

The transition from High School to University Mathematics: Messages interpreted by first year mathematics students

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This paper reports on a pilot study of a project that seeks to investigate the different discourses that surround teaching and learning interactions during the transition to university mathematics. The focus is to study the different messages that first year mathematics undergraduates receive within the university community, how they interpret these messages according to their individual backgrounds and previous experiences and how this facilitates or hinders their transition.

Keywords: transition; messages; mathematics

Introduction

This study was conducted in a large research-intensive university in the midlands of England among ten first year undergraduate students who were attending a module on Multivariate Calculus as a part of a joint degree in Mathematics. The students were interviewed in focus groups and were asked to comment on the various messages they receive in the lectures. I will discuss the ways through which these messages were communicated to the students and the interpretations they made. For the analysis of the messages Bernstein's theoretical work on educational transmissions was employed, more specifically the concepts of classification and framing.

Literature review

Various researchers revealed different views on the secondary-tertiary transition by using different approaches (Gueudet, 2008). The majority of the studies conducted in this area focus on the difficulties that students face during their passage from school to university mathematics. These difficulties have been classified according to their kind. De Guzman, Hodgson, Robert, & Villani (1998) classified them in epistemological/cognitive, sociological/cultural and didactical perspectives.

Clark & Lovric (2008) described the transition from secondary to tertiary education as a 'rite of passage'. The changes that govern this transition have to do with the type of mathematics that is taught in university and the ways that are employed for this teaching. University mathematics puts an emphasis on conceptual understanding, abstraction, proof and reasoning, advanced mathematical thinking and rigorous mathematical language.

Apart from the factors related to the corpus of mathematical knowledge itself, other factors are also important when students are entering university. These include their mathematical background, the academic environment, their study habits, their social environment and the teaching competence of mathematics teachers, as Pongboriboon (1989) states in his research on first-year students at Khon Kean University in Thailand. Furthermore, Pampaka, Williams & Hutcheson (2012) investigated how background social factors interact with students' experiences of

mathematics education practices in order to shape students' learning outcomes during their transition to tertiary level.

Thomas & Klymchuk (2012) report the differences that students identify in university mathematics courses: 77.8% of students reported differences in teaching style and/or the emphasis, 21.4% of the students commented that there was less interaction at university and the 23.4% commented on the fast pace of the lectures.

The pilot study

The research was conducted through observations of the lectures and focus groups with the students. Students' selection was based on accessibility. The observations and the focus groups were preceded by an informal discussion with the lecturer at the beginning of the semester; the lecturer referred to his teaching plan and the ways he expected students to work for this module. In addition I scrutinised the module's webpage where the lecturer was posting various kinds of resources and information about the course.

During the observations I focused on the messages that the lecturer transmitted to his students and kept a record of them. With the term 'message' I refer to a unit of communication intended by the source which produces it for consumption by some recipient or a group of recipients. Messages can be delivered by various means and are distinguished using the terms verbal and non-verbal. A verbal message is an exchange of information with the use of words and a non-verbal message is communicated through actions and behaviours. Messages can be implicit or explicit. An implicit message is a message that is implied or understood but not directly expressed. An explicit message is fully and clearly expressed or demonstrated and leaves nothing merely implied.

Most of the time during the lectures the messages derived from the gaps that the literature recognizes as existing in the procedure of the transition, for instance messages about students' study habits, messages about the didactical approach that the lecturer employs etc.

The focus groups lasted around 30 minutes and students talked mostly about the things that took place in the lectures. Students discussed specific messages that I had observed their lecturer giving them through various ways. Afterwards I tried to see how students interpreted these messages and in what ways they responded. The discussions from the focus groups were audio recorded. The audio recordings were transcribed and the transcripts were used for the data analysis.

Here some of the messages that the lecturer sent out to the students are presented, in addition to the ways that he chose to transmit them. Each kind of message is followed by the interpretations that students made out of it and the ways that they responded.

The concepts of classification and framing help us understand the underlying structures of power and control in educational transmissions. Donnelly reports that classification is "the degree of separation between contents and so gives the basic structure of the curriculum" and framing is "the degree of control within the pedagogical relationship" (Donnelly 2014, 87). More specifically for framing he quotes Bernstein: "the degree of control teacher and pupil possess over the selection, organization, pacing and timing of the knowledge transmitted and received in the pedagogical relationship" (Bernstein, 1975, p. 89). The use of Bernstein's concepts of classification and framing helped in a particular way to illustrate the different kinds of messages that students received during their transition to university mathematics and

their interpretations. With the concept of classification we can make sense of the boundaries created between the different practices that the university actors suggest to the students, explicitly or implicitly. The concept of framing is helpful because it can make apparent the degree of control that certain messages have in teaching-learning interactions; the control can be possessed by both lecturers and students.

All the names used in this paper are pseudonyms to protect the anonymity of the participants.

Results

Messages about learning habits in university mathematics

The lecturer tried to show to his students how university mathematics differs from that at school. He attempted it from the very first lecture by making a presentation under the title: “Tips for (maths) students: What is university about?” At the end of the presentation he quoted the following as useful tips: students should be responsible for their own learning, they should attend all the lectures and tutorials, they should study their notes after the lecture, do all their problem sheets (even if no one is going to mark them), read mathematics textbooks, work with their peers, make sure that they stay on top of their work and that they are not left behind, visit the university’s mathematics support centre, consult their tutors and finally, maintain their enthusiasm for mathematics. The lecturer by making this presentation in the very first lecture and suggesting some tips to the students regarding how university is going to be, is exerting great control which could eventually shape students’ thinking about how to study for a mathematics degree in university.

The students in the focus groups were asked about the presentation and what were the main points they got out of it. The message that Brian gets about university mathematics from this presentation is mostly regarding independence in university:

“He [the lecturer] is saying to you that at school your teachers are always like ... making you, well they are making you do your work, getting it on time but obviously the lecturer can’t chase up each student, so you got to oblige yourself to learning basically.”

The most important message that Ria gets from the presentation is the efficiency of peer working that the lecturer suggests:

“I remember when he said: “Do it with your classmates.” That’s what really stuck to me cause I think that helped me a lot, especially like when you can’t go and see your tutor ... then you can go ask your friends...”

From the students’ responses it is obvious that the control exerted by the lecturer in the presentation transmitted successfully the message about how things work in university and what approaches they should adopt during their studies. Students recognized the difference from school, the independence that characterizes university; though this does not entail that they have followed entirely the tips.

Messages about students’ engagement in the lecture theatre

The lecturer during the lectures is expecting students to do a variety of things. Some of them are taking notes and working on problems. In what follows there are quoted some extracts from the observations of the lectures that make the lecturer’s expectations apparent. Through his actual words he makes explicit the boundaries

between the different practices that he expects his students to follow while they attend the lecture.

Taking notes

By not providing the notes while at the same point he always writes on the board during the lecture there is a strong framing showing to the students that they need to keep notes. More specifically in the sixth lecture the lecturer reminds the students about something taught in a previous lecture and he says:

“Hopefully you have it already written in your notes.”

Another incident comes up in one of the following lectures when a student finds in his note something that was written incorrectly by the lecturer and he mentions it to him. The lecturer wants to make the rest of the students aware of this mistake and he says:

“Someone came to me afterwards... have a flip back in your notes and fix them.”

From the previous excerpts the lecturer tries to make clear to his students that he expects them to take notes while he is teaching. The framing that he puts in his words and practices affects students who eventually perceive the message and try to act accordingly. Though given that his pace is fast during the lectures they try to find a middle ground between his expectation and reality; they struggle when trying to take notes when the lecture progresses at a fast pace.

Students were asked to comment on the things that he expects them to do. Denis thinks that he wants them to do a variety of things during the lectures; keeping notes and following what he says:

“I think he wants us to do a mix of like, it can be quite hard to write everything down and keep up like if you try to write down every word ... you can find yourself getting like a page behind on some things. So I think it is like taking notes that you will be able to look at and understand both... so I think... you don't have to take notes, I think the main part is like keeping up with what he is saying and listening to what he is saying...”

Working on problems

During some lectures the lecturer poses problems to the students. He leaves some time to the students to work on them while he is wandering around in the lecture theatre trying to see how different students work. He encourages them to solve these problems:

“It is something good when you are doing it yourself...”

“Have a look at this and try to modify it [...] I'll give you some time...”

The frequency with which he chooses to implement this practice and his encouraging words transmit a clear message to the students. Paige refers to the times that he gives them tasks to work on:

“...He gives us a couple of questions and then says: just work it through. Meanwhile he walks around trying to help people. So I think that is actually quite good in a way because it kind of forces us to try to understand it before he actually just gives us the answer straight away.”

Nick though considers that this is not enough and suggests that a wider variety of solved examples would be more helpful:

“...it would be better if we did more examples... sometimes when I try to do the problem sheets they are just completely different from what he taught us in the lectures.”

From the aforementioned excerpt and through Nick's interpretation we may conclude that the lecturer gives an implicit message to his students about university mathematics that maybe they do not want to hear; it is not just about regurgitating similar problems but exploring new problems for themselves. The strong framing which is evident from these practices sends out messages to the students about how they can be active participants in the process of learning.

Messages about what students should do when they feel stuck

The lecturer suggests a variety of options regarding what students should do when they feel stuck. He advises them to discuss with their friends, use the mathematics support centre of the university, to ask him, and to have meetings with their tutors. The framing that he puts in each of the suggestions varies.

During one of the lectures the lecturer tried to remind them what they should do:

“If you get stuck there are three, four things that you can do:

- Talk to a friend, mathematics isn't something that you do only on your own
- Tutorial
- MLSC (acronym for the university's mathematics support centre), if you haven't found it do that soon
- You are always welcome to email me”

In this case, through the order of the recommended options he makes apparent what he considers important as the first thing they should do when they feel stuck. It is evident that he frames strongly the cooperation between the students and the framing seems to be weaker when he suggests himself as a source of help. Nevertheless there are moments during the lectures when he invites his students to ask him. For instance he mentioned once while students were working on a problem:

“Feel free to raise your hand if you are stuck and ask me a question, I will wander around.”

Students were asked to comment on all the options suggested by their lecturer for supporting their study when they feel stuck. Although he offers a variety of them, some of the students choose their own way to deal with the difficulties when they do not understand; Dag for instance states that in such cases the first thing he does is to reread his notes:

“Usually when I am stuck in a lecture I ... all I need to do is go home and read over it a lot and if I am still stuck on that I will probably just go online or ask a friend about that... something like that.”

Leonard believes that their lecturer expects them to ask questions but many of them do not feel comfortable doing that:

“I think in the lecture he wants you to ask questions, but obviously not all people feel comfortable doing that... I don't personally, no... Cause it just feels like you are disturbing everyone else.”

Cole hasn't been in the support centre because when he faces difficulties he asks his tutor:

“If anything I would ask Peter (tutor). Just to bring a question to him. Bring a question to this tutorial session.”

The lecturer opens up a wide range of options that students could follow when they feel stuck. He exerts strong framing and this is evident also from students' responses; they choose to ask their tutor or work with their peers when they face difficulties. Nevertheless they do not seem to be comfortable asking him in person. This could be associated with the fact that among the options he suggests this one is listed at the end.

Discussion

In this pilot study I tried to investigate the different kinds of messages that the lecturer sends out to his students through the discourses and the practices he uses in the lectures during the first year of their studies. According to the framing that the lecturer puts in his words some messages can be more evident compared to others. Thus, there are cases that strongly framed messages make an explicit sense about the different approaches that students should adopt for studying mathematics in university. In some cases this can work as a motivation for them. Though sometimes even when the framing is strong and the students perceive and interpret the messages, due to their past experiences, it is hard for them to adopt new practices and ways of thinking in order to facilitate their transition. Hence, the fact that the message is transmitted is not a guarantee for its effectiveness.

The findings of this study are preliminary and more consolidated results are expected through the main study. Nevertheless, these findings give a hint about the extent that the different kinds of messages sent out by the lecturer are important, provided that they can shape the ways students conceive of university mathematics and therefore affect their transitional experience in the Department of Mathematical Sciences. This is a significant aspect of this study given that there is no research so far into the impact of messages that students receive in the secondary-tertiary transition.

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