

Developing “use value mindsets” to enhance undergraduates’ perceptions of learning mathematics in a first-year service mathematics environment

Andrew Potter and Gerry Golding

The Open University

This paper will introduce ongoing scholarship work at the Open University (OU) aimed at better understanding perceptions of level-one (first-year) study on the introductory service mathematics module “Discovering Mathematics”. We are concerned about students’ ability to achieve passing grades without really engaging with the material in depth, and how this lack of engagement might impact their future study. Following Williams (2012), we use the concepts of “use value” and “exchange value” to explore student perceptions of their mathematical study. Using data from tutors’ reflective journals and tutor focus groups, we will analyse perceptions of students through the eyes of their tutors in relation to their mathematical studies over two presentations with a focus on two key assessment points. We hope that our findings from the tutors’ reflective journals will inform the development of a range of context-based activities in the learning environment that facilitate the development of use value mindsets.

mindset, service mathematics, use value, exchange value, undergraduate

Introduction

Service mathematics can be described as the study of mathematics within another discipline, for example, science, engineering, computing or business. In most traditional universities this type of mathematics is delivered within specific contexts such as engineering mathematics or science mathematics. In the OU, however, we deliver a large proportion of service mathematics through mathematics modules. For the purpose of our research we focus on one such module.

Discovering Mathematics (MU123) is a pre-calculus level-one undergraduate module delivered over a 31-week period with presentation starts in October and February, worth 15 European Credit Transfer System (ECTS) credits. We have approximately 3,800 students and 150 tutors over both presentations and currently approximately 60% of the students are on a computing & information technology pathway, 15-20% are on a mathematics specific pathway, 10% are studying economics and business, with the remainder spread across education pathways and the open degree.

Teaching model

The OU teaching model is a supported independent distance learning model. There is a dedicated academic module team supported by a curriculum manager that oversees the running of the module, writing of assessment, and monitoring of the tuition. Students are sent the learning materials in hard copy. The module has its own virtual

learning environment (VLE) where the students are given access to soft copies of materials, extra computer resources, a study calendar, a student forum and the assessment materials. Students are allocated to a tutor, based primarily on their geographical location, in group sizes of approximately 20. The tutors mark assignments, deliver tutorials, and offer individual support sessions if required. The assessment comes in the form of 8 coursework assignments and an end-of-module assessment. The marking of assignments is undertaken by correspondence tuition. The module has consistently performed well from both a retention and progression point of view for the past number of years – so what is the problem? Our concern is that the scores that students are achieving may be masking a deeper problem.

MU123 is designed to cover a broad range of mathematical topics, from basic arithmetic skills through to more advanced topics in algebra, trigonometry, logarithms and exponential functions. Students who register for the module come from varying levels of mathematical ability. Those with more competent mathematical backgrounds can often complete the earlier assessment purely from memory and without any need to engage properly with the module materials. This relates to work by Hernandez-Martinez, & Williams (2013) on transitions to university study: in particular, there is a danger that relying on prior knowledge alone, and forming habits of limited engagement with MU123 materials, both inhibit the development of resilience. If they struggle later in the module when their adopted strategy doesn't suffice, they may decide that the effort of reviewing the material they have missed is not worth the time and settle for a lower grade. There is evidence of this occurring when we have looked at grades achieved over the presentation, student engagement with the VLE, and comments from tutors on forums about a general lack of engagement by some students. So, do students fully appreciate the relevance of their level-one undergraduate study? Anecdotally, it would appear that many students just focus on “doing enough to pass”. When level-one study involves mathematics in a service mathematics environment, we believe that students' perceptions of “why they study mathematics” can exacerbate the problem.

Our Objective

To investigate our concerns and to provide a deeper understanding of the issue, we define a “use value mindset” as a frame of mind that endorses the perception of studying mathematics being inherently enjoyable and/or useful to future study and career goals. It promotes engagement with deep conceptual learning and self-gratification – in contrast to the perception of studying mathematics having only a tangible “exchange value”. An “exchange value mindset” fosters a strategic focus on imminent assessment, where passing grades are exchanged for progression and accreditation. Please note that while we are using the word “mindset” to suggest orientation to learning (Blenkinsop, McCrone, Wade, & Morris, 2006), we do not mean to map these mindsets to Carol Dweck's more well-known work on growth and performance mindsets.

Kooken, Welsh, McCoach, Johnston-Wilder, & Lee (2016) define “value” as “the extent to which students find studying mathematics important in attaining their current or future goals” (p.220) and consider it to be a factor which contributes to the development of mathematical resilience. Furthermore, they establish that the value a student places on his or her mathematical studies is a factor in educational success (Deci, Vallerand, Pelletier, & Ryan, 1991). However, Kooken et al. (2016) stop short

of exploring the types of value a student might place on his or her mathematical studies.

Williams (2011; 2012) introduces the idea of “use value” and “exchange value” in the context of mathematics education. Borrowing the terms from Marxian economics, Williams equates the “use value” of mathematics learning with its value as useful to the learner and to society in general. Note that for Williams, “use value” includes the value of learning mathematics as being an inherently enjoyable pursuit, so it should not be thought of as a value which is solely focused on the utility of its applications. On the other hand, the “exchange value” of mathematics learning is equated with its status as a “strong subject”: a passing grade in mathematics can be exchanged for other commodities, such as a qualification, or a desirable career.

The exchange value of mathematics learning can be identified via Bourdieu’s (1990; 1991; 1998) concept of educational capital. In Bourdieu’s view, learning confers the accumulation of educational capital, which can be exchanged for economic capital (e.g. a career) at an appropriate exchange rate determined by social factors. Williams (2012) argues that this theoretical standpoint, while not incompatible with the “use value / exchange value” model of educational value, neglects the use value of mathematics learning. Williams (2012) further argues that both use value and exchange value have their place in mathematics education and warns against a theory of education which prioritises one over the other.

We believe that many of the students studying MU123 develop what we have defined as an exchange value mindset, focusing solely on strategic approaches to gaining a passing grade, and failing to appreciate the use value that their mathematical studies may have. It may well be that those students with previous mathematical ability develop this mindset as a result of their perception of the early materials as presenting limited challenge. It may be based on some negative perceptions of the usefulness of mathematics. Our primary objective is to investigate, keeping an open mind, whether our concerns are justified and if appropriate, use emerging evidence to develop suitable interventions that encourage a use value mindset. The intention is to complement, rather than prioritise one mindset over the other (Williams, 2012).

Methodology

Figure 1 describes our methodology which is based on action research. Our initial beliefs are based on anecdotal evidence from tutor forums, assessment scores and general student engagement with the VLE. Tutor reflective journals will form an evidence base on which initial interventions will be developed. After implementation of the interventions, we plan to hold focus groups and use existing student feedback surveys to assess the impact of the interventions. We will continue to revise these interventions until we see evidence that students are engaging more with the module and displaying more of the characteristics of a use value mindset. In this paper, we discuss our method for developing our initial student perceptions through the eyes of their tutors using reflective journals.

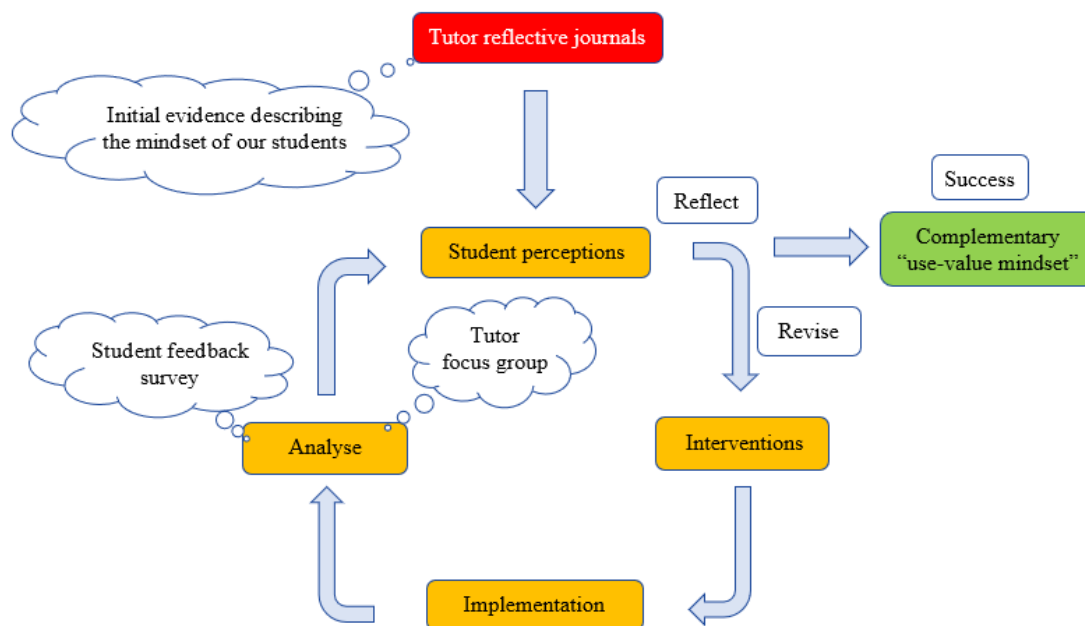


Figure 1: Methodology

Tutor reflective journals

We already have detailed demographic data about our students. What we are looking for is evidence that incorporates aspects such as: what a student wants to get out of the module and how they perceive it in relation to past work, relevance to current undergraduate pathway, and their future career goals. One way of approaching this would have been to interview or survey students directly, but with 3,800 students this posed a problem of practicality. So, at this stage, it was decided that a pragmatic approach would be to combine two resources:

- Students' reports on two strategically placed questions in coursework.
- Tutors' in-depth knowledge of students.

We devised a method based on a traditional teacher journal in which they keep a rolling profile of their students in preparation for school reports and parent-teacher meetings. The tutors were asked to keep a reflective journal of each of their students throughout the module with a key focus on students' answers to reflective questions posed during their coursework. These reflective questions were designed to build resilience and help students transition to university-level study (Hernandez-Martinez, Williams, & Farnsworth, 2011). In their first assignment, students are asked to briefly describe their reasons for studying the module and to reflect on factors that might influence their work. In their final assignment prior to the end-of-module assessment, they were asked to reflect on how their studies so far fit in with their wider study interests and future study plans. Tutors were asked to use their experience and personal judgement to assess if the students' responses to these questions was reflected in the students' engagement with the module materials, in their presentation of their work, in any specific interactions between the tutor and students outside of the normal support involved in correspondence teaching, and their perceived general

attitude towards study: did they come across as being proactive and/or enthusiastic about their learning, or was there a sense of doing just enough to pass with minimal effort?

We enlisted the help of five tutors. To ensure that we have a broad representation of our student cohort, we chose a tutor from each of the four nations; Ireland, England, Scotland and Wales. The fifth tutor was chosen from the remaining tutors who teach across both the February- and October-start presentations. Each tutor has a group of approximately 20 students giving us a total of 200 students across both presentations. All five tutors are female, which is a limitation of our methodology we have had to accept based on the demographic of our tutor cohort, willingness to participate, and who teach on both presentations. We have made the assumption that the tutors themselves are not systematically biased in a way that will affect the final student profiles. The tutors will attend a recorded online focus group meeting in January, before the start of the second presentation of the module, to discuss their initial experiences of keeping reflective journals with us so that we can refine the process for the second presentation if deemed necessary.

The tutors will submit their anonymised reflective journals soon after the completion of the final coursework. Thematic analysis will be used to distil the 200 tutor profiles into approximately 10 broader profiles that give us a representative picture of our students' perceptions of the module and its relevance. We will share our findings initially with the five tutors in a second focus group to discuss our interpretation of their reflective journals and seek any refinements. Each tutor will be paid for their time spent completing the reflective journals and attending the focus groups.

Application

We will share these student perception profiles with the wider module team and colleagues from other schools that use MU123 as a service mathematics module. We have had some initial discussion about potential interventions, and we will use these profiles to make initial refinements.

Potential interventions

- Life after MU123 seminars: online recorded seminars with former MU123 students or tutors from the schools that use MU123 to give the students an opportunity to learn about how the mathematics is used in their discipline.
- Post-Christmas online activities: there is a fear that it may be difficult for some students to self-motivate after the Christmas break, especially when there is no assessment due. Having some activities that require student engagement may help.
- Forum activities for different pathways: having context-specific forum activities that encourage students to work on context-specific mathematics problems which are more challenging than MU123 presents.
- New context-based streams through the module: review the learning outcomes to provide the possibility to introduce new streams that allow students to study more appropriate material based on their study intentions.

Discussion

This paper describes the initial work that has been done to set up our methodology and engage our tutors in the collection of data through tutor reflective journals. We are aware that the data that we expect to gather from these tutor reflective journals leading to student perception profiles may not be what we initially expected to find and that is why we have taken an action research approach enabling us to reflect and refine as we learn more about our students.

References

- Blenkinsop, S., McCrone, T., Wade, P., & Morris, M. (2006). *How do young people make choices at 14 and 16? National Foundation for Educational Research Report* [online]. Available from: <https://core.ac.uk/download/pdf/4156060.pdf>.
- Bourdieu, P. (1990). *The logic of practice*. Oxford: Polity Press.
- Bourdieu, P. (1991). *Language and symbolic power*. Cambridge: Polity Press.
- Bourdieu, P. (1998). *The state nobility: Elite schools in the field of power*. Chicago: Stanford University Press.
- Deci, E., Vallerand, R., Pelletier, L., & Ryan, R. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist*, 26, 325–346.
- Hernandez-Martinez, & Williams, J. (2013). Against the odds: resilience in mathematics students in transition. *British Educational Research Journal*, 39(1), 45–59.
- Hernandez-Martinez, P., Williams, J., & Farnsworth, V. (2011). Supporting students in their transition to university mathematics. *Proceedings of the British Society for Research into Learning Mathematics*, 31(2).
- Kooken, J., Welsh, M. E., McCoach, D. B., Johnston-Wilder, S., & Lee, C. (2016). Development and validation of the mathematical resilience scale. *Measurement and Evaluation in Counseling and Development*, 49(3), 217–242.
- Williams, J. (2012). Use and exchange value in mathematics education: Contemporary CHAT meets Bourdieu's sociology. *Educational Studies in Mathematics*, 80(1/2), 57–72.
- Williams, J. (2011). Looking back, looking forward: Valuing post-compulsory mathematics education. *Research in Mathematics Education*, 13(2), 213–221.