

**INVESTIGATING THE NATURE OF EPISTEMO- LOGICAL ACCESS
AFFORDED BY A FIRST-YEAR CHEMISTRY INTERVENTION
PROGRAMME: TOWARDS A PEDAGOGY OF POSSIBILITY!**

Sue Southwood - CHERTL, Rhodes University, South Africa

Duncan Samson - Education Department, Rhodes University, South Africa

Joyce Sewry - Chemistry Department, Rhodes University, South Africa

Abstract

This paper describes a study motivated by a general concern to capture innovative and effective practice in higher education, supporting a move towards a 'pedagogy of possibility', 'understanding who we are and what we do', opening up 'new ways of being in the university' (Boughey, 2010). The research seeks to investigate the nature of epistemological access afforded by a first-year chemistry intervention programme, with an ultimate aim of contributing to the development of effective spaces for learning in higher education. The study is regarded as dynamic in terms of its emergence from, and its intended contribution to, practice. The outcome of this somewhat emergent process not only suggests relevant and useful insights into educational practice in higher education but also offers an appropriate and meaningful model for conducting research in higher education. This research contributes to the field both pedagogically as well as methodologically.

Introduction

The intention of this paper is to contribute to the scholarship of teaching (Boyer, 1990) in a context where 'reflection on and thinking about practice' (Boughey, 2010) is encouraged and supported. It describes a study informed by a general concern to capture innovative and effective practice in higher education, supporting a move towards a 'pedagogy of possibility', 'understanding who we are and what we do', opening up 'new ways of being in the university' (Boughey, 2010). The aim of the study is to engage in research which seeks to understand and inform and to contribute ultimately to the development of effective spaces for learning in higher education. The study is regarded as dynamic in terms of its emergence from, and its intended contribution to, practice. The motivation was interest in understanding the efficacy of a specific context, with the intention of insight and understanding gained being used to inform and develop future practice both in the context of focus and beyond. The specific aim of this research project was to develop an understanding around how the teaching and learning context of an intervention programme in first-year chemistry [Chem1R] supported effective student learning, specifically in relation to affording or facilitating epistemological access.

The outcome, of a somewhat emergent process, not only suggests relevant and useful insights into educational practice in higher education but also offers an appropriate and meaningful model for conducting research in higher education. Echoing a participatory mode, claimed as an essential characteristic of the learning and teaching context, the approach taken here is one not just of participation, but rather partnership.

The context of higher education offers a space in which colleagues can collaborate on research projects from positions of equity in terms of the knowledge and skills they bring to the context. The contributions may be different but are not regarded as unequal. While the collaborators might be operating in different discipline arenas (higher education development, mathematics education, and chemistry), they share a common interest in research as well as practice, offering a strongly praxis-orientated milieu, conducive to rich and rigorous research. While this study has afforded insights

into a specific case, it is anticipated that it will have resonance beyond it and encourage the proliferation and interrogation of further positive and constructive interventions supporting learning in higher education.

Research context and background

Over the past two decades, the South African higher education system has seen both expansion and restructuring. This has in part been an attempt to meet the imperatives of equity and redress in relation to past injustices, but it has also been a response to global demands in terms of development and massification. The expansion of the higher education system has seen a dramatic increase not only in terms of student enrolment, but also in the diversity of the student body. However, there is an urgent necessity that such expansion and widened access is not accomplished at the expense of quality and academic standards. As Bak (1998: 204) sums up, there is a requirement for higher education institutions to develop ‘teaching and learning strategies that will ensure an increased yield of quality students drawn from a large and diverse student body.’

The present study emerged in response to the identification of a unique situation exhibiting evidence of being successful in terms of its aim to support the throughput of first-year chemistry students who were unsuccessful in the preceding semester of their studies. The Chem1R programme at Rhodes University runs six months out of phase with the Chemistry 1 course. Unsuccessful students are afforded the opportunity to review the course content in the tutorial-like supportive environment of a smaller class. Due to the increased number of students being placed in the Chem1R programme in the second semester of 2009, a second person was appointed to assist with the teaching of Chem1R for the period July 2009 to June 2010. A team-teaching strategy was adopted by the lecturers involved, an uncommon approach in the institution. This led to an emergent and collaborative research project centred on investigating the nature of epistemological access afforded by the Chem1R intervention programme.

The lecturers involved in the team teaching both have formal qualifications in chemistry, but have different teaching backgrounds. Joyce has been teaching the chemistry support tutorials since 1989, has taught the Chem1R course since its inception in 1993 and is embarking on doctoral research in chemistry education. Duncan has been teaching mathematics at the school level since 2002 and is in the process of conducting research in mathematics education for his doctoral degree. Joyce and Duncan are also involved in the development of mathematics and science school teachers.

Both Duncan and Joyce were present at every lecture and tutorial. Each elected to introduce and teach the topics with which they felt most comfortable. Material would be introduced in a formal lecture-type setting and then problems would be set for the students to attempt either on their own or in collaboration with peers, as they preferred. During this time the two lecturers would circulate throughout the lecture venue to help individual students who were struggling with the work. The solution to each problem would be discussed amongst the students and then developed on the board (with student input) so that all students could see, and have the opportunity to contribute to, the solution process.

The lecturers were both aware that because students had been placed in the Chem1R programme, it was highly likely that many would have a low chemistry self-concept, and some would not have adapted to the 'culture' of studying chemistry at university (Angel and LaLonde, 1998). Angel and LaLonde (1998) found that students who were not strong in mathematics and science benefit from advice and encouragement. It was thus recognised that it was important for students to feel comfortable to ask questions during the lecture time as well as while doing the problems and to feel comfortable to ask for, as well as offer, alternative explanations. Both lecturers also felt comfortable to offer alternative general explanations if they could see a different way of tackling a problem. Wherever possible, the context of the chemistry topic was explained, applications were deliberated and class demonstrations were conducted.

Conceptual orientation

The notion of 'access' has become a critical issue in higher education for the reasons outlined above. When discussing access, it is important to distinguish between what Morrow (2007) refers to as 'formal access' and 'epistemological access'. While formal access relates to the various policies which allow for legal registration at an institution, epistemological access has to do with engaging students with the practices and specialised discourses of the discipline.

As Morrow (2009: 77) critically points out, formal access to higher education institutions is not on its own necessarily a sufficient condition for epistemological access. Intricately tied up with the notion of access is that of agency. Epistemological access is not something that can be delivered or transmitted to a passive student. Morrow (2009: 78) articulates the reason for this by describing epistemological access as 'learning how to become a successful participant in an academic practice'. In the sense that each student is ultimately the agent of their own learning, so too are they the agent of their own epistemological access. There are of course any number of things that could aid the process, or make the process more effective, but at best this will only facilitate epistemological access, it will never guarantee it (Morrow, 2009). This study attempts to identify characteristics which 'aid' such access in a particular context.

As Bak (1998: 206) comments, the broadening of epistemological access is the domain of teaching and learning strategies. In addition, Bak makes the pertinent point that epistemological access needs to be coupled to the notion of 'epistemological labour', a concept that links closely with Morrow's notion of 'agency'. Thus, a critical aspect of facilitating epistemological access within higher education rests on the development of teaching and learning strategies that take into account a rapidly increasing student body drawn from diverse backgrounds (e.g. language, culture, quality of schooling, etc.) while at the same time maintaining academic standards and being respectful of learners' efforts to achieve epistemological access.

Theoretical orientation

At the meta-level this research is underpinned by a critical realist orientation, recognising the layered nature of reality (Bhaskar, 1989). The focus of this paper is on the empirical layer. The purpose of the research is thus not to gauge the success of the intervention initiative per se, but rather to engage with the experiences of the individuals who were part of the intervention programme, the meanings they made of their experiences and how the experience might be contributing to their learning and supporting epistemological access. The research was consciously approached through a lens of redress and transformation. As Bhaskar (1989: 271) comments, at its core, 'critical realism rests on the assumption that the accounts of the research participants are valid scientific data that can lead to consequential social transformation if properly interpreted.' The intention is to understand in order to inform both inherent and potential transformatory realisations.

At the substantive level, the central concept of 'learning' is framed with reference to Illeris' work around contemporary learning theory (2001). Illeris claims such theory rests on two fundamental assumptions. Firstly, that learning involves two essential processes both of which 'have to be actively involved if any learning is to take place' (2001: 3): an external interaction process between the learner and their environment, and an internal cognitive process of acquisition and elaboration where new concepts are linked to already held understandings. Secondly, learning involves three dimensions: cognitive (knowledge and skills), psychodynamic (motivation, emotion and attitude) and social (communication and cooperation). Illeris' triadal framework of dimensions offers an overarching framework for the multitude of learning theories which deal with different aspects of learning, positioning each in an overall 'structure of the landscape of learning' (2001: 1). Cognisant of the internal and external dimensions of learning, this triadic framework proved useful in informing the framing of the research reported in this paper.

Methodological orientation

In situating the study in terms of the methodological orientation of this research, it could be described as interpretive in intention, responsive in motivation and development, active in terms of engagement and its potential for contributing to development, and collaborative in terms of process. As an 'interpretive' piece it seeks to understand the experiences of others, recognising the subjective and inter-subjective nature of the perspectives drawn on. While this does not negate a critical realist orientation to the study, it locates it clearly at Bhaskar's empirical layer of reality. It is 'responsive' both as a reaction to a specific concern in a specific context and as a process which responds to what emerges, resulting in deepening layers of engagement and understanding. As an 'active' engagement, it echoes characteristics of action research in its reflective engagement aimed at improving rationality, justice and understanding of practice (Carr and Kemmis, 1986: 162), at the same time involving the researchers in a self-motivated quest for making meaning, a search for (and creation of) knowledge. Finally, the 'collaborative' nature of the research speaks to the participatory engagement of the three researchers, each making different, but not unequal, contributions. Two of the researchers were the lecturers responsible for co-teaching the Chem1R intervention programme, while the third was a Higher Education Development Practitioner (HEDP) working in the Centre for Higher Education Research, Teaching and Learning (CHERTL). The collaboration involved a process of mutual engagement, a deliberative and negotiative process in which each stage of the research was discussed, developed and carried out together. While the inter-subjective nature of such a study is recognised and celebrated, it is also argued that the collaborative involvement of all three researchers contributed to a richer and more rigorous engagement, leading to deeper and more richly textured understandings of the data, and affording stronger validation of the process and the emerging ideas.

Research design

Data generation and analysis

The data generation unfolded in three phases. An initial anonymous questionnaire was completed by the students focusing on their experience of learning in the Chem1R course context (2nd semester 2009), with particular reference to the team-teaching approach employed. These responses were collated and synthesised, a process which in turn informed the design of a simple framework for a focus group discussion which interrogated in more depth the central themes emerging from the initial data. The final phase, the individual interview, was designed to elucidate deeper insight and understanding relating to the specific context under investigation. Alongside these forms of data generation a process of observation was engaged in, where the HEDP sat in on a number of sessions and, without a predetermined schedule of any form, made informal notes focusing on the nature of the teaching and learning that was taking place.

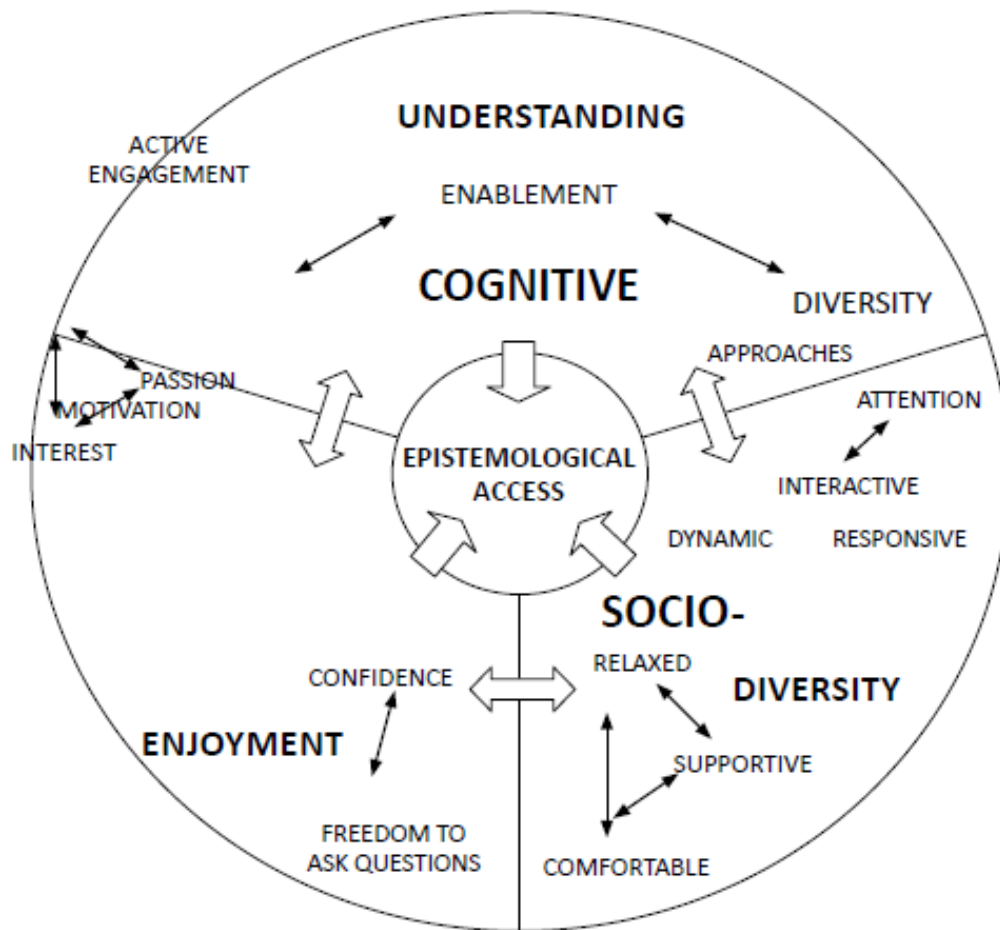
The data generation tools (questionnaire, focus group discussion and interview frameworks) were developed collaboratively by the research team, allowing for greater critical and more holistic engagement. The facilitation of the data generation was conducted by the HEDP. This was a deliberate part of the design, identified as important in creating distance between the students and the lecturers to ensure greater data validity, at the same time helping to avert the potential of the study being a self-validating project.

The analysis took the form of a multi-layered process focusing on the identification of emergent themes. The process of analysis led to the categorisation of three interweaving layers: themes (understanding, diversity and enjoyment), threads (enablement, interest, diversity of approaches and perspectives, attention, interaction, active engagement, comfort and support) and strands (cognitive, affective and socio-cultural). These were recognised as intimately linked, each regarded as having an influence in terms of facilitating epistemological access.

The following diagram (Figure 1) attempts to capture these different layers and suggest the dynamic interdependence between them.

Figure 1

Triadic framework of themes, threads and strands identified as facilitating epistemological access



Discussion

A number of broad themes emerged during the initial analysis of the student responses to the questionnaire. These included a heightened sense of enjoyment and interest in the study of chemistry, improved levels of understanding and an appreciation for the diversity of the context afforded by the team-teaching model.

A strong thread running through the responses related to the manner by which the team-teaching approach was able to create spaces for greater individual attention and thus better enable understanding. The students particularly appreciated the more hands-on approach and the way in which one of the lecturers would move around the class providing one-on-one assistance to students while the other carried out the more formal aspects of teaching. Improved understanding was in part attributed to the dynamic engagement between lecturers and students. Furthermore, it was recognised that the level of attention and interaction were directly related to the adoption of a team-teaching approach.

There was also a strong appreciation and celebration of the diversity afforded by the team-teaching context. The students appreciated having different people teaching different things in different ways, offering alternative approaches and perspectives, all of which were cited as contributing to a broader and more thorough understanding, not only of the disciplinary knowledge but as one student articulated, 'about learning and how I'm being taught'.

In general, the students expressed strong feelings about the method of team-teaching: I believe that the 'team' allows for much better and effective teaching. I think that 'team teaching' has been the best style of lecturing here at Rhodes.

It was even suggested that this is how all subjects should be taught and not only be implemented after students have failed.

An analysis of the second layer of data, the focus group discussion, allowed the central themes which emerged from the first layer to be interrogated in greater

depth. We were particularly interested in furthering our understanding of issues specifically surrounding the team-teaching model in order to gain deeper insights into the nature of the epistemological access it afforded.

A strong theme running through the responses related to the supportive nature of the tutorial-like environment of a smaller class in which students and lecturers are able to get to know each other to a greater extent. This not only assisted in creating a more comfortable learning atmosphere with a 'discussional' feel, allowing hesitant students to ask questions more easily, but was important in enabling more *active engagement* in the development of understanding and supporting affective domains such as *confidence, enjoyment, motivation and passion*.

Chemistry became more interesting and easy to understand. We as students are really comfortable and relaxed.

They have made chemistry very exciting.

Having two lecturers, as opposed to just one, had a number of important practical benefits. Students recognised that the team-teaching model enhanced the level of interaction between students and lecturers as well as enabling the provision of greater individual attention, particularly when the class was engaged in working through example problems and exercises:

Having two lecturers makes it easier to get the individual attention we want. It is as close to a one-on-one experience you can get in undergraduate.

Students also appreciated that the team-teaching approach made it possible to be ...individually attended to in class while that particular section is being taught. thus enabling students to ask about their problem...straight away, and not have to wait until the end of the lecture.

In relation to the thread of diversity, many of the responses concerned the advantages afforded by the differing yet complementary backgrounds,

viewpoints, experiences and teaching styles of the two course lecturers.

By having different ways of explaining the same thing you are able to understand it better yourself and have more than one way to go about a certain problem.

Students appreciated having access to different explanations, alternative ways of grasping concepts, and different approaches to solving problems, all of which led to enhanced communication between lecturers and students, and heightened understanding of important concepts.

It helps me to understand every concept better because if I didn't really understand how Mrs Sewry (Joyce) taught something then I can ask Duncan to explain to me in another way.

In addition, having two lecturers with different but complementary teaching styles was cited as strengthening the class's overall confidence towards the subject.

A number of comments made during the focus group discussion led to a deeper appreciation of the complementary roles played by the two course lecturers.

Duncan is more of a teacher and Joyce is more of a lecturer and people love that because there are things better explained by Joyce and some by Duncan and knowing that they are always there to explain helps with our understanding.

Duncan has got a mathematical background and is very good with numbers and explaining them, while Mrs Sewry (Joyce) is very good with the theory ... so their different strengths made the interaction and understanding better. You get to understand both theory and numbers clearly.

In the light of Boughey's (2005) call for collaboration between disciplinary and academic development expertise, it was recognised that this situation was quite unique in terms of the dynamic created by the two team members as a result of their specific backgrounds. One member of the team is a disciplinary expert while the other, although not an academic development practitioner, has not only background in the discipline but also has a background in the academic engagement of teaching and learning. Interview data suggested that the complementary backgrounds, experiences and approaches of the two lecturers might even be, at least in part, effective for some students in smoothing the transition from school classroom to university lecture theatre and the associated changes in mode of delivery, i.e. from classroom teaching to university lecturing.

A further consideration suggested by the present research is that splitting a relatively large class into two smaller classes may not necessarily be the most appropriate course of action in terms of effective learning and teaching. Although it might be assumed that splitting a class into two smaller groups, each with their own lecturer, would lead to greater individual attention and more meaningful student-lecturer interaction, this assumption does not recognise or appreciate the potential richness which could emanate from the complementary roles of two lecturers team-teaching a single large class.

Another interesting comment made by a number of students was that the team-teaching model adopted in the Chem1R course afforded the two lecturers the opportunity to present those sections of the course that they either particularly enjoyed, or which more closely resonated with their particular strengths. It was suggested that this enhanced the lecturer's passion which in turn led to greater engagement and understanding on the part of the students.

These insights provide an image of experience from the perspective of the students. Observation of the learning space by the development practitioner offered a complementary image, confirming that generated by the students but also helping to elicit a much stronger sense of the context. Observation led to

a deeper understanding and articulation of the context dynamics, supported by and manifest through the characteristics suggested by the students. Interpretation of these observations identified an interesting shift from what might be termed more traditional, reproductive approaches to learning, towards a more innovative, transformative approach (Biggs, 1978; Thomas and Bain, 1984; Mezirow, 2000). Despite the traditional physical layout of the lecture theatre in which the sessions were facilitated, the lecturers created the space for more dynamic and responsive engagement than would traditionally have been offered. Questions were asked of the students by the lecturers, and of the lecturers by the students. Solutions were discussed by both the lecturers and the students and different possibilities were offered and deliberated between the students themselves as well as between the lecturers and the students. Relations between the lecturers and the students were more dynamic; the students actively engaging in the learning and taking responsibility for their own understanding.

Concluding comments

This study highlights the complexity of teaching and learning in higher education, suggesting important implications for the staffing of intervention programmes, (echoing Boughey's (2005) concern in the foundation context) and pedagogical approaches adopted. Careful and critical deliberation around course facilitation has the potential to create enhanced learning experiences impacting on the cognitive, affective and socio-cultural domains of students, and thus influencing epistemological access. This study only touches the surface, acknowledging the complexity of the teaching and learning context. The challenge is not only to recognise, but to hold and work with that complexity if we are to enable epistemological access in our learning spaces and develop a 'pedagogy of possibility'.

References

Angel, S.A. and LaLonde, D.E. (1998) 'Science success strategies: An interdisciplinary course for improving science and mathematics education' *Journal of Chemical Education* 75 pp.1437-1441.

Bak, N. (1998) 'Organising learning in large group teaching' In W. Morrow & K. King (Eds.) *Vision and reality: Changing education and training in South Africa*. Cape Town: University of Cape Town Press. pp.204-213.

Bhaskar, R. (1989) *Reclaiming reality: A critical introduction to contemporary philosophy*. London: Verso. Biggs, J.B. (1978) 'Individual and group differences in study processes' *British Journal of Educational Psychology* 48 pp.266-279.

Boughey, C. (2005) "'Epistemological" access to the university: An alternative perspective' *South African Journal of Higher Education* 19(3) pp.638-650.

Boughey, C. (2010) 'Access and success in higher education: Being in and of the University' Inaugural lecture. Rhodes University, South Africa.

Boyer, E. (1990) *Scholarship Reconsidered: Priorities of the Professorate*. Carnegie: Princeton, NJ.

Carr, W. and Kemmis, S. (1986) *Becoming Critical. Education, knowledge and action research*. Lewes: Falmer.

Illeris, K. (2001) 'The Three Dimensions of Learning' Keynote address at NFPF/NERA 29th Congress, Stockholm, March 15–18. <http://www.ped.gu.se/projekt/nfpf/nfpfkongress01/illeristhethree.html> (Accessed 17 June 2010).

Mezirow, J. (2000) 'Learning to think like an adult: Core concepts of

transformation theory' In J. Mezirow and Associates (Ed.) Learning as Transformation: Critical Perspectives on a Theory in Progress. San Francisco: Jossey-Bass. pp.3-33.

Morrow, W. (2007) Learning to teach in South Africa. Cape Town: HSRC Press.

Morrow, W. (2009) Bounds of democracy: Epistemological access in higher education. Cape Town: HSRC Press.

Thomas, P.R. & Bain, J.D. (1984) 'Contextual dependence of learning approaches: The effects of assessments' Human Learning 3 pp.227-240.