FIRST YEAR STUDENTS' MATHEMATICS LEARNING EXPERIENCES AT THE NATIONAL UNIVERSITY OF IRELAND MAYNOOTH

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Biographical Note

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ABSTRACT

This paper considers the factors that impact on student success in first year science mathematics courses at the National University of Ireland Maynooth (NUI Maynooth). These factors include previous performance in the subject, attendance at lectures and tutorials, the number of assignments submitted, and attendance at the Mathematics Support Centre (MSC). The results of this initial study will be used to identify behaviour patterns that lead to successful completion of first year courses. The findings will help mathematics departments to target support initiatives in areas which are most likely to improve student learning.

INTRODUCTION AND RATIONALE FOR THE PROJECT

The aim of this research is to determine the factors that impact on assessment grades in a first year mathematics course for science students. The factors that we will consider are: Irish secondary school Leaving Certificate (LC) grades in mathematics; diagnostic test scores; tutorial and lecture attendance; attendance at the Mathematics Support Centre (MSC); and homework submission rates. The motivation for this study is twofold. Firstly we would like to be able to identify students who are at risk of failing, so that we can offer them timely and appropriate support. Secondly, we would like to know whether the supports offered by the mathematics department at NUI Maynooth are successful. The department invests a lot of its resources in providing student support, and many of these resources are targeted at first year students. This is true of most mathematics departments in Ireland, and the last few years have seen an increase in the supports available. It seems sensible therefore to try to determine the most successful types of support.

Many Irish third level institutions have opened mathematics support or learning centres over the last ten years (Gill et al, 2008). The MSC at NUI Maynooth opened in the academic year 2007/08. It operates as a drop-in centre which is open for eighteen hours per week for twenty-four weeks of the year. It is staffed by a manager and a group of experienced tutors. In its first year of operation, there were 2493 visits by 273 students. In its second year, these numbers increased to 4647 visits by 509 students. Research on the centre at NUI Maynooth (Mac an Bhaird et al, 2009) has shown that students who attend have a higher probability of succeeding in mathematics modules than those who do not attend. Similar results have been found in studies of other support centres (Croft, 2008).

Of course, support centres are not the only resource available to students and are not the only factor determining success. In a study of first year engineering students at Loughborough University, Symonds (2008) showed that lecture and tutorial attendance, diagnostic test results, as well as mathematics support centre attendance were significant predictors of success in mathematics modules. At the University of Limerick, Liston and O'Donoghue (2009) found that success was related to affective variables such as attitude to mathematics, enjoyment of mathematics, and mathematics self-concept. Their study also reported that measures of previous mathematical achievement such as Leaving Certificate grades and diagnostic test results were good predictors of final examination scores.

THE STUDY GROUP

This paper investigates the effect of a number of variables on the mathematics grades of the first year science class at NUI Maynooth for the year 2008/09. It considers the 267 students who sat the summer examinations. Of these students, 35% had taken higher level mathematics at Leaving Certificate, 63% had taken ordinary level mathematics and 2% had not taken the Leaving Certificate examination. Mathematics is a compulsory subject for these students and only about 10% wish to study the subject to degree level.

METHODOLOGY

A diagnostic test is administered to all first year mathematics students during their first week in the university. The test assesses basic mathematical skills, and the department uses the results to identify students with weak mathematical backgrounds. These students are offered additional help in the form of an online course and a weekly workshop. In the year 2008/09, 27% of the class were deemed to be at-risk of failing first year mathematics.

Each first year mathematics student is assigned to a small group tutorial. These tutorial groups meet twenty times in the academic year and attendance is recorded by the tutor. Students are required to submit a weekly assignment which is graded by the tutor. These assignments count for 25% of the module marks. Over the course of the year, the students study four mathematics modules. In the year 2008/09, lecture attendance at one of these modules was recorded by the lecturer. This module was on integral calculus and is considered the most difficult of the first year modules.

Students were asked to inform us of their Leaving Certificate results during the first week of term. The final first year subject marks were obtained from the departmental administration. Attendance at the MSC is recorded by a dedicated staff member, and all figures are compiled by the MSC manager.

RESULTS

The median number of tutorials attended by students was fifteen (out of twenty). Approximately 22% of students missed no more than one tutorial. The median number of lectures attended was sixteen (out of twenty-four). The majority of students handed in most of their assignments. The median number of assignments submitted was 17.5 (out of twenty) and 18% submitted all assignments. Almost 61% of the group attended the MSC at least once, and of these 84% returned.

A regression analysis, a common statistical tool, was carried out with the final subject mark (out of 1000) as the dependent variable and with Leaving Certificate mathematics points (LC points), Leaving Certificate mathematics level (LC level), diagnostic test results, lecture attendance, tutorial attendance, number of assignments submitted, and MSC attendance as independent variables. Table 1 shows the Pearson correlations between these variables. (Here * denotes that the correlation is significant at the 0.05 level).

Table 1: Table of Pearson Correlations

	LC Points	Diagnostic Test	Lecture Attendance	Tutorial Attendance	Assignments Submitted	MSC Attendance
Final Mark	0.68*	0.6*	0.4*	0.48*	0.64*	0.26*
LC Points	1	0.73*	0.05	0.14*	0.26*	-0.08
Diagnostic Test		1	-0.003	0.11	0.25*	-0.16*
Lecture Attendance			1	0.55*	0.59*	0.34*
Tutorial Attendance				1	0.74*	0.32*
Assignments Submitted					1	0.28*

All of our independent variables are positively and significantly correlated with the final subject mark. The diagnostic test results and the LC points are highly correlated. This is not surprising since both of these variables measure students' mathematical background. Both of these variables are negatively correlated with attendance at the MSC. It may be that students with a strong mathematical background have fewer problems in first year mathematics modules and therefore visit the MSC less often than those who are struggling.

A stepwise regression was carried out and the predictors in the final model were LC points and level, diagnostic test results, MSC attendance, and number of assignments submitted. The model excluded the number of tutorials and lectures attended. The R-square for this model was 0.772, which suggests that the model variables account for 77% of the variance in the final subject mark. The regression equation is:

Final Mark = -89.79 +3.195 (LC Points) +84.106 (LC Level) +2.51 (Diagnostic test) + 19.108 (Assignments submitted) +6.144 (Attendance at MSC).

Note that LC Level was coded 0 for students who had studied mathematics at ordinary level and 1 for higher level. From this equation, we can see that if all other variables are held constant then a student with higher level mathematics at Leaving Certificate would be expected to score eighty-four marks out of 1000 more than an ordinary level student. It also seems that each visit to the MSC adds six marks out of 1000 to the student's final mark and each assignment adds nineteen marks.

CONCLUSIONS

The mathematics department provides learning support to students both through its tutorial and homework assignment system, and through the Mathematics Support centre (MSC). From our study, we can see that these resources are being used by the first Science group. Indeed attendance at tutorials and lectures is relatively high when compared with other similar studies (for example Kirby and McElroy, 2003). Attendance at the MSC is considered good, with 61% of our group attending at

least once. This figure was dramatically up from 32% the previous year.

Our regression model showed us that the significant predictors of success could be divided into two groups: mathematical background (LC level, LC points and diagnostic test result); and measures of student engagement (number of assignments submitted and number of visits to the MSC). Since attendance at the MSC is purely voluntary, the number of visits can be thought of as a measure of a student's engagement and effort. Unlike studies carried out by Symonds (2008) and Kirby and McElroy (2003), our model did not include lecture and tutorial attendance as significant predictors of final grade. This does not mean that attendance at lectures or tutorials is unimportant. Recall from Table 1 that these variables are highly correlated with the number of assignments submitted and the number of visits to the MSC, and this may be the reason why the final model did not include them. It may be that the experience of attending a lecture or tutorial is a passive one for some students. The lecture group is very large and this makes it difficult for lecturers to foster active learning. On the other hand, working on an assignment or visiting the MSC requires the student to take responsibility for their own learning. This act of taking personal responsibility is vital in our opinion.

Our study leads us to believe that in order to identify at-risk students we need to look not only at the students' past mathematical achievement but also at their level of engagement with the subject. The results also suggest that supports that foster active rather than passive learning are beneficial. We plan to carry out a further analysis of our data to refine our model and we are in the process of interviewing students in an effort to ascertain which supports help them the most.

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