as requiring avoidance, but rather that they understood the important role played by teachers in ensuring change. Kumashiro (2002) writes that

> antioppressive reading/learning/teaching practices do not aim to merely change the ways we read others. They also aim to change the ways we read ourselves. They aim to queer the very sense of self (p. 108).

These responses therefore suggest that the pre-service teachers did not separate the sensitisation that had occurred in class from their individual actions. Rather, they saw the change that had occurred in themselves as a trigger for further change that ought to happen in schools. This was evident in their responses as noted here:

> I can use words like partner when referring to two people together (252);
>
> Words like *stabane (faggot)* should not be allowed (238)
>
> correct information must be provided to learners because learners come to class with negative information (188)
>
> …in school there must be anti-homophobia awareness days e.g. like anti-bullying day. There must be sexual orientation policy and there must be posters around the school showing anti-homophobia (240)
>
> If I didn't do Education Studies 420, I would have gone to school next year with my bad ideas. How many teachers go to schools believing that gay people are possessed (290)
>
> We need government to provide books that will enable teachers to teach about these issues (061)

> ….I plan to go to deep rural areas as well, because nobody ever goes to those areas and yet we expect the same understanding as the people from townships who have access to information. I believe it is unfair…I want to create relations with communities as to gain their trust first…not to say there will be no education at school, but I believe at school I will have more platform to model the appropriate attitude than I will have with communities (302)

The above responses from students not only suggest that deep learning had occurred, they also suggest that the pre-service teachers understood the complexity surrounding the teaching of same-sex issues. Bhana (2013) highlights the role that parents play in resisting the teaching of same-sex issues, often appealing to heteronormative discourses. The student's suggestion of the need to teach beyond the classroom environment, like going to rural areas, comes from an understanding that parents are instrumental in the transmission of *bitter knowledge*, and are therefore crucial for effective school change. While not explicitly studied in class, the students were also able to make connections to the dearth of appropriate content on same-sex sexualities in existing texts (see Potgieter & Reygan 2012), thus their reference to the need for government to produce textbooks which are relevant and appropriate. Such a heightened awareness is not simply about sensitisation. It suggests that students had received an education that could possibly lead to social change. This is further evident in the next theme where students' professional responsibilities were referred to as possible avenues for which same-sex teaching could be pursued.

Role of Teacher Professionalism in Intervening

Existing research into practices of teachers suggests that teachers are often complicit in the victimisation of students who engage in same-sex relations (see Bhana 2013; Msibi 2012) and that such teachers often appeal to their cultural and religious values in their rejection of same-sex desire. Like O'Malley (2009: 95), our intentions for this module were to

> work with many religiously and politically traditional and fundamen-

> talist students ... not to change or denigrate their religious, cultural, or political beliefs.

Rather we wanted to explore intently issues of identification 'within the democratic spaces of schools and society' (ibid). We therefore worked directly with students to address their religious and cultural apprehensions by appealing to their ethical and professional responsibilities. Judging from the students responses, this intersectional approach worked as many of the students emphasised their professional role as teachers to promote gender equality and challenge homophobia, with many directly making reference to the professional code of ethics. While the lack of policy directly dealing with same-sex issues at a basic education level has been decried by scholars as restricting, the responses from the students suggest that they believe that schools need to work within the existing policy frameworks to generate their own policies as both the Constitution and the South African Schools Act are clear in their repudiation of discrimination in whatever form. Instead of placing the policy challenge at the door of government, the students seem to suggest that it is their own professional responsibility as teachers to ensure that all sexualities and gender diversities are accepted and included within the schooling space. Note for instance the captions of the students' responses:

> Teachers need to have an open mind (008)
>
> Teachers need to act immediately against homophobia to nip it in the bud (282)
>
> Professionalism requires putting own views like religion aside (172, 244)
>
> What we teach is not what matters, it's what we do (252)
>
> Teachers need to change their attitudes (233)

The above captions suggest a clear deviation from the usual discourses which emanate from teachers when asked about same-sex issues. This suggests here a different type of teacher; one that sees the inclusion and acceptance of every learner in the school as his or her own concern. Of course, some may dispute this claim given the existing research in teacher professional

development which suggests that pre-service teachers have naïve ideas about the teaching profession, therefore suggesting that these ideas may change when the pre-service teachers start teaching. While this may be the case, the responses of these students appear to be in direct contrast to existing literature on the teaching of same-sex issues to other pre-service teachers (see Johnson, 2014; Zack, Maaheim & Alfano 2010). The students' responses suggest a deep commitment and willingness to drive an agenda for change.

A concern however is that some students appeared again to espouse an approach based on tolerance as opposed to full citizenship and acceptance. Note for example some of the responses from students:

> some people say according to the Bible it is wrong, yes I agree but who said that you are perfect as if you don't do any other wrong thing. In God's eye all sins are equal so being judgemental is wrong too (313)
>
> we need to keep peace in our country, no matter what we think about it (241)
>
> Teachers must swallow their pride. It's not easy, but they have to (038)

What these responses suggest is that some students still continue to see same-sex engagement as 'sinful', something which should be accepted merely to keep the peace. Of course, this may not be surprising given the deep entrenchment of religion in the psyche of the South African nation. While these responses should raise some concern, they do nevertheless present a reality that teacher educators committed to social justice should accept. As already mentioned, our teaching will not reach our students in the same way, and shifts and movements in thinking will not occur in a similar way for all students. That many students demonstrate a heightened awareness and willingness to change the schooling space should, I argue, be sufficient to demonstrate potential for change.

The Asexual Teacher Discourse

While our approach was to adopt a more critical paradigm, borrowing mainly

from Kumashiro's (2002) anti-oppressive education, the analysis of the exam suggests that the module may not have sufficiently enabled students to trouble their own sexual identifications. Very often students avoided the presentation of their own sexual identifications, often choosing to refer to 'the other'. Words such as 'them', 'they', 'these people', 'queer people' featured strongly in the responses from students. Note for instance below:

> They need to be respected because everyone deserves respect (056)
>
> Gay learners should be supported. These people are like anyone else (330)

This came as a surprise given that at least 10% of the student group could be assumed to have been same-sex identifying (see Richardson 2009). What this suggests is that our approach tended to prioritise education 'about the other'. The students continued to view teachers as asexual and did not interrogate their own sexualities. Given the urgent need to address homophobia in South Africa, together with the limitations in the time given to teach, I suggest that perhaps our designs and the environment created did not enable the students to openly claim same-sex identification. In spaces where lecturers were teaching anything between 80 and 100 students per group, it was difficult to adequately design lessons which enable students to directly grapple with their own sexualities. There are examples above which suggest that some students were able to interrogate themselves in the process of learning. However, such examples are clearly limited, suggesting the need to pay more attention on this aspect moving forward.

What Lessons can we Learn from these Responses?

There are several implications that this study has for future research and practice. A clear point is that a study premised on the analysis of examination papers can provide an indication about the thinking of our students pertaining to the controversial issues we teach. Very often similar research is premised on course evaluations and interview data. However, from the analysis of examination papers, this paper has been able to identify some important observations from the students' responses on their understanding of the

material taught as well as possibilities for the teaching offered for future interventions in school. This is important data as, very often, interviews may only reveal students' thoughts patterns, not the level of understanding of the materials taught. Through the analysis of examination responses, more in-depth data has therefore been gained.

This method clearly has limitations, not least the fact that students were writing the exam for marks and may have therefore written their responses to gain marks. Additionally, the data drawn only represents a segment of the student population who chose question 4. It could be argued that those students who chose the topic were already supportive of same-sex issues, therefore an important segment of the student population was left out in the analysis process. While indeed such claims can be made, that such a significant number of students chose to pursue the question is data on its own. It is suggesting a possible gradual change in the attitudes of the students we teach. It would, of course, still be interesting to interview those students who opted not to write this question to enquire about the reasons for their disinterest.

There are also important lessons that emerged from the data in relation to the structure and content of the module. While the module sought to present an education that captures the four approaches to teaching anti-oppressive education, it is clear that our content did not adequately interrogate the students' own subjective identifications. This in part can be explained by the students' inability to focus on the teacher-self as sexual. This points to the need for the module to move beyond only the provision of knowledge, to enabling students to locate their own sexualities in the learning process. The challenge however is how this can be enabled in large class environments where homophobia is a daily reality for students. It is argued here then that this perhaps calls for varied approaches to teaching, particularly the need for the creation of smaller classes. This has further implications for the time allocated for such teaching, as very often teaching on same-sex issues requires consistent reinforcement.

Another important aspect that this study highlights is the need for an investment on the development of local languages to enable students to understand the content of the modules taught. It is clear from the above discussion that language can be a hindrance to understanding. While this may not be an immediate concern for contexts where English is the first language, being able to explain phenomena in the language that students understand

may assist to shift students' thinking from confusion, to interrogating the content in a language they can understand. As argued elsewhere (see Msibi 2013), the continued confusion of 'gay' to be synonymous with wanting to be a woman needs to be sufficiently troubled. This can only happen when students can understand Butler's heterosexual matrix in a language that they can comprehend.

Finally, it is clear that the fear that many teacher educators have about the teaching of same-sex issues is often unfounded. Done sensitively, the teaching of controversial issues such as same-sex identification and gender non-conformity can go some way towards empowering pre-service teachers to be better informed and therefore able to support same-sex identifying students at school, while also able to challenge their own homophobia and heterosexism. As Kumashiro (2002) notes, anti-oppressive education should create 'new, activist possibilities [so that] students can be and become' (p. 201). This paper therefore opens further research and practice possibilities for the development of the field to ensure the process of 'being' and 'becoming'.

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