CHAPTER 11

TRANSFORMATIVE AND NORMATIVE? IMPLICATIONS FOR ACADEMIC LITERACIES RESEARCH IN QUANTITATIVE DISCIPLINES

Moragh Paxton and Vera Frith

MEANINGS OF TRANSFORMATION IN SOUTH AFRICAN HIGHER EDUCATION

Social Transformation

Transformation can mean many things but it has very specific implications in the South African higher education context. Although there has been a marked improvement in equity of access to higher education in South Africa since 1994, equity in completion rates remains racially skewed and disappointing (Ian Scott, Nan Yeld & Jane Hendry, 2007). Transformation, at the formerly white and privileged institution of the University of Cape Town, therefore involves reappraisal and reorganization of teaching and learning in the university in order to cater to a growing black student population, many of whom are second language speakers of English from poor, rural, or urban working class backgrounds. It is a priority to ensure that completion rates are increased, reflecting that higher education and students' experience of it are *transformed* (see Thesen Reflections 6 this volume).

Pedagogic Transformation

Academic developers teaching in foundation courses and extended curricular programmes such as the one discussed in this chapter have a very clear mission, which is to focus on preparing students for epistemological access, defined by Wally Morrow (2009, p. 77) as "learning how to become a successful participant in an academic practice." We recognize that there is a mismatch between teaching approaches and student experience at our institution, mostly because staff come from very different backgrounds from those of the students. Therefore we work with the staff helping

DOI: https://doi.org/10.37514/PER-B.2015.0674.2.11

them to understand students' prior and existing knowledge-making practices and to critically explore the way students' prior knowledge and practices may enable or present barriers in the learning and teaching of new, unfamiliar, or what we think of as "mistakenly familiar" conventions (as we illustrate below), discourses, and concepts. We see our role as change agents in the broader university, improving the effectiveness of teaching and learning in the interests of both equity and development.

ACADEMIC LITERACIES AS TRANSFORMATION

In the context of science and maths education at the university level, we find the tension highlighted by Theresa Lillis and Mary Scott (2007) between normative and transformative approaches to language and literacy particularly heightened. Lillis and Scott (2007, p. 13) have highlighted the transformative role of academic literacies research as being interested in discovering alternative ways of meaning making by considering the resources that students bring as "legitimate tools for meaning making." They have contrasted this with the normative understanding of academic literacy which tends more towards "identifying" disciplinary conventions and "inducting" the students into correct ways of thinking and writing. In our particular context we are acutely aware that—given the history of apartheid and the ongoing crisis in South African schooling including the lack of resources and breakdown of a culture of learning and teaching in the schools—normative approaches that involve inducting students into existing and available discourses are essential. Where we locate the transformative dimension to our work is in the following two key elements: 1) a rejection of a deficit position on students and the semiotic and linguistic resources they draw on and enact in higher education; and 2) a commitment to understanding and uncovering existing and prior practices that may enhance or present barriers to learning and teaching. We will illustrate this argument by discussing some of the data from an academic literacies research project in a foundation course in the Biological, Earth, and Environmental Sciences (BEES) at the University of Cape Town.

THE CASE STUDY

Through researching a collaborative initiative aimed at integrating academic literacies in this course, we have developed a three-way conversation between the academic literacy, numeracy studies and science specialists, which has informed the curricular design. Most of the students, in a class which averages around 50 students, came from educationally disadvantaged backgrounds and many of them were speakers of English as an additional language.

In 2010 and 2011 students in the BEES course were required to write a scientif-

ic research report which acted as a central focus for formative assessment. Numeracy and academic literacy specialists offered teaching and learning activities throughout the year to prepare students for the writing of the report. Assessments explicitly addressed these activities and built incrementally towards the final scientific report. After a series of lectures and Excel-based tutorials on the analysis and interpretation of data, they were given data and a series of directed questions which guided them through its analysis. These were presented in the form of a structured Excel spreadsheet, on which the students could perform the statistical analysis, create the charts and graphs and write the descriptions of the results. This data analysis was carried forward into the results section of the final scientific report. In doing this project students were engaging in a very diverse range of modes integrating verbal, graphic, pictorial and mathematical representations in order to make meaning in the natural sciences.

In 2011 we developed a collaborative action research project between the academic literacy, numeracy studies and science specialists aimed at further development of the pedagogy and curriculum for this course. Our research project follows the typical action research spiral: Plan, Act, Observe, Reflect (Stephen Kemmis & Robin McTaggart, 1982). A key finding emerging from this phase of the project was that a much greater degree of collaboration between the people teaching students about writing the research report was needed in order to integrate the different aspects taught and hence allow students to produce a more integrated product. In 2012 we moved into the second action research cycle as we designed and planned changes to the course on the basis of our early findings.

We used Academic Literacies research methods to gain insights into the practices and assumptions students drew on as they learned to write about quantitative information in science. This involved adopting an ethnographic stance, orienting both to texts and to writers' perspectives: we analyzed early drafts of student writing and then interviewed students about their writing. Instead of assuming that the student is cognitively unable to grasp the concepts, we recognize the socially situated nature of literacy (Mary Lea, 2004; Mary Lea & Brian Street, 2000; Lillis & Scott, 2007; Street, 2005) and that if we are to appropriately address students' needs and help them to become successful participants in the science disciplines, it is crucial for us to understand and build on what students know and to uncover prior practices and conceptions that may enhance or present barriers to further learning.

In the following sections we illustrate how we have worked with students to uncover prior practices and assumptions. We describe the ways in which students were understanding quantitative concepts (Theme 1) and highlight some of the prior schooling practices that may be impacting the way students write in the natural sciences (Theme 2). Finally, we outline some implications of these findings for teaching, curriculum and staff development.

THEME 1: CONCEPTS IN NUMERACY

Quantitative information and concepts are conveyed through language, often using precise terminology and discipline-specific forms of expression which are associated with specific quantitative ideas. Writing about quantitative information involves using terms and phrases that often include everyday words, but which have specific meanings, and which convey a richness of conceptual meaning. An example is the word "rate," which has an everyday meaning (speed) but in more technical contexts is used more broadly to describe ratios of various kinds, not only those that express changes with respect to time. Understanding the term "rate" in a given context involves understanding the significance of describing a quantity not in absolute terms, but relative to some other quantity, which is for most students not a trivial concept. Learning to use terms and phrases of this kind correctly (and with a proper understanding of the concepts to which they refer) is fundamental to quantitative literacy and is essential for a science student.

In their writing of a scientific report many of the students used quantitative terms and phrases inappropriately, often in a manner that was grammatically correct, but conceptually incorrect, revealing that they either did not understand the specific contextual meanings of the terms they were using or that they did not understand the concepts the terms refer to, or both. One example of a phrase applied incorrectly is "is proportional to"[1] as illustrated in Figure 11.1.

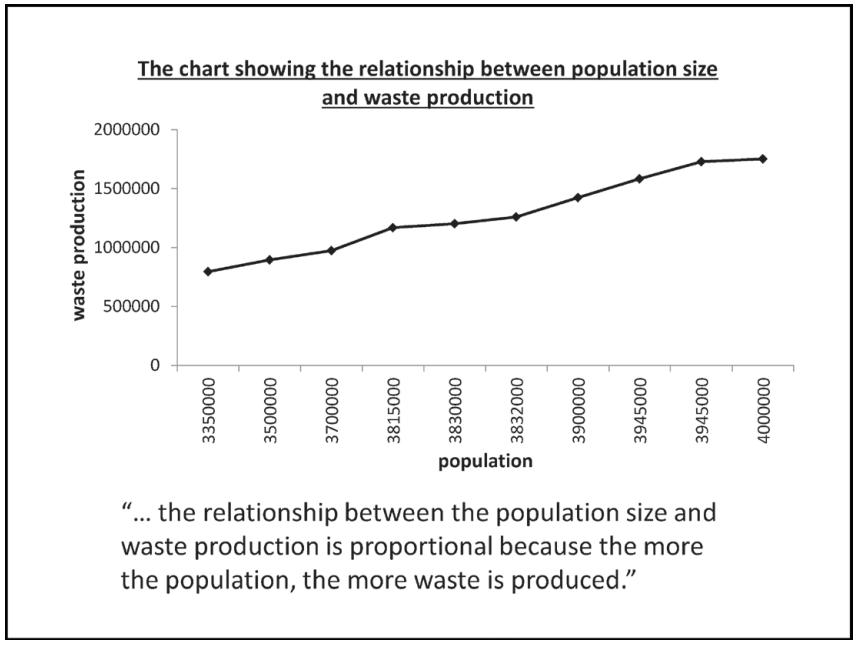

Figure 11.1: Graph and description from student's report.

We will discuss this example to illustrate how the ethnographic approach helped us to gain a better understanding of what the students were signifying by their use of this term and of the origins of this usage. We will then suggest how this insight helps us to teach the use of quantitative language more effectively.

Because many students had used "is proportional to" to describe relationships that were not proportional (that is, where the two variables were not in a constant ratio with each other), in the interviews we asked, "What does it mean when you say one thing is proportional to another?" All but one student expressed their understanding in a manner similar to this: "… if the other one increases the other one which is proportional to it also increases …." Further questioning revealed that all these students believed that this was a sufficient condition for proportionality; or in other words, that "is proportional to" defines any relationship where an increase in one variable is associated with an increase in the other. So for example, when shown a sketch of a graph showing an exponential growth situation, students confirmed that they understood this to be a case of proportionality.

When asked where they first encountered the use of a phrase like "A is proportional to B," all students said their first encounter with the term was in physics lessons at school. For example, a student sketched a formula of the form "$V \propto p$" and said "mostly in physics … for formulas where you are maybe told the volume of something is directly proportional to this … as this increases the other increases the change in this, if this changes it affects the other one"; whilst saying "this," she pointed to the p in the formula, and when saying "the other one" to the V. In school physics it is common to use the symbol '∝' to represent "is proportional to" in a formula. This disguises the fact that the relationship being represented is of the form $V = kp$, where k is the constant of proportionality (that is, the constant ratio). In explaining that if V is proportional to p, then as p increases so will V, a physics teacher is making a true statement, but it seems that in many cases teachers have not prevented students from concluding that the converse is true. It is easy to see how if whenever a student hears the phrase "is proportional to" it is in the context of noticing how one variable is associated with an increase in the other variable, they will conclude that this is what the expression means.

In reading students' written reports we might have been tempted to discount the incorrect statements about proportional relationships as "poor English" but through questioning students about their writing we gained rich insights into an unexpected realm of their experience. From the point of view of what many of the students apparently learned in physics classes, their use of the phrase "is proportional to" was a correct description of the relationship they were describing, so simply correcting the language would have been merely confusing to them. For us, the realization that students' incorrect use of this phrase is not a superficial slip, but rather an expression of an entrenched conceptual misunderstanding, has been very useful. It helps us to appreciate that if we want to teach students to use quantitative

words and phrases appropriately in context, we must first make sure they properly understand the concepts to which the words refer before attempting to teach the conventional ways of expressing those concepts. It is through talking to students about the understanding underlying their choices of expression that we can find out which concepts we should give attention to. The insights gained in this way will (and already have) changed the nature and emphasis of our teaching in this course.

THEME 2: STUDENTS' PRIOR PRACTICES IN WRITING FOR SCIENCE

There has been extensive research indicating that the transition from school to university is complex and that students have difficulty trying to reconcile the discursive identities of home, school and university (Ken Hyland, 2002; Roz Ivanič, 1997; Moragh Paxton, 2003, 2007a, 2007b; Lucia Thesen & Ermien van Pletzen, 2006). However we had not realized that local schools had recently started teaching academic literacy practices such as report writing and "referencing" and that the way these were taught conflicted quite markedly with university academic literacy practices.

Students spoke about their experience of writing school assignments for life sciences and geography as being very "free." They reported having had freedom to use any form they liked:

> In geography you could do anything, there were no rules or anything you just wrote like you were writing your own diary … point form, flow chart and mind map …

They were required to write scientific reports at school, but it seemed—from students' accounts—that this involved collecting information from the World Wide Web and cutting and pasting it into the text. Students also reported that in school writing opinions or claims unsupported by evidence were also acceptable. The students were surprised at the fairly rigid genre and discourse of the university research report in the natural sciences and that their lecturers had expected them to "write only facts" and use supporting evidence drawn from the readings or their own graphical and numerical results. The students believed they had been taught to reference at school, yet they had found university referencing practices very different and very rigorous:

> (At school) you didn't have to all the time do in-text referencing, you just had to do like something of a bibliography, we were used to that … like writing which book it comes from.

At school, referencing often meant simply pasting URLs into a bibliography, and there was no need to acknowledge explicitly those whose ideas and words the students were drawing on. In fact, the idea of acknowledging outside sources **in the text** was quite foreign to them.

This research has been transformative for us because it has made us aware of new school-based digital literacy practices and made us more sensitive to the precise challenges facing the students. We recognize that the transition from school to university literacy practices demands new self-understandings and the development of new identities around authorship. The experience of interviewing the students not only made us aware of conceptual difficulties they experience (and their origins), but also gave us a great deal more insight into students' lived experience of schooling and of being new university students, which we believe has made us into more empathetic teachers.

CONCLUSION

The action research project has been important for teaching and curriculum development, and significant changes were incorporated into the curriculum based on the findings of the first action research cycle. We have found that it has been critical to understand the way students are constructing understanding and to get to know their prior practices and discourses so that we can address these in our teaching of concepts and of university literacy practices. Based on the research findings which show that students are confused about some of the quantitative concepts, we have incorporated fuller explanations of these concepts and pointed students to the reasons for their confusion. In addition, the research has highlighted changes in school literacy practices that we were not aware of. It has given us the opportunity, as we assist students in taking on new scientific identities, not only to signal distinctions between school and university discourses, but also to note that the disciplines of mathematics and science call for a particularly rigorous approach to use of language and genre. This is perhaps particularly true in our country which is itself in the process of change and where we, as teachers, have to respond regularly to changing structures and changing discourses.

Thus the collaborative research project has been very useful in informing the on-going development of the curriculum, but has also contributed to our own academic development. The science discipline specialist, through participating in the academic literacy and numeracy workshops, has realized that she needs to embed the teaching of these literacies and concepts in her own teaching throughout her course (which for us would represent the best-practice scenario): she has changed and developed her curriculum accordingly. The science discipline and numeracy specialists have learned the importance of the language they use in conveying conceptual information, while the language development specialist has gained insight into the role played by numeracy in a broader conception of academic literacy.

NOTE

1. We say "a" is proportional to "b" when the variables "a" and "b" are in a constant ratio

with each other. So if the value of "a" is doubled then the value of "b" will be doubled, etc.

REFERENCES

Hyland, K. (2002). Authority and invisibility: Authorial identity in academic writing. *Journal of Pragmatics*, *34*, 1091-1112.

Ivanič, R. (1997). *Writing and identity: The discoursal construction of identity in academic writing.* Amsterdam: John Benjamins Publishing Company.

Kemmis, S., & McTaggart, R. (1982). *The action research planner*. Victoria, AU: Deakin University.

Lea, M. (2004). Academic literacies: A pedagogy for course design. *Studies in Higher Education*, *29*(6), 739-756.

Lea, M., & Street, B. (2000). Student writing and staff feedback in higher education: An academic literacies approach. In M. Lea & B. Stierer (Eds.), *Student writing in higher education: New Contexts* (pp. 32-46). Buckingham, UK: Open University Press.

Lillis, T., & Scott, M. (2007). Defining academic literacies research: Issues of epistemology, ideology and strategy. *Journal of Applied Linguistics*, *4*(1), 5-32.

Morrow, W. (2009). *Bounds of democracy: Epistemological access to higher education.* Pretoria: HSRC Press. Retrieved from http://www.hsrcpress.ac.za/product.php?productid=2254&freedownload=1

Paxton, M. (2003). Ways in which students gain access to university discourses: The intersection of the academic curriculum with student voices. In C. Prichard & P. Trowler (Eds.), *Realizing qualitative research into higher education* (pp. 21-39). Aldershot, UK: Ashgate Publishers.

Paxton, M. (2007a). Students' interim literacies as a dynamic resource for teaching and transformation. *Southern African Linguistics and Applied Language Studies, 25*(1), 45-55.

Paxton, M. (2007b). Tensions between textbook pedagogy and the literacy practices of the disciplinary community: A study of writing in first year economics. *Journal of English for Academic Purposes*, *6*(2), 1-14.

Scott, I., Yeld, N., & Hendry, J. (2007). *Higher education monitor no. 6: A case for improving teaching and learning in South African higher education*. Pretoria: The Council on Higher Education. Retrieved from http://www.che.ac.za/media_and_publications/higher-education-monitor/higher-education-monitor-6-case-improving-teaching

Street, B. (2005). Applying new literacy studies to numeracy as social practice. In A. Rogers (Ed.),*Urban literacy: Communication, identity and learning in development contexts* (pp. 87-96). Hamburg: UNESCO Institute for Education.

Thesen, L., & van Pletzen, E. (Eds.). (2006). *Academic literacy and the languages of change.* London: Continuum International Publishing Group.