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Tutorial teaching to enable undergraduate students to make meaning with mathematics

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The poster reports from a study of teaching in one small group tutorial with first year mathematics students in a UK university. The aim was to characterise teaching that was designed to support students' meaning making in mathematics. The research was developmental in that it contributed to the development of the teaching, as well as the tutor's knowledge in teaching. Two researchers, one who was also the tutor, collected and analysed data in the form of recordings of each tutorial and reflections of the tutor. Analysis was grounded in the data and a theoretical construct, the Teaching Triad, was used to support analysis. Findings showed the tutor taking a questioning approach, seeking to probe students' meanings, but needing to prompt frequently due to students very short and tentative responses. The study points to the difficulties in encouraging students to articulate their mathematical understandings.

Keywords: University mathematics teaching in small group tutorials; teaching triad; teacher questioning; difficulty in students' articulation of mathematics.

INTRODUCTION

In this paper, we focus on teaching in a small group tutorial in the first year mathematics programme at a UK university. We studied 10 tutorials in all and focus here on one tutorial which addressed questions in linear algebra. We are interested in studying relationships between the planning for teaching and teaching approaches, and the responses of students in so far as they gave access to the students' meaning making in mathematics (Jaworski & Didis, 2014). Our three basic research questions are:

1) What is the nature of the teaching manifested in the tutorials?

2) What student meanings can we discern and in what ways?

3) In what ways can we link (1) and (2) and what issues does this raise?

We took a sociocultural approach toward the research, recognising the many factors that underpinned activity in a tutorial, contributed to the interactions between students and tutor, and to mathematical meaning-making by the students. We see that, making connections to the worlds of mathematics and beyond, and processes of socialisation into culture and values are all central to how mathematics is taught and, associated with this, how students make meaning in mathematics.

APPROACHES TO OUR RESEARCH

The tutor (the second author of this paper) planned the tutorials and worked with the students. Her co-researcher (the first author) observed and audio-recorded tutorials and transcribed the recordings. Our conversations we sat together after tutorials were also audio-recorded; capturing the tutor's teaching reflections and our analytical discussion as two researchers. In working on our data we combined a grounded approach with the application of the 'Teaching Triad', a theoretical model which has been used extensively for analyses of teaching (e.g., Potari & Jaworski, 2002).

We read and reread the data, developing a coding scheme and seeking to make sense of the data in relation to our research questions. In addition we explored the nature of the teaching using the Teaching Triad. These forms of analysis were inter-woven to provide a rich characterisation of teaching practice. Our approach was two-fold: (a) reflections on the tutor's discerning of meaning-making in the

tutorial in order to guide the teaching approach; (b) the discerning of meaning making through analysis of tutorial dialogue in order to link teaching with learning.

RESULTS AND CONCLUSION

Analysis revealed many aspects of teaching and ways in which the teaching approaches “in practice” related to the approaches planned. A finer grain of analysis showed that the codes relating to “tutor questioning” were the most prevalent. Through questions, the tutor not only invited and encouraged students’ participation, but also tried to control the mathematical focus of the tutorial. She asked *prompting questions* to invite students to respond and articulate students’ meaning, trying to promote both individual meaning and collaborative meaning of students. The following dialogue illustrates an example of the tutor’s approach.

Tutor: Now, Julia, what is the standard basis in \mathbb{R}^3 ? [*Prompting-Q*]

S: (Julia) A matrix [*SR-short/hesitant*]

Tutor: Is a basis a matrix? [*Prompting & Probing-Q*] [*Mathematical challenge*]

S: (Julia) No [*SR*]

Tutor: Ok, what is a difference? [*Probing-Q*] [*Mathematical challenge*]

S: (Julia) Vectors (*student smiles*) [*SR-short/tentative*]

Tutor: If I asked to write down the standard basis in \mathbb{R}^3 , what would you actually write? [*Prompting-Q*]

Students’ responses were mostly short, tentative and hesitant. This led us to deduce that discerning meaning making was difficult and time consuming. University cultures and practices, in which students are rarely expected to speak their mathematical thoughts or engage in discussion, result in such engagement being uncommon. Therefore, in relating the teaching approach to students’ meaning making with mathematics, we need to address further: (i) what students expect from these tutorials and what their readiness is to deal with the planned teaching; (ii)

what the tutor expects from the tutorial and wants to see from students, and how this can be achieved; and, (iii) what time factors influence the depth of students’ meaning making.

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