What type of student avails of mathematics support and extra mathematics initiatives?

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Abstract: Most mathematics support initiatives aim to help struggling or at-risk students. However, studies show that students who avail themselves of mathematics support vary both in terms of their ability and their reasons for seeking extra support. It is also well known that a considerable number of at-risk students do not avail themselves of support services. To provide efficient and effective supports it is important to have a description of the type of students attending or not attending and the reasons why. We present an overview of the initial findings of two research projects on these topics. We will discuss preliminary findings from a study of repeat and non-repeat mathematics students which suggests several reasons (not necessarily related to ability) why students do not avail themselves of mathematics support. We will also present evidence that at-risk first year students are more likely to attend the Mathematics Support Centre than students who are not deemed to be at-risk. However, a significant minority of at-risk students do not avail themselves of the supports offered.

1. Introduction

The Mathematics Support Centre (MSC) at the National University of Ireland Maynooth (NUIM) is now in its third year of operation. The MSC was originally set up in order to provide support for at-risk students. The MSC is one of many supports in place to help students if they experience difficulties; others include weekly small-group tutorials, graded assignments, online courses and follow up workshops.

In the academic year 2007/2008 the drop-in centre had 2493 visits from 273 students. In its second year (2008/2009) there was a 93% increase in the number of visits to 4647 visits from 509 individual students. To date in 2009/2010 (with two weeks of operation remaining) there have been 6474 visits from 590 students.

As a result of initial investigations by Mac an Bhaird and O'Shea (2009) into the operation of the MSC evidence emerged to suggest that a small minority of at-risk students were not availing themselves of the supports and that students, other than at-risk students, were using the centre also. In this paper we will focus on first year students. We will present evidence which shows that the majority of first year students who attend the MSC are at-risk students. We will also discuss investigations into the possible reasons why first year students do not avail themselves of support. Several themes have emerged including fear, lack of awareness of the details of support services, embarrassment etc. This is also reported upon in more detail in Grehan et al

(2010). In this paper we will focus on their apparent lack of awareness when compared to their counterparts.

The dramatic increase in numbers attending the MSC has put the service under severe strain and the results and implications of our research are crucial to making our service more efficient and effective.

2. Related research.

Some recent research by Patel and Little (2008); Dowling and Nolan (2006) and Lee et al. (2008) highlights the benefits of mathematics support to students with weak mathematical backgrounds.   Mac an Bhaird et al. (2009) discussed the impact of the MSC on the grades of first year students. In addition, Pell and Croft (2008) and MacGillivray (2009) have reported on the use of support services by students with strong mathematical backgrounds. Ryan et al. (2001) and Hannula (2006) have found that the fear of showing a lack of knowledge or ability negatively impacts on students' willingness to ask questions. This fear factor and many other reasons were also identified in a study of students at Loughborough University by Symonds et al. (2008).

3. Methodology

The data collected and analysed on the type of student who takes advantage of support comes from MSC attendance and registration forms, students' second level grades and Department of Mathematics diagnostic tests and end-of-semester exams. The data was analysed using SPSS.

The data presented on the reasons why students do not take advantage of support was collected from anonymous questionnaires and follow-up interviews. In October 2009 39 students who were repeating first year mathematics modules were identified, contacted and invited to participate in the study. Twelve students agreed and they were asked to complete a short questionnaire concerning their first year mathematical experiences. Seven of these students were also interviewed. The transcriptions were coded using grounded theory, Strauss and Corbin (1990). In February 2010, we contacted students who had passed first year mathematics modules despite having similar mathematical backgrounds to the students who had failed. Nine of these students were interviewed. The most recent interviews have not been completely analysed to date but initial findings will be reported on here.

4. Results

4.1 What type of student avails of support?

We consider the composition of the first year student groups that took advantage of the MSC drop-in services in 2008/09. The overall breakdown of attendances for 2007/08 was very similar and the breakdown for 2009-2010 is not yet available. In the year 2008/09, 54% of visits were by first year students registered for a mathematics module with the Mathematics Department. This group consists of Science students, for whom mathematics

is compulsory, and Arts and Finance students who have chosen to study Mathematics as one of their three first year subjects. For the sake of brevity, we will refer to the Arts and Finance group as the Arts group, since they take the same modules. The remainder of visits is made up of second year and third year mathematics students and students who were not registered for a mathematics module or by a small group of students who were taking a pure mathematics module; a more complete analysis is available in Mac an Bhaird and O'Shea (2009). There is evidence that the MSC is being used by students who are not registered for a mathematics module. Many of these students are studying Engineering, Psychology, Geography, Sociology and Economics. Since we do not have access to these departments' records, we will not be able to include these students in the analysis that follows.

Table 1 shows the percentages of 1st year groups who attended the centre. It is clear that there has been a huge increase in the percentage of students attending. The increase in the attendance rates of the first year students is encouraging.

Groups	2007/2008	2008/2009
First Science	32%	61%
First Arts	34%	55%

Table 1: Percentage of 1st year groups attending the MSC.

We decided to consider the number of visits made by students from each group. Note that we did this for all year groups and the pattern of visits was not uniform, for example second arts students attended more regularly on average than the other groups, which is not surprising as they are a highly motivated group and usually do not fit into our at-risk category. We only considered students who took the final examinations and the data is reported in Table 2. In this table we consider the percentage of the group who made no visit, one visit, two to five visits etc.

Group	n	0 visits	1 visit	2-5 visits	6-10 visits	11-15 visits	16-20 visits	>20 visits
First Science	267	39%	10%	25%	12%	7%	2%	5%
First Arts	204	45%	15%	20%	12%	4%	2%	2%

Table 2: Numbers of visits to MSC in 2008/09 by 1st year group.

We then wanted to determine if the MSC was catering mostly to at-risk students.

The Mathematics Department administers a diagnostic test to every first Arts and Science student in the first week of term. This test has 20 questions and students receive 3 marks for a correct answer and -1 for an incorrect answer. Students who receive 20 marks or less are considered to be at-risk of dropping out or failing their examinations. In the Irish Education system,

students take an examination called the Leaving Certificate at the end of their second level education. Mathematics can be taken at Foundation, Ordinary or Higher levels. Only students who have passed Mathematics at Ordinary Level (OL) or Higher Level (HL) may enter university. Students who have studied mathematics at OL are often disadvantaged compared to their peers who have studied HL mathematics. For this reason, the Mathematics Department also considers OL students to be at risk. An in-depth analysis of the breakdown of pass and fail rates within the HL and OL groups is available in Mac an Bhaird et al. (2009). Table 3 shows the percentages of first year students in these at-risk categories who attended the MSC.

Group	Attendance	Leaving Cert Level		Diagnostic Test	
		HL	OL	Pass	Fail
First Arts	Attended >1	48%	54%	53%	73%
	Attended >15	2%	6%	5%	3%
First Science	Attended >1	45%	62%	57%	62%
	Attended >15	1%	8%	5%	7%

Table 3: Percentages of at-risk first year groups attending the MSC in 2008/09

It appears that on the whole the attendance rate for students in the at-risk categories is higher than the rate for the students who are not considered at risk. However the differences are not very big and HL students and those that have passed the diagnostic test are still attending the MSC.

Additional data presented in Mac an Bhaird and O'Shea (2009) shows that in higher years, students who attend are less likely to be at risk, they also attend more often and it appears that they stay longer than the average first year visit to the MSC. For the most part they are students who are seeking higher grades in their exams.

However, it is clear from the data above that there are at-risk first year students who are not attending. This is supported by a similar outcome reported in the end of year (2008/2009) MSC anonymous questionnaire. It was completed by 446 students, 307 had attended the MSC and 139 had not. Amongst other questions, students were asked 'How often do you have difficulties with Mathematics?' and given the options: always, often, sometimes, rarely and never. The majority of students (both attendees and non-attendees) reported having difficulties with Mathematics. There was a significant difference (Fisher exact test, $p < 0.0001$) between the responses of attendees and non-attendees to this question. Attendees reported having difficulty more often than non-attendees. It is reassuring that students with difficulties are accessing support, however, there are a significant number of non-attendees with difficulties; 12% said they always had difficulties; 24% often and 39% sometimes. As the questionnaire is anonymous we can not determine how many of these are at-risk students. However, the following section confirms that some at-risk students are not attending the MSC.

4.2 Why do students not avail themselves of support?

A preliminary analysis of the interview and questionnaire data from the students who failed some mathematics modules in 2000/2009 has shown that the main factors in students' non-engagement with mathematics support were fear, lack of awareness of services, personal difficulties, and lack of personal motivation. Students were also reluctant to ask for help and feared embarrassment. Grehan et al. (2010) focus on the fears that students expressed and how these fears prevented them from engaging with mathematics during their first year at university. We found that this fear manifested itself in four different ways: fear of failure; fear of showing a lack of knowledge or ability; fear of being singled out; and fear of the unknown. Students also displayed a lack of awareness of services or structures within mathematics.

When we compare these comments to the comments of students with similar mathematical backgrounds who had attended the MSC regularly we see a marked difference. It is important to note that the students who failed had almost exclusively not engaged with supports whereas the students with similar mathematical backgrounds who passed had engaged.

The transition from second to third level is difficult for most students, and often they are not sure how the system works. The students who failed seemed to be wary of anything that they did not understand and were unwilling to try anything new. This was particularly true of their reaction to the MSC. Some students expressed reservations about attending when they were not sure what happened there.

> *You know, kinda nervous to go off somewhere you didn't understand, you know you didn't, stuff that you want to (inaudible) strangers of stuff that you did not understand. And you just kind of felt embarrassed about not knowing how everything was working.* **(MSF2 on the MSC)**

> *Then second semester I went to the door, looked in and it was really, really busy and I just thought "hmmm, no!". And I turned around.* **(FFF1 on the MSC)**

If we compare these responses to some from students who attended the MSC and passed first year, there is a stark contrast in their attitude towards support.

> *I thought, you know, that's a really good idea to help people so you're not on your own. 'Cause you know yourself, sometimes if you're struggling with a problem, you just look at a blank page, you know, you have to start something but sometimes somebody can just say, "have you considered this?", and it just sets you off doing the whole thing on your own.* **(MFP1 on the MSC)**

> *Ciarán [MSC Manager] came in our first or second lecture and told us about it. And he told us the opening hours and I took them down straight away. Then after the first week I decided I better go. He said*

there was tutors there, willing to help, willing to help explain stuff and I thought "well, what have you got to lose?" **(FSP3 on the MSC)**

So the difference in attitude towards engaging in support is quite different. There also seems to be a difference in their understanding of the reasons for trying mathematics problems. The students who failed do not seem to understand that you need to try problems to gain a better understanding and that asking for help is part of this process. This clearly ties in with their fear of failure.

> *'Cause I wasn't going to lectures, when I was doing my homework I didn't have a clue so I was just like "I can't go to a tutorial 'cause I won't know how to do...", you know that sort of way?* **(FFF2 on lack of engagement)**

> *If you hand in a bad homework the lecture can focus a lot more on you and you know it will make you feel, not stupid but if you hand in a bad homework, this is me personally, I'd be less inclined to go to the tutorial. I probably, coming back from being a 1st year just coming from secondary school I would have thought as well that if I went up to lecturers and said things, like "I haven't been coming to many of your classes, I haven't a clue what's going on". I would have thought I just be given out to or I dunno, I didn't know what way it worked you know?* **(MSF3 on lack of engagement)**

Students who engaged with support had significantly different responses.

> *It's fundamental, how can you learn anything if you're not gonna get help with it? I mean, you can improve on your own and I must say, when you're stuck on a problem and you solve it yourself it's a wonderful feeling. But unfortunately, it's all too rare.* **(MFP1 on engagement)**

> *No, like I'm one of few people who don't mind doing that, but like, most people wouldn't be like that, most people would not put up their hand and say, "that makes no sense! "You can't put a value on how important that is because if you don't seek the help then, you know, you're [in trouble], you're just digging a hole for yourself." They're too embarrassed that someone's gonna look at them and say, look at them like they're an idiot, whereas my attitude was, well I don't care if they think I'm an idiot. As long as they help me at the end of the day, I'll put up with that!* **(FSP3 on engagement)**

So there is a clear difference in the attitudes and behaviour of the two groups of students and a more in-depth analysis is underway. It is important to note that these attitudes do not appear to depend solely on ability. Some of the students who failed do not fall into our at-risk category.

5. Conclusions

Our analysis to-date has shown that the MSC is very well attended by all year groups and also by students who are not studying mathematics. The at-risk students in first year have good attendance rates as do the high achievers from the senior years. This shows that the centre is not viewed as a 'remedial mathematics' centre, but as a resource for the entire student body. However, a considerable number of at-risk students still do not avail themselves of support. Initial analysis of the interview and questionnaire data has shown many reasons for this lack of engagement and this requires much more in-depth investigations.

Analysis of the data allows us to tailor supports to the specific needs of different groups. For example, we have started a pilot mentoring system for students who are at risk and the Department of Mathematics sends out letters to all students who fail their module to encourage them to come and talk about their issues. A review of these initial interventions will take place in the summer 2010 to decide if they should be adapted on a wider scale.

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