

A PROJECT-BASED APPROACH TO NUMERACY PRACTICES AT UNIVERSITY FOCUSING ON HIV/AIDS

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ABSTRACT

In this 'Information Age' it is increasingly important that students at university are numerate at an appropriate level for their discipline. This paper reports on an attempt to achieve this through a project-based curriculum component in an 'Effective Numeracy' course. The practice of numeracy within relevant contexts is emphasised, rather than the decontextualized acquisition of skills. We explore the way in which students engage with curriculum-embedded projects, how they draw on their representational resources in the production of 'texts', and the manner in which the projects contribute to changes of attitude towards numeracy competencies.

The choice of the HIV/AIDS epidemic as the project topic is motivated by the need to raise awareness of the magnitude of the threat and its social implications. Its obvious social relevance is also essential to motivate the students to engage fully with the project. The project develops an appreciation of the relevance of numeracy, by requiring the students to practice numeracy in a context where there is close linkage with other vital competencies, such as writing and information and computer literacies.

The project design provides opportunities for co-operative learning, and includes the provision of scaffolding, especially for and through writing. Students were required to present their research in a range of genres, which enabled different kinds of engagement with the material, and different affective reactions to the tasks. In all cases, the learning was not only through reception, but through synthesis and transformation of knowledge in the processes of production.

1. Introduction

Many first-year students at the University of Cape Town (UCT) arrive without the appropriate quantitative literacy, language competence or computer literacy to enable them to succeed in their chosen course of study. South Africa is still suffering the consequences of the Apartheid policies on education, which results in a large proportion of the population being 'educationally disadvantaged' in terms of basic numeracy, visual, linguistic and conceptual practices. The traditional approach to various literacies at schools and universities in South Africa is to teach 'skills' in a very compartmentalised way. It is also generally assumed that a student who has studied mathematics to a sufficiently high level in school will automatically be able to apply mathematical knowledge to real-life situations. The Numeracy Centre at UCT administers an 'Effective Numeracy' course that aims to provide for the needs of some of these students, by increasing their quantitative and computer literacy, and their ability to exercise these competencies appropriately in the variety of contexts they will encounter in their studies. This paper thus argues for an approach to literacy and numeracy which sees them as practices embedded in particular social contexts.

2. Numeracy as practice in context.

There is an ongoing debate about the meaning of the term 'numeracy' or quantitative literacy and its relationship to 'mathematics'. In talking about numeracy, we adopt the proposed working definition of numerate behaviour from the Adult Literacy and Lifeskills Survey:

Numerate behaviour is observed when people manage a situation or solve a problem in a real context, and involves responding to mathematical information that may be represented in multiple ways; it requires the activation of a range of enabling knowledge, behaviours and processes (2002: 9).

This emphasis on real context, responding to information, and multiple processes has led to the adoption of the following guiding principles for curriculum design:

- Numerate behaviour is always embedded within a context
- Numerate behaviour can be thought of as a practice involving the exercise of several related competencies, not just arithmetic skills.
- A numerate University student should be able to exercise these competencies to express their understanding of numerical information in the form of a 'text', which we define in the largest sense as communication, in written, oral or visual mode.

Numerate behaviour, as opposed to mathematics, is embedded within a context.

An important component of numeracy, often mentioned in the literature, is the ability to operate in a context. Yet, the dominant pedagogical practice, particularly in South Africa, of teaching numeracy in the restricted context of the formal mathematics classroom is at odds with this idea. Hughes-Hallett (2001) summarises the difference between quantitative literacy or numeracy and mathematics as follows:

...mathematics focuses on climbing the ladder of abstraction, while quantitative literacy clings to context. Mathematics asks students to rise above context, while quantitative literacy asks students to stay in context. Mathematics is about general principles that can be applied in a range of contexts; quantitative literacy is about seeing every context through a quantitative lens (94).

In thinking about 'context', Usiskin (2001) warns against the use of contrived 'real-life' examples masquerading as 'reality' in the mathematics classroom, such as treating word problems as if they are applications. Teaching quantitative literacy requires the use of real contexts, which need to be understood as clearly as the mathematics that is being applied. This is why students often experience a numeracy course as rather challenging, even if the mathematics required is quite elementary. Students often avoid or skim over the quantitative aspects they encounter in their disciplines. For a university student to be numerate, they would have to be able to see the contexts they encounter in all the courses in their programme of study 'through the quantitative lens'. For instance, understanding graphs in a discipline like Psychology as opposed to learning these graphs in a rote fashion.

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Viewing numeracy as a set of identifiable arithmetic skills, construes 'it' as a set of techniques that can be taught and learnt without reference to social contexts and are therefore seen as universal across time and space. Baker, Clay and Fox use the term numeracy to draw attention to the parallels and links between numeracy practices and literacy practices, to refer to "the collection of *numeracy practices* that people engage in – that is the contexts, power relations and activities – when they are doing mathematics" (1996: 3). Regarding numeracy as a social practice alerts us to the fact that power relationships and possible contests over meaning and values might arise. To consider numeracy as a social practice is to question whether numeracy is value-free or to what extent it is positioned in cultural contexts and value-laden. Chapman and Lee (1990) also argue that it is not possible to draw an artificial separation between the notions of numeracy and literacy, but rather that numeracy should be situated within a larger notion of literacy that involves many competencies: "reading, writing and mathematics *are* inextricably interrelated in the ways in which they are used in communication and hence in learning." (279). Focusing on numeracy and literacy practices is an excellent way of integrating the curriculum by combining subjects, genres, conventions, and creating new forms and new ways of knowing. This is in line with a multiliteracies approach to pedagogy and curriculum design. A multiliteracies approach emphasizes competencies in different semiotic systems: numbers, written language, visual design or graphical representation (Cope and Kalantzis, 2000).

A numerate university student should be able to exercise these competencies to express their understanding of numerical information in the form of a 'text'.

Being numerate does not only encompass an ability to interpret information, but also the ability to *express* information of a numerical nature coherently in a verbal and visual form. Contextualized writing reinforces understanding of concepts in context because it requires the student to retrieve, synthesize and organize information in meaningful ways. In dealing with quantitative or mathematical ideas in context, students should be able to *interpret* ideas presented verbally, graphically, in tabular or symbolic form, and be able to make *transformations* between any of these forms. This is consistent with a multiliteracies approach which emphasizes the importance of being able to transcode between semiotic systems as evidence of learning. Kress (2000) defines learning as the movement between modes and the transformation of meaning. We would like to argue that 'numerate behaviour' furthermore requires the ability to choose the appropriate form for the expression of a quantitative idea, and to produce a 'text' that expresses that idea. This synthesis and transformation of knowledge in the process of production is vital in the learning process. Thus, the 'practice' of numeracy at tertiary level must include the ability to

put together a particular document for a particular purpose in a particular social, political or other context.

3. The Effective Numeracy course.

The ‘Effective Numeracy’ course is based in the ‘Gateway Programme’ which is a four-year extended curriculum programme in the Humanities faculty at UCT. Students enter this programme in their first year and proceed to a variety of economics related programmes of study. Effective Numeracy is one of the core courses in first year, the others being Microeconomics and Philosophy (Quantitative reasoning). The philosophy and development of this course over the last five years is described by Brink (2001) and Frith and Prince (2001). The classroom sessions are run as ‘workshops’ with limited presentation of course content. Students sit in groups and engage with the course materials provided as printed worksheets, while lecturers and tutors act as facilitators. Interactive computer-based tutorials are used to support the learning of numeracy/mathematics concepts, where appropriate.

Projects

The course design includes a project-based approach to learning numerate behaviour, which creates the opportunity for contextualized teaching practice and encourages student participation. Students were given a choice of four projects on the topic of HIV/AIDS. This is a particularly relevant topic in South Africa since predictions of the HIV/AIDS pandemic are very alarming, especially for teenagers. The project tasks, criteria for assessment, reference list and reading materials were made available on the web. Students had a choice of genre between pamphlets, poster and reports:

Genre	Objectives	Audience
Poster	Awareness of risk of infection and prevention	Primary Health Care Clinic
Pamphlet	Awareness of projected impact of HIV/AIDS on industry	Human Resource Managers
Report	Motivating the need for educating teenagers about HIV/AIDS	School governing body
Report (independent research)	Development of HIV/AIDS epidemic over the last decade	Non-governmental organization

Students were encouraged to work in pairs on the projects, but not compelled to do so. Some of the students mentioned how co-operation is vital, rather than working in isolation, and astutely mentioned that it seemed to be a very feature of the subject of maths itself: “It was easy to work as a group - I couldn’t have done it alone”.

Scaffolding

Significant scaffolding for the projects was built into the curriculum, including a range of tasks, that functioned as both formative and summative assessment. The classroom materials included comprehension exercises on newspaper articles dealing with the HIV/AIDS epidemic, with titles such as: “R120m for poor in AIDS battle”; “AIDS The facts behind the smokescreen”. These exercises required the understanding of numerical information embedded in a text, and the

ability to produce brief written expressions of this understanding. This prepared the students for the kind of writing that would be required for the production of the project.

In the tasks for assessment, the criteria were always made explicit, and a mark for writing was included. One student's comments on these tasks:

They were useful – introduced a new aspect to (the classroom work), something you hadn't gone through in thorough detail in the exercises – incorporating classroom and lab work together, so you had to put what you learned in lab and in class together. They encouraged exploration.

Scaffolding also took the form of guiding the students through the writing process. In the UCT context, acquiring academic discourse is complicated by the fact that English is a second language to most students. The Writing Centre analysed the strengths and weaknesses in student writing on the homework assignments and provided feedback to both the students and the lecturers on the course. The Writing Centre also offered workshops for all students and one-to-one consultations for those students who needed more assistance. The students were given clear guidelines regarding the specifics of the different genres and different registers required in writing for different audiences. Each student (or pair) was required to produce a first draft and discuss it with their 'supervisor'. This student highlights the usefulness of the scaffolding activities:

I enjoyed the project. It is at the heart of what is happening in the country. I enjoyed it and worked hard. I never expected to get 78%. But we got help in class with the writeup and we also took our work to the Writing Centre, where the lady spoke to us and guided us in a help session. I was aware of the criteria for marks and I had to think about whether the writing was really relevant to the subject - was my interpretation of the graphs applicable to the specific piece of work?

4. Analysis of the Projects and Students responses

If one views all sign-making or production of texts as based on 'interested action', the emphasis focuses on students' motivations for the uses of particular forms; rather than on incompetence and error. In looking at student representations of an important issue such as HIV / AIDS, it may be interesting to look at the degree of personal involvement and how this influences the representation of 'data'. As opposed to the more depersonalised and 'objective' language of the written report, many students battled to operate within an appropriate register in creating the posters. Perhaps this reveals a degree of personal involvement which was not enabled to the same extent through the written report, which tended to be more linear, objective, factual and formal. The posters concentrated less on 'argument' and more on persuasion through 'display'. For instance, the use of abbreviated visual symbols pointing to a host of meanings: ! for caution, a stop sign, predominant use of red indicating both 'blood' and 'danger'; and red ribbons to indicate solidarity with AIDS sufferers. Students also managed to insert a sense of identity with signifiers irrelevant to the overall message of the poster, such as red, yellow and green colours to indicate kinship with the Rastafarian movement.

As noted in an introductory course in engineering, there is often an element of parody in students' use of dominant genres, and the production of multimodal texts in the academic context tends to enable this play with form to a greater degree (Archer 2000). The HIV/AIDS issue was represented in the poster genre as a gothic skull and crossbones experience; a detective adventure story ("The killer is on the loose!"); a photostory; a 'comic-style' narrator that leads the reader through an argument. All of these choices may also be ways of dealing with the sensitive subject

matter. Some students took the opportunity to exploit the innuendos generated by the topic. “ Use your shaft wisely” was the title for a pamphlet in the mining industry.

The interpretation of the poster genre was broad, ranging from dense written text to almost purely visual texts. The visual, verbal and graphical elements were integrated with varying degrees of success. One poster chose another mode, a three dimensional model of a female figure (See figure 1). The emphasis is on the body as ‘text’, where the inner and outer workings blur into one organism in a kind of depersonalised medical way. The body is represented as permeable, vulnerable and relatively distasteful (red and blue wire for veins, splashes of blood, grimacing teeth). This inside/outside dichotomy is echoed in the depiction of Africa within the belly; the ‘body’ represents the larger body politic where the individual is responsible for the collective well-being of society. The integration of the different modes is highly problematic in this poster. The students have done extra research but have represented the information in an inappropriate form. They have chosen dense text rather than graphical representation. The graphical representations they have included do not relate to the written text and are not explained in any way. They are also copied from the reading provided. In copying these charts, the students demonstrate an ability to read and decode the charts, but an inability to *produce* graphical representation of data.

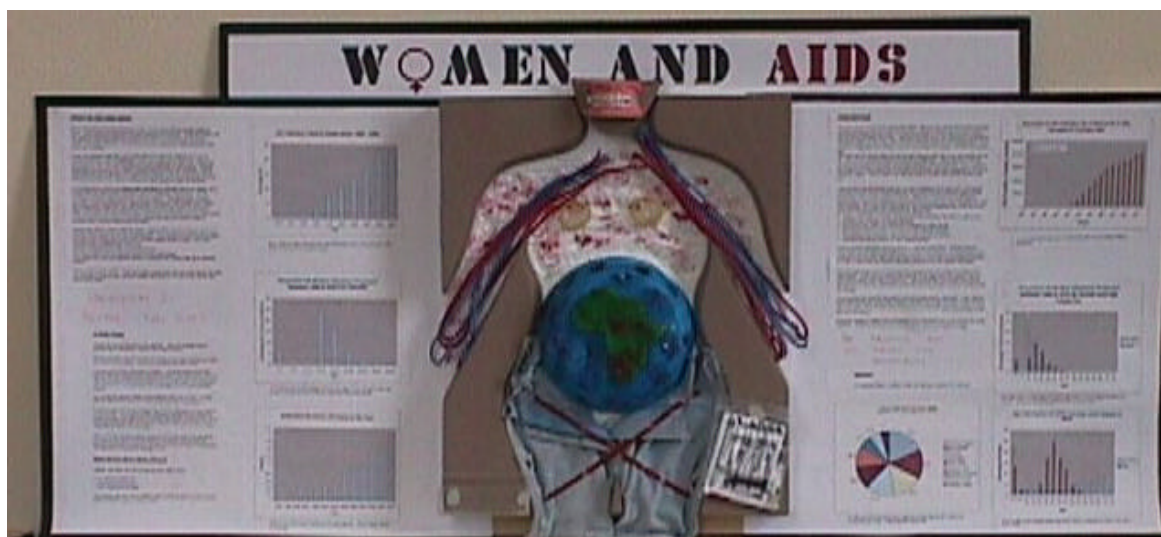


Figure 1

In figure 2, the students have understood the data, internalised the message and represented it in a visually appropriate way, which is not necessarily mathematically correct. In our definition of ‘being literate’ as being able to choose from a range of semiotic resources to produce a message deemed appropriate for a particular audience, this poster certainly succeeds. Although, it may not be completely accurate mathematically, the visual representation of the data has a specific impact. It manages to put a human face to the talk about statistics; as opposed to the depersonalised ‘medical model’ looked at above. This human face is important in a discussion about HIV/AIDS where numbers can easily become a distancing mechanism from the issue.

The audience is situated in relation to the numbers and through the informality of language used: “Stats show that 52% of newly infected females are between 20 and 24. This number is said to rise. How old are u?” Here mathematics is used to persuade rather than to inform. The key point is that there is no right answer for this kind of project as it is dependent on context, and is not abstract mathematics.

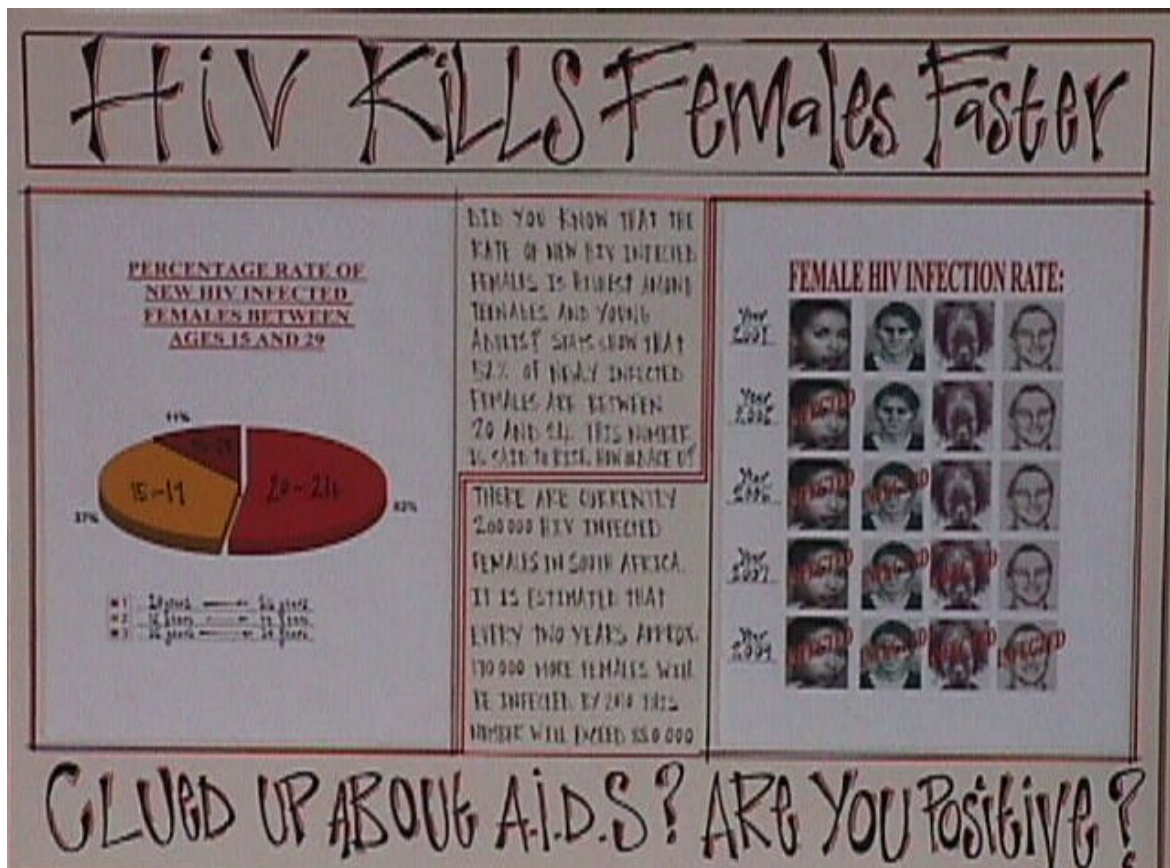


Figure 2

5. Final comments

In talking through past experiences of mathematics, students typically provided highly personal accounts using strong words such as ‘hate’ and ‘fear’. Our project-based multimodal approach hoped to combat anxiety and build student confidence by drawing on their representational resources and different knowledges, and engaging them on an affective level. The general principles for curriculum design to emerge are largely focused around these issues.

- Frame numeracy as a ‘behaviour’ or ‘practice’ in context rather than a collection of separate and definable ‘skills’.
- Chose the contexts for study carefully, as relevant and interesting to the people for whom the intervention is being designed.
- Encourage the ‘production’ of multimodal texts as an outcome of numerate practice, not only the ‘reception’ (understanding and interpretation) of existing texts.
- Incorporate a multiliteracies approach, where different knowledge and competencies must be displayed and exercised by a student in order to achieve the required outcome.
- Build in scaffolding throughout the curriculum. This includes pre-tasks to develop the context, writing and computer competence. Scaffolding also includes making assessment criteria explicit and giving guidelines around specific generic conventions.
- Provide students with an unthreatening and supportive environment, and opportunities to succeed.

In the interviews with a random sample of students, working together on the projects was mostly perceived positively, and even as ‘fun’. The project was variously described as challenging, creative, eye-opening, interesting and relevant. Students appeared to appreciate the opportunity to

research and write, which they did not usually associate with a mathematics course. The aim was also to design a curriculum which would accommodate and validate the diverse social, and cultural backgrounds of our students, as well as address the inequitable educational opportunities afforded them. This kind of cross-genre, cross-disciplinary, multimodal approach to teaching numeracy and literacy practices has important implications for democracy, equal opportunities and social justice, which is of crucial importance to South Africa at this time.

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