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Promoting Student Engagement with Mathematics Support

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Abstract

This paper reports the findings of qualitative research undertaken to seek to identify the key reasons why some students are not engaging with mathematics support provided by Loughborough University. The research involved a number of focus groups and "on the spot" interviews with 'non-users' from across the campus. Barriers identified include a lack of awareness of the location of support and a fear of embarrassment. Further interviews were conducted with regular users of the support in an attempt to understand how some of these barriers to usage might be overcome. The paper will discuss actions that may be taken to improve student engagement with mathematics support and the issue of how student motivation may effect such action.

1. Background

It is widely accepted that there has been a decline in the mathematical preparedness of students on entry to universities in the UK and that many students embarking on a degree course lack some basic mathematical skills [1,2]. A strategy adopted by many universities to respond to this is the establishment of a mathematics support centre, whereby learning support is offered to students, which is additional to that provided by their normal teaching. In 2004, Perkin and Croft [3] found that 66 out of 106 universities questioned provided mathematics support.

At Loughborough University mathematics support is offered by the Mathematics Learning Support Centre (MLSC). It provides a wide range of support mechanisms including one-to-one support on a drop-in basis, paper-based handouts and computerbased material. Due to the MLSC's success in supporting students and similar work at Coventry University, both Loughborough University and Coventry University were jointly awarded Centre for Excellence in Teaching and Learning (CETL) status in 2005. A new centre, **sigma**, has been established between the two universities and the funding that the CETL award brings is currently being used to expand and enhance the provision of mathematics and statistics support.

2. Introduction

The MLSC at Loughborough University is highly valued by staff and students and recognised as an integral part of the University [4]. The success of the MLSC is evident from its popularity amongst students, with 3926 visits recorded in 2005/6 [5]. However, analysis of recent MLSC usage data has revealed that a large proportion of Science and Engineering students who need mathematics support are not using the centre. In particular, data from 2005/6 reveals that of 626 Engineering and Physics students taking a first year mathematics module, 96 failed at the first attempt. Of those who had failed,

it was found that over 90% (or 87 students) had never, or very rarely, accessed the extensive support available via the MLSC. Support provided by the MLSC requires students to be *proactive* and take the initiative in accessing the support available. Consequently, if students are unaware of their weaknesses or lack motivation to seek support, then the support will remain unused. Therefore, it is essential that the reasons behind the lack of uptake of support are identified so that appropriate action can be taken to improve it.

This paper will describe a study conducted in the academic year 2006/7 which sought to identify the reasons why these failing students do not use the MLSC. It will give details of the study itself including the participants and the methodology used. Data from the focus group and interviews will then be analysed and the results of these will be discussed in detail. The paper will then use these findings to suggest possible action to improve the lack of uptake of support.

3. The Study

3.1 Methodology – Phase 1

In the first stage of this research, undergraduate students taking a Science, Technology, Engineering or Mathematics degree at Loughborough University who had failed a mathematics module during their first year (in 2005/6 and 2006/7) *and* who had never or rarely used the MLSC were targeted. 179 students met these requirements and were contacted via e-mail (on three separate occasions). Seven students responded, and they were interviewed individually, in a group setting or via a focus group. All sessions were led by one of the authors of this paper, Symonds, and the discussions were recorded using a digital voice recorder.

To obtain additional data, "on the spot" interviews were conducted with a variety of students across the university campus. Students were recruited on three separate occasions and from two locations, namely the Students' Union and the campus library. 85 students (who had a mathematical component in their course) were questioned in this manner, of which 10 met the original requirements (and so were part of the 179 targeted students). Of the remaining 75 students, 60 had never or rarely used the centre but had passed their mathematics module, two had used the centre but failed their mathematics module and 13 had used the centre and passed their mathematics module. For all 85 students, their responses were recorded in writing by the same author. It should be noted that in the same manner as above, the students were free to give entirely open responses and were not asked to choose from a list of options based on the reasons given by other students.

3.2 Methodology – Phase 2

The second stage of the research was conducted in a similar manner. Students who were identified as being regular users of the centre in 2006/7 *and* who had failed a first year mathematics module were targeted. 105 students met these requirements. However, 27 of these students were no longer studying at Loughborough University. The remaining

78 students were contacted via e-mail, and nine responded.

A further eight participants were recruited by approaching students in the MLSC on several occasions. The seventeen students were interviewed individually (by the same author, Symonds) and all sessions were recorded using a digital voice recorder. In the second phase of the research the regular users were approached with the list of reasons given by the non-users and asked specifically whether any of these reasons had initially prevented them from using the centre and, if so, how they had overcome this barrier.

4. Barriers preventing students using the centre

Analysis of the Phase 1 data reveals that a number of factors may have contributed to the lack of uptake of mathematics support by failing students. These reasons are summarised in Table 1 below. Note that in terms of the responses from the Focus Group and interviews, many students gave more than one reason to explain why they had not used the available mathematics support. Since these sessions lasted considerably longer than the "on the spot" interviews, the students had more time to discuss and think about these reasons. Only a small number of students from the "on the spot" interviews gave more than one reason; this was probably due to the more constrained nature of these interactions.

	Total number of responses (77)			
Reason	Focus Group / Interviews Non-user and failed (7)	"On the spot" Interviews		
		Non-user and failed (10)	Non-user and passed (60)	Tot.
Lack of awareness of the location of the MLSC	4	2	21	27
Lack of awareness of the facilities available in the MLSC	1	3	17	21
Lack of awareness of the need of mathematics support	5	3	10	18
Too many problems that need addressing	2	0	0	2
Fear of embarrassment / intimidation / demoralisation	6	4	10	20
Mathematics support perceived as not appropriate for non-STEM* students	0	0	8	8

* STEM covers science, technology, engineering and mathematics

Table 1: Reasons given for non-use of the MLSC

It can be seen that some of the barriers preventing students from using the centre are relatively 'simple', for example a lack of awareness of the location of the MLSC. However, there also appear to be more complicated issues that act as a barrier. A more detailed discussion of these reasons will now follow, accompanied by illustrative

quotes.

4.1 Lack of awareness of the MLSC's location and its facilities

As can be seen from Table 1, the greatest number of students (27 in total) felt that their lack of awareness of the location of the centre was a significant barrier that had prevented them from using the support. Although advertising helps to promote an awareness of the MLSC, it is the lack of knowledge of the location of this support that is preventing some students from accessing its services.

"I wasn't aware of where it was...I did ask a few people in my year and they were like 'Oh, I'm not really sure'... because I don't really think a lot of people come."

In addition, a notable proportion of the students questioned expressed that they had not used the centre because they lacked an awareness of what support facilities were available. Such students were unsure of how the support was delivered and whether this was relevant to their individual needs.

4.2 Lack of awareness of the need of mathematics support

For some students, the barriers, which had prevented their lack of engagement, are more complex. It appears that many students are failing to either monitor or direct their own learning and, consequently, students are unaware that support is needed. This was commented upon by eight out of the 17 students who had failed, which suggests that students are not aware that they may be 'at risk' of failing the mathematical component of their degree. This was also commented upon by 10 out of the 60 students who had passed the mathematical component of their degree. Although these students were successful, in terms of the mathematics, they expressed that they had only started 'learning' the mathematical material during the revision period. Consequently, the students felt that they could have achieved a much higher grade if they had applied more effort throughout the year.

From the focus group and interview data it appears that students are not aware of their problems because of two main factors. The first being a lack of motivation by the students. In particular, some students are failing to attend their lecture/tutorial sessions and, furthermore, they do not complete the work in their own time.

"I would say I didn't really come here [the MLSC] because I didn't really do the problem sheets, so I didn't know I had problems."

A second factor is that students are failing to manage their time effectively in order to cope with the demands and workload of their courses. For some students, mathematics is perceived as a lower priority than the other modules on their courses.

4.3 Too many problems that need addressing

Since some students are failing to monitor and direct their own learning, students become overwhelmed by the amount of module material. From the data, two students in particular felt that they had failed to grasp basic mathematical concepts and as a result the number of problems and their general lack of mathematical understanding increased. Consequently, they felt that they had too many problems to address, which could not be solved in one visit to the MLSC.

"I think it was more just I'd come and have so many questions because it was more than one thing I had a problem with. So I didn't really fancy camping out here [the MLSC]."

The data suggest that the students perceive the MLSC as a 'quick fix' to their problems as opposed to a long-term solution in supporting their lack of mathematical competency.

4.4 Embarrassment, intimidation and demoralisation

An additional barrier that prevented 20 of the students from using the MLSC was feelings of embarrassment or intimidation. In particular, this was a significant barrier in preventing the failing students from accessing the support, since 10 out of the 17 students attributed this factor to their lack of attendance. From the focus group and interviews it was suggested by the students that they felt that their mathematics knowledge was inadequate and, consequently, they felt ashamed to ask for help. Other students felt intimidated to ask the support staff for help. There was also a consensus that if students did come and ask for help then they would feel demoralised by the staff.

"The lecturers are just so far and away cleverer than us that I feel a bit small asking them something that is so incredibly easy for them."

Generally the comments made suggest that some students feel particularly daunted by the prospect of asking for help from unfamiliar staff members and feared they would appear 'stupid' or would be mocked by the staff and their peers.

4.5 Perceived to be not appropriate for non-STEM students

Data from the survey interviews revealed that some students from non-STEM backgrounds do not perceive the MLSC as a place where they can obtain support (eight students commented upon this). Such students felt that the help provided is not relevant to their courses, since they perceive the MLSC as a place where students studying 'real maths' can obtain support. This is not the case, since the MLSC provides support for any students across the university.

It is apparent from the above analysis that there are a number of perceived barriers that have prevented some students from accessing the available support. The following section will now consider the perceptions of students who had regularly used the centre.

5. How regular users overcome barriers

To understand how some of the barriers discussed above might be overcome, regular

users of the centre were asked specifically if these barriers had influenced their usage. A discussion of their responses is given below. A summary of their responses is also given in Table 2 (responses given by non users who had failed a mathematics module are given for comparison).

Reason	Number of Regular users (17)	responses Non users and failed (17)
Lack of awareness of the location of the MLSC	5	6
Lack of awareness of the facilities available in the MLSC	14	4
Lack of awareness of the need of mathematics support	2	8
Too many problems that need addressing	2	2
Fear of embarrassment / intimidation / demoralisation	4	10
Mathematics support perceived as not appropriate for non-STEM* students	3	0

Table 2: Comparison of responses given by regular users of the MLSC with non users (who had also failed a mathematics module) of the MLSC

5.1 Lack of awareness of the MLSC's location and its facilities

Few of the regular users (5 out of 17) felt that a lack of awareness of the MSLC had prevented them from using the centre. For the remaining 12 students, this was not an issue since they had already known where it was before they needed to use it. Those from the Mathematics and Physics departments indicated that they were aware of the MLSC's location because the centre is within their department building and so they pass it on a day-to-day basis when attending their lecture/tutorial sessions. Others were aware of its location due to the rigorous advertising of the centre, particularly during the first week of term when the students are introduced to the facilities on campus which may be helpful to their degree.

The five students who felt that they did have to overcome this barrier said that they had actively sought out the MLSC's location - they took the initiative to find the centre. These students regarded themselves as generally motivated individuals and so when they felt the need for mathematics support, they went out to find the centre.

In terms of awareness of the MLSC's facilities and resources, 14 students agreed they had not known such details about the centre before they had used it. However, these students felt that this was not a barrier, since they were aware that some type of support in mathematics was available and this information was enough to motivate them to

investigate the centre.

5.2 Lack of awareness of the need for help

The 17 regular users of the centre were asked if they were ever unaware of their need for mathematics support, which may have prevented them from using the centre at some point. Only two of the students felt this had been a barrier. The responses from the remaining 15 students indicated that these individuals were academically engaged and motivated, since they had attended their lectures/tutorials regularly and had frequently completed problem sheets. This suggests that, unlike the non-users of the centre, these students were monitoring and directing their own learning and were aware of the need for help. In addition, five of the students said that since they had felt weak in mathematics during their prior education, they were aware that they would need support at university and had therefore intended to use the MLSC from the outset.

5.3 Too many problems

For most regular users the issue of having too many problems was not a barrier. There were two students who had at times felt that the amount of problems they were encountering was overwhelming. However, unlike the non-users, this had motivated them to seek out help from the MLSC as they felt that without it they would undoubtedly fail. These students indicated that once they had made their first visit they had felt welcomed to come back with their problems, despite being behind in their work.

5.4 Embarrassment, intimidation and demoralisation

Only four students felt that they had had to overcome feelings of embarrassment before using the centre. They had initially felt intimidated to ask for support but their need for help and the advantages of receiving the support outweighed their misgivings. In particular, such students felt that the pressure of the amount of work and the fear of failure were more important to them than feeling embarrassed. Two of the students also indicated that the encouragement of a friend helped them to overcome such feelings.

The remaining 13 students said that they did not mind asking for help for a number of reasons. Some students were familiar with asking for and receiving extra support from their experience prior to university. Others indicated that they preferred to ask for help from a tutor in the centre, since they perceived the MLSC staff as more friendly and approachable than their own lecturers.

5.5 Perceived to be not appropriate for non-STEM students

Of the 17 students interviewed, only four were from non-STEM departments. Of these four, three students indicated that initially they had felt that the centre was not for them because of their discipline. These students overcame this barrier largely due to encouragement from MLSC staff and friends. In particular, all three students said that a tutor from the centre had advertised the centre during one of their lecture slots,

encouraging students from their department to use the support. It was also indicated by the students that they had felt it was easier to come to the centre with a group of friends, since they provided moral support.

6. Discussion

From student feedback, at face value there are a number of straightforward explanations as to why some students are not accessing the support provided by the MLSC. Based on these reasons, as outlined above, we suggest that the MLSC needs a more extensive advertising campaign to engage students in using the support facilities. In a previous paper [6], possible suggested action to improve the uptake of support included increased advertising via posters, leaflets and lecturer recommendation (particularly within non-STEM departments), actively seeking out students who need mathematics support and recruiting staff members who are familiar to the students (lecturers from other departments, besides Mathematics, and post-graduate helpers).

However, analysis of the responses from the regular users indicates that such reasons had initially prevented a number of these students from using the centre. Nonetheless, these students were able to overcome these barriers in order to avail themselves of the support facilities. This poses the question; would simply implementing the above suggestions be enough to improve the uptake of support amongst failing students?

A common theme that emerged from the analysis of the regular users' responses was that of motivation and engagement. Generally, students who use the centre regularly tend to be frequently attending timetabled lecture and tutorial sessions and regularly monitoring their own learning by completing problem sheets. Consequently they are aware of any mathematics difficulties and the need of support. Indeed, eight out of the 17 students who had failed a mathematics module did not use the centre because they were unaware of their problems. In comparison, only two out of the seventeen regular users of the centre felt that a lack of awareness of their problems had prevented them from using the centre at some point. However, unlike the non-users, once the regular users were alerted to their weaknesses they were motivated to obtain the support required.

In addition such students are motivated to seek help by a desire to improve their performance. These students are aware that they must work hard to achieve their goals; indeed, many aspire to the top grades. Whilst, on one level, all the students interviewed wanted to pass their mathematics module, amongst the non-users of the centre, it appears that their motivation to pass was not enough to make them take action.

In terms of the students who fail to engage with mathematics support and who also fail a mathematics module, it appears that such students lack some form of intrinsic motivation. However, if a student is not intrinsically motivated then it may be possible to provide extrinsic motivation. If such students are provided with an outside influence or reward in order to encourage them to put in more effort then they may be more inclined to engage with mathematics support. Since the external reward of passing the

exam does not seem to be a strong enough extrinsic factor in improving motivation and engagement with the support provided, then we must consider alternative methods of extrinsically motivating students. For example, at Coventry University, incentives such as free calculators were used to encourage students to visit the mathematics support centre. For many students, making the initial visit in obtaining mathematics support can often be a difficult one. Consequently, it was anticipated that if students were encouraged to make the 'first step' they would be more inclined to use the support throughout the year. Therefore, in the first week of term leaflets advertising the centre and containing a voucher for a new calculator were distributed around campus. This was successful in alerting students to the available support and making them discover the location of the centre as 390 students used their voucher in the first two weeks of term.

In light of these findings it is apparent that action needs to be taken motivate students to access mathematics support. Whilst on one level this can be done be implementing relatively 'simple' action, as discussed above, it is believed that a more pro-active strategy may also be necessary. This may involve changing the way in which mathematics is delivered to the students. It is possible that if the teaching methods are changed with a view to motivating students to engage more with the mathematics then this will also foster engagement with mathematics support. Such methods could involve changing the general teaching approach of mathematics at university by introducing student-centred instructional methods, which are claimed to significantly enhance motivation and engagement. For example, Problem-based learning (PBL) [7,8] is an organisation of learning around real world tasks. Students work in small self-directed teams to define, carry out and reflect upon a large multi-layered task, which can often be a 'real-life' problem. Since students see a strong and direct connection between their learning and the real world they are seeking to solve, they are motivated to engage with learning. Not only does this encourage students to monitor and direct their own learning, so that they are aware of mathematical difficulties, it is hoped that they would be motivated to seek out and use the mathematics support available to them when they identify areas of weakness.

Another example of a student-centred approach is Inquiry based learning[9]. As the term suggests, Inquiry based learning is a process of inquiry, which actively involves participants in learning by encouraging discussion, questioning and investigation. This approach helps foster feelings of interest and a desire to acquire knowledge. In a way similar to PBL, extrinsic motivation is fostered by linking task performance to consequences that students value. Within the context of using an inquiry approach, these consequences may be in the form of rewards (such as future success) that are achieved through competition with others.

It is acknowledged that further research is needed to investigate if such action would be successful in motivating students to engage with mathematics support. Our findings suggest that simple actions (such as improved advertising) could bring some improvement in the uptake of support, however, for many students the reasons for not accessing the support are complex and need deeper analysis.

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