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DOI:
10.1080/0020739X.2019.1603407

Document Version
Peer reviewed version

Citation for published version (Harvard):
Grove, M, Guiry, S & Croft, T 2019, 'Specialist and more-able mathematics students: understanding their engagement with mathematics support', *International Journal for Mathematical Education in Science and Technology*. https://doi.org/10.1080/0020739X.2019.1603407

Specialist and more-able mathematics students: understanding their engagement with mathematics support

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Along with a growing body of evidence of the challenges experienced by specialist and more-able mathematics students during their undergraduate studies, there now exists evidence that these students are increasingly accessing mathematics support centres as a means of enhancing their mathematical learning experience. Here we report on a survey of 47 specialist mathematics students, studying within the mathematics department of a large, UK research-intensive university. Our findings show that whilst such students have high levels of engagement with core teaching components, additional, and optional, opportunities for personalised support and dialogue provided by the mathematics department to support their studies are less well used and valued. Friends provide an important source of additional support along with visits to the mathematics support centre. Our data show that users of mathematics support from later years are not necessarily returners, but instead are new to the centre. Whilst many students use the centre only occasionally and as the need arises, there is evidence that others are more regular users and are using the centre as a core part of their mathematical learning experience. The reasons given for their usage are linked to the convenient availability of support, its personalised nature with friendly tutors of a similar-age and subject profile, the ability to use the centre as a group study space to work with friends, and as an opportunity to engage in dialogue about their mathematical learning.

Keywords: mathematics support, peer support, postgraduate tutors, dialogue.

1. Introduction and background

Well-documented challenges exist [1,2] relating to the learning of mathematics by students beginning their undergraduate studies within the UK. Whilst much of the work exploring the issues has focused upon the transition between school and university and in disciplines such as engineering [3] and physics [4], there is an increasing body of literature exploring the learning experience of what we call the *specialist mathematics student*; that is the student who chooses to come to university to study single or joint honours undergraduate mathematics programmes. Croft and Grove [5] provide an overview of the literature in this area and in doing so note concerns in relation to staff-student relationships, the quality of teaching, pedagogic practices and students becoming demotivated as their studies progress. Mathematics support [6], and in particular the mathematics support centre (described fully below), may have had its origins as a means of assisting students who were struggling with their learning of mathematics in engineering, however there is now evidence that specialist, and indeed more-able, mathematics students are also taking advantage of the opportunities that mathematics support offers [7,8]. The work we describe here was undertaken in response to the observed usage of the mathematics support centre in a research-intensive university by the specialist and more-able mathematics student. Our motivation was to answer the following research questions: 1) to what extent is use made of the mathematics support centre by specialist mathematics students? And, 2) what are their reasons or motivations for the usage patterns observed? We begin by considering the context within which this work was situated.

1.1. The undergraduate learning experience of specialist mathematics students

As Solomon [9] notes, many students are motivated to study mathematics at university because they are successful at the subject and find it easy whilst at school or college. They begin their university studies with a positive attitude towards the subject, and whilst for some this positivity will remain throughout, for others their attitudes towards the subject change as their studies progress. Daskalogianni and Simpson [10] refer to this change in student attitudes as '*cooling-off*'. They note that when these 'cooling-off' students begin their university studies the teaching and learning environment they encounter is not only different from that experienced at school or college but that it is also different '*from the one they know how to function in successfully*'. As a consequence for these cooling-off students, the '*experienced mismatch between their beliefs about the nature of mathematics and its rigorous university character soon makes them lose their interest in mathematics and develop a negative attitude towards it*' [10].

In their three-year project examining the progress and changing attitudes of a cohort of single honours mathematics students in two research-intensive universities, Brown et al. [11] identify that one of the factors influencing students' attitudes towards mathematics was success at the subject. They found that amongst those students whose attainment was average and below '*the problems of coping with the work were accompanied by a growing disillusionment with mathematics.*' In general, although as they note not in all cases, they found this to be coupled with a decline in the students' enjoyment of mathematics over time, and identified that this was linked to perceptions of success in the subject: '*When some no longer perceived themselves to be particularly successful, there was little to motivate them to continue studying except a need to maintain self-esteem and gain credentials*'.

Goulding et al. [12] cite evidence from students of the challenge in maintaining an enjoyment of mathematics when they experience difficulties in understanding it, but go on to identify that for '*those students who chose to comment about the university teaching they had experienced, most were very critical of the teachers and the teaching methods, particularly lectures*.' Williams [13] found that students identified lectures at university as intimidating places and were not sure how to learn within them. Brown et al. [11] identify a clear link between the lecture and student perceptions of their success when studying mathematics: '*Students who found they could not follow many of the later lectures in a series and could not do much of the work set, were in no doubt about their lack of success*.' One of the issues most commonly cited by students in relation to the lecture is its lack of interactivity, with Williams [14] going as far as noting that in his research study the lecture '*was observed habitually to become a monologue*'. In their survey of over 400 recent graduates, Inglis et al. [15] report that in relation to the style of university teaching many respondents *'wrote about the need to make lectures more interactive and engaging'*.

Lectures have an important role within the undergraduate mathematics learning experience [16], but they form only one of the teaching and learning approaches that students will encounter. In recent times, universities have offered students increased choice in how, and when they learn with a range of additional opportunities also being made available. Whilst such a 'blended' approach [17] offers students greater choice, it places an increased emphasis upon the students themselves to access the available provision. In exploring the way in which those students studying mathematics, or subjects with a large mathematical component, used three learning resources (attended live face-to-face lectures, accessed online recorded lectures, and visited a mathematics support centre) in a blended learning environment, Inglis et al. [18] found that of the

four strategies that emerged '*none involved making heavy use of more than one resource*'. This not only indicates that students have their own preferred ways of learning, but also that students learn in different ways; as such it is important for a department to provide students with a range of learning opportunities.

We have so far focused upon the challenges encountered by specialist students when learning mathematics at university, however we can also identify from the literature the aspects that contribute to a positive learning experience. A major finding identified by Brown et al. [11] '*related to the extent to which students felt part of a mathematical community'*. This was linked to the availability of a social study space within the mathematics department, near to staff offices, where students could work together, and also because its positioning facilitated interaction with staff since students '*could 'catch' lecturers going to and from these offices, as well as make formal and informal appointments to discuss various concerns*.' The importance of opportunities for dialogue with staff and their peers as part of student learning in mathematics has been reported elsewhere. Williams [14] investigated the experience of students making the transition to mathematical study at university from school or college and as part of the research asked them to rate their opportunities to ask questions and discuss ideas at university compared with school. He concluded that, for those making the transition to university study in mathematics, '*negative feelings are generally associated with a perception of poorer dialogue when students enter university programmes, and vice versa*'. Perhaps more significantly, he also found that '*interactions with lecturers were often fewer and less engaging than students had expected, and this was associated with a negative view of the university experience*'. A second finding emerging from the work of Brown et al. [11] was that '*positive attitudes related to students being able to share their ideas/problems with other students*' and as such indicates the importance of peer

communities. Croft et al. [19] reinforce these findings and found that for some students, it is their peers they first turn to when they require support with their learning of mathematics, and in the survey of Inglis et al. [15] fifteen out of sixteen unsolicited references to peer support referred to its benefits.

There might be a tendency amongst some to consider students who experience the 'cooling-off' effect as 'failing students', however this should not be the case. As Croft and Grove [5] significantly note in their review of the literature these '*are not failing students…many are doing rather well.*' What differentiates those who go on to be successful when compared to those who fail and drop-out is that the successful students develop new ways of working or their own coping strategies [11,20]. Brown et al. [11] note that amongst some who were struggling they '*seemed to lack immediate sources of support and the motivation to seek these out*' and Goulding et al. [12] also highlight students feeling unsupported when struggling with their studies. As we have already seen, peers form an important source of such support.

1.2. Mathematics support and the mathematics support centre

Mathematics support forms a '*facility offered to students (not necessarily of mathematics) which is in addition to their regular programme of teaching, lectures, tutorials, seminars, problems classes, personal tutorials, etc.*' [21]. Whilst it may have originally been aimed at those within the science, technology, engineering and mathematics (STEM) disciplines, it now also forms a means of addressing the 'mathematics problem' observed in a wide-range of disciplines including business and finance, health and biological sciences, and the social sciences [22]. The case for mathematics support in addressing the mathematical challenges of non-specialist students has been extensively articulated elsewhere (see [6] for a comprehensive

overview) and as such is not repeated here.

Mathematics support can take many different forms, however one of the most popular means is that of the mathematics support centre. A mathematics support centre forms a physical location, staffed by tutors, where students can drop in at any time during its hours of opening to receive advice on their mathematical queries. In their most recent review of the extent of mathematics support provision within the UK, Perkin, Croft and Lawson [23] identified that '*the dominant provision is drop-in support*' with 74 of the 103 responding institutions offering mathematics support through a drop-in centre model.

The prevalence of drop-in mathematics support is not unique to the UK. In a 2015 audit of mathematics support provision across the island of Ireland [24] 25 out of the 30 responding institutions were identified as offering mathematics support; in 16 of these the dominant form of provision was through a drop-in centre. A similar situation has been observed in Australia. MacGillivray [7] reports on a 2007 survey of provision which found that 32 out of Australia's 39 universities had some form of learning support in mathematics and statistics with the most commonly-offered type of assistance again being the drop-in model.

Lawson, Croft and Halpin [25] identified that students value mathematics support and their reasons for doing so. They found that students particularly value the provision because '*it provides them with the opportunity to receive one-to-one assistance from a sympathetic tutor who is willing to take time to explain things to them. Furthermore, students also value highly being able to use the centre at times which are convenient for them rather than at times which are determined for them.*' Carroll and Gill [26] report similar reasons for student engagement but also found that their mathematics learning centre was having a positive impact with students '*because it*

helped them to gain a greater understanding of mathematics', with a number commenting that the tutors in the centre '*helped them achieve greater understanding than the lecturers*'.

1.3. The specialist and more-able mathematics student

There is much evidence that specialist and more-able students are also choosing to access mathematics support. Pell and Croft [27] found in their institution that the centre was '*used more by the better students who are seeking excellence, than by less able student who are looking to avoid failure'* and as such '*the mathematics support model has moved from one of remedial support to one of enhancement*'. Similarly O'Sullivan et al. [28] identified that mathematics support '*was not viewed by students only as a remedial support but rather, utilised by those students seeking to improve their understanding of mathematical concepts*'.

Croft et al. [29] report on an action research project that established a learning space for specialist mathematics students in year 2 and beyond. They note that the motivation for this was a result of the existing mathematics support centre becoming so busy there was a need to restrict it to year 1 students only. Evidence obtained from those students who used the new learning space indicated they were using it for social learning and that '*many students attend the centre in groups to work informally on coursework problems*' and '*peer support within these groups is often clearly evident*' [29]. Solomon et al. [8] also highlight the important role that mathematics support centres can have as spaces for facilitating social learning in mathematics, but MacGillivray [7] goes further when discussing the use of mathematics support by specialist mathematics and statistics students in one Australian university. She notes that not only are there '*students in the 'mainstream' mathematics and statistics courses with a diversity of capabilities for whom MSLS* [mathematics support] *is meeting a*

need' but that there '*is also strong association between even minimal usage of MSLS and progression in mathematics/statistics programs*.'

There have been many studies that explore student engagement with mathematics support, however it is the case that the majority focus upon students from disciplines other than mathematics. In the overall current body of mathematics support research there is little work that focuses upon the specialist mathematics student, and even less that considers specialist and more-able mathematics students beyond the first year of their studies.

The work that we now go on to describe has been motivated by the usage patterns observed within a mathematics support centre in a large UK research-intensive university. We set out to answer the following research questions: 1) to what extent is use made of the mathematics support centre by specialist mathematics students? And, 2) what are their reasons or motivations for the usage patterns observed? As we shall see, usage of the centre is not only dominated by specialist mathematics students, but it is primarily those in years 2 and 3 of their studies who take advantage of the support on offer.

The work described here differs from that in the small number of studies currently in this area. Whilst the use of the mathematics support centre space for peer learning may have been a motivating factor for some specialist mathematics students attending the centre under consideration here, it is known from discussions with the tutors themselves [30], that the majority of visitors were instead accessing the centre to *specifically* seek mathematical help and guidance from a tutor.

2. Local context

In September 2012 a mathematics support centre opened for the first time within a large UK research-intensive university. It was developed with the support of the **sigma** mathematics and statistics support network [22] which enabled access to expertise from Loughborough University Mathematics Education Centre to inform its development [31]. The centre had its own dedicated room within the university library but was not located in a prominent location and as such was only likely to be found by those seeking it. It was able to accommodate around 10 students at any one time, and contained student workspaces, computers, books and printed resources. Initially opening for three hours per day (excluding weekends) during term time, it was promoted to students across the university by a variety of means including posters, postcards, awareness raising by academic and centre staff during lectures, and through the use of student ambassadors. By January 2015 the centre was opening for six hours each day during term time (again excluding weekends) and this has remained the format since.

For the start of the 2016/17 academic year, a significant change occurred when the centre moved to a new location within the newly-built replacement university library. It now occupies a spacious room within a prominent location, highly visible from the main staircase, and can accommodate approximately 20 students. Facilities remain similar with the exception that there are two large ‘whiteboard walls’ and presentation viewing screens. Whilst the room forms a dedicated support centre during its hours of opening, the room is available as a student study space outside of these times.

Since its establishment, postgraduate students have always been the tutors who work in the centre. They work in pairs for three hours at a time, and receive hourly payment for their endeavours. Since the move to the new location in 2016, all tutors have been from the mathematics department and studying for PhDs in either pure,

applied or management mathematics or statistics. Their role and experiences within mathematics support have recently been explored elsewhere [30].

Since the mathematics support centre opened, attendances have been recorded to observe the number of visits and collect user information (name, student ID, year of study, academic programme, and nature of support sought). Originally students would sign in on paper-based sheets, however to coincide with the move to the new location, students were asked to sign in electronically upon arrival. As we shall discuss below, whilst there are some challenges with analysing this captured data, it has nevertheless allowed the overall usage of the centre to be monitored.

The support available in the centre has always been particularly targeted at foundation and first-year undergraduate students from all disciplines and programmes of study, and at students from other year groups identified as having particular difficulties with introductory mathematical and statistical techniques; in all of the promotional activities for the centre undertaken over the years, this messaging has not changed. However, whilst Table 1 shows that there has been a steady growth in the usage of the centre (the anomalous case of 2017/18 will be discussed later), there has always been significant use of the centre by specialist mathematics students, and in the last two years, they have very much formed the primary users. It is these observed attendance patterns that have motivated this work to try and understand why this particular cohort is using mathematics support so extensively.

3. Research Methodology

The research methodology for this study consisted of two components. The first comprised an analysis of collected support centre usage data from the last six consecutive academic years, and the second was a survey targeted at specialist

mathematics students studying within the university. Ethical approval was granted by the university and appropriate ethical guidelines [32] were followed.

As noted previously, usage data for the centre has been collected since it opened in 2012. This engagement data was input directly by students themselves upon arrival. Whilst tutors are asked to encourage all users to sign in, this is not always possible, particularly at busy times, and as such it is known that the attendance of all users has not been logged. This, coupled with a failure of the online attendance logging system in 2017/18, has meant that the figures for 2017/18 (Table 1) are much lower than their reality. Nevertheless, they have been included as the in-year trends remain highly relevant to our work.

Prior to the analysis of the attendance data, the names of all individual users were removed such that seven digit 'Student ID' remained the only means of tracking users. The data was provided by students at each visit, and some of this data was subsequently transferred for storage in an electronic format from paper-based records. As such there existed errors in the data including misread entries, typos and blank entries that required a process of data cleaning. Where identified errors could not be corrected, the entries were disregarded. Overall, no more than 20 entries were disregarded in total. The challenges posed by several factors, including the integrity and accuracy of the data, when attempting to use it to investigate the impact of mathematics support provision has been discussed by Matthews et al. [33].

The survey was circulated in autumn 2017 to all students within the mathematics department ($n \approx 800$). It contained 24 questions (listed in Appendix 1) to ascertain mathematical backgrounds, their views on the current learning activities and opportunities they receive to aid their mathematical learning, and a series of questions relating to the mathematics support centre and their use of it.

4. Results and analysis

4.1. Support centre usage patterns

Table 1 demonstrates that the overall number of visits to the support centre has been increasing year-on-year. Most interesting, however, is that in the five-year period up to the end of the 2016/17 academic year, whilst overall visits have more than doubled, the number of visits made by specialist mathematics students has increased by almost a factor of five. In 2016/17, four in every five recorded visits to the centre were made by a specialist mathematics student.

Given the remit, and promotion of the centre to support students at the transition to university, it might therefore be reasonably expected that the growth in usage from specialist mathematics students comes from those in year 1 of their studies. Further interrogation of the data, however, reveals this not to be the case (Table 2). The proportion of visits made by specialist mathematics year 1 students has declined over time from just under two-thirds in 2012/13 to just over 20% in 2017/18; over the same period, the proportion of total visits made by specialist mathematics students in years 2 and 3 combined has increased from just under a third to around 70% (with a peak of almost 80% in 2016/17). Whilst there are evidently more visits to the centre, and indeed a greater number of unique users accessing the provision, its move to the new location (start of 2016/17 academic year) appears to have had little effect upon the *proportions* of students from each year group who choose to visit.

Within mathematics support centres, it can be unclear from headline usage statistics as to whether the students making the visits are first-time users or returners making multiple visits. Our data allowed the ability to track student usage *across* academic years as shown in Figure 1.

Figure 1 represents both the number of unique (specialist mathematics) student visitors to the centre within each year group (either an integer or the denominator if

shown as a fraction) along with the number of these unique visitors who also made use of the centre in a *previous* academic year (the numerator of the fraction). An example will make this clear. Amongst the cohort who began their studies in year 1 in 2012/13 there were 44 unique visitors to the support centre. In 2013/14, and when these students had progressed to year 2, there were 29 unique student visitors in year 2; of these 29 students, 18 had previously made a visit to the centre when they were in year 1. In 2014/15, and when this 2012/13 starting cohort had progressed to year 3, there were 30 year 3 unique visitors to the centre; of these 30 students, only 9 had previously made use of the centre when they were in year 1 or year 2 of their studies.

What the data show is that whilst some of the centre's users *each year* are evidently returners, the majority are in fact new users. Of the individual students who used the centre when they were in year 2 (201 students), only 33% (67 students) had used it previously in year 1. Similarly of the 205 unique users from year 3, only 29 (14%) had accessed the support offered by the centre in either of their two previous academic years. This suggests that whilst some specialist mathematics students are perhaps reliant upon mathematics support throughout their programme of study, the overall proportions are small when we get to year 3; the majority appear more strategic in their use of it choosing only to do so as, and when, a specific need arises. Nevertheless, in the case discussed here, the dominant use made of the support centre by such specialist mathematics students indicates it plays an important role in their mathematics learning experience.

Whilst these data offer an insight into how the centre is used by specialist mathematics students, particularly in the later years of their studies, they cannot explain the reasons behind these usage patterns. To offer greater insight, we now turn to the

results of the survey that was conducted amongst specialist mathematics students who were both users and non-users of the centre.

4.2. Survey of specialist mathematics students

4.2.1. Respondent backgrounds

The survey attracted a total of 47 responses representing a response rate of approximately 6% amongst the target population of specialist mathematics students. Whilst this is lower than we would have liked, it is consistent with other optional student surveys that have been undertaken in the department. Of the respondents, eight were studying on joint honours programmes, but in all cases mathematics formed at least 50% of their studies. They were distributed across all academic years: five respondents were year 1 students; 10 were from year 2; 16 from year 3; and, 16 were from year 4.

The profile of respondents indicates they were amongst the most mathematically able within their cohorts and as such not expected to unduly struggle with the mathematical demands of their course when beginning their studies. All respondents entered the university with some of the very highest grades; in the UK's A-level (pre-university) qualifications system, this would have been at least AAA in three subjects, one of which was mathematics. Additionally, of those who had completed their pre-university qualifications within the UK, 79% had also studied an A-level in Further Mathematics. Further reinforcing that the survey responses overall represent a mathematically able cohort, 85% had not failed a mathematics module whilst at university, and 11% had failed only a first year module (or modules).

4.2.2. In-course learning opportunities and support

Lawson et al. [25] note clearly that mathematics support forms an offer which is *in addition* to the regular teaching that students receive as part of their studies. However the current reality of this definition is not quite so clear-cut. Students will not only receive a range of *in-course learning opportunities*, that is teaching sessions, resources or feedback with which they will be expected to engage, but mathematics departments are increasingly providing additional, and most importantly voluntary, opportunities for students to consolidate their learning. We choose to call this *internal learning support* and it includes virtual learning environment (VLE) resources, peer support sessions, lecturer office hours, and indeed mathematics support centres. There also exists what we call *external learning support* that forms further voluntary opportunities for students to enhance their mathematical knowledge, skills and understanding which may not only be external to a mathematics department but also the institution itself. Examples include friends, websites and online videos, textbooks and private tutors.

To understand why specialist mathematics students choose to access mathematics support, and in our context we specifically mean the mathematics support centre, it is helpful to understand their views on the wide range of learning activities or opportunities that are available to them. Respondents were asked to indicate how often they used 15 learning activities or opportunities that we have divided into the three categories noted above. The results are shown in Figure 2. It should be noted that at this stage, and given that the mathematics support centre formed a specific theme of questioning in the later sections of the survey, it was deliberately not included as a possible response here.

When considering responses for the *in-course learning opportunities*, lecture notes (96% of respondents) and lectures themselves (89% of respondents) were identified as being the most frequently used. Whilst the results for tutorials (groups of

approximately 6 students meeting weekly with an academic tutor to discuss and receive feedback on their submitted work and tackle additional mathematical exercises) may appear surprising, there exists a local context in that they are only offered to students in year 1 and year 2; 11 out of the 12 students who said they never used these were from either year 3 or year 4. If the responses for tutorials are restricted to those in year 1 or year 2, 60% of students indicated that they used these ‘a lot’. Most surprising were the responses for example classes. These are large informal classes, offered every two weeks, where students attend to work on an exercise sheet associated with a corresponding lecture course, with support typically provided by a member of academic staff and postgraduate teaching assistants (PGTAs), yet only 51% of students indicated that they used these ‘a lot’.

Opportunities classified as *internal learning support* were much less well used with three of the five forms of support (recorded lectures, peer assisted study support (PASS) provided by Year 2/3/4 student volunteers to students in all years of study, and departmental-based drop-in help sessions) being ‘rarely’ or ‘never’ used by over 50% of respondents. Additional resources placed on the VLE, to complement lectures, were overwhelmingly the most well used with 57% of respondents indicating they used these ‘a lot’; whilst lecturer office hours were used at least ‘a little’ by 53% of respondents, we choose to discuss these in more detail later. Of the *external learning support*, friends were identified as the most common with almost 80% of respondents indicating that they used such opportunities regularly.

4.2.3. Engagement with the mathematics support centre

Of the 47 specialist mathematics students who responded to the survey, 25 indicated that they had used the mathematics support centre at some point during their studies.

Reinforcing that those using the centre represented a mathematically-able cohort, 23 of these 25 centre users indicated that they had never failed a mathematics module whilst at university.

How frequently the centre was utilised by respondents varied. Whilst around a third of students indicated that they used it more than once a fortnight, almost a half indicated that their usage was no more than once a term. Some students appear to be reliant upon mathematics support if they do not understand the content of lectures:

> They have retaught me things the lecture could not convey clearly, which helped my general understanding.

> I find it easier to understand a topic when it is explained again, by someone who has the time.

For others, it is accessed as a source of help as soon as difficulties are encountered with the assessed components (problem sheets) of their studies:

> I always use it for any problems I'm stuck on for assessed problem sheets.

> It has helped me on numerous occasions when I have been stuck on assigned work.

However for many others their use is more strategic and occurs as, and when, a specific need arises:

> Helped me understand a key concept in a course last year.

> Because it helped me understand an important fundamental of degree level mathematics.

Regardless of how often students made use of the centre, the primary motivating factor for its use was to gain assistance that would enable them to tackle the assessed problem sheets for themselves. Whilst the centre's tutors are instructed during training that they may provide guidance on the concepts associated with assessed work but that they should not tackle the actual problems themselves, the enhancement of grades for assessed tasks was the motivation for 75% of respondents:

> It helps to cement understanding in concepts of maths, and also to be able to answer assessed assignments leading to better grades.

> I can ask questions on topics I am unsure about so I can do my problem sheets and get better marks in my modules.

Those who indicated that they had made use of the mathematics support centre were asked whether they felt it had contributed in some way to their success whilst at university. The results in Table 3 show that just over 70% of users reported that they felt the use of the centre had impacted positively upon their success. Whilst several references were made to the centre helping with the completion of assessed problem sheets, a more prominent feature (nine responses) was an indication of how users felt the centre had contributed directly to developing or enhancing their mathematical understanding:

> Helps break down parts of the course in another way and a way I can understand.

> Given some confidence to my answers and increased my understanding to the work.

> They have helped me understand various aspects of the course.

The impact of the centre upon perceived success was not only restricted to frequent users (i.e. those who used the centre a minimum of once a fortnight); 10 of the 18 students who answered positively were much less frequent users with seven of them visiting at most once a term.

Whilst respondents were less clear on whether, and indeed how, their usage of the centre had impacted positively upon their mathematical confidence and/or motivation, just over half indicated that it had. Some students reported that using the centre had increased their confidence in their knowledge of a particular topic or their ability to solve problems, but for others, it was more about providing reassurance of their existing abilities:

> I'm more confident as I see that I can answer these questions, just needed a little guidance.

> With my answers, sometimes I go to check my answer and it's already correct.

This development of confidence and motivation was not only in relation to the mathematics itself, but also in their subsequent desire to ask further questions and seek help to aid their own mathematical learning:

> I am motivated to understand a topic more so that I can ask further questions.

> More motivated to ask questions

> More confident in asking for help. More confident in my mathematical ability.

Even amongst non-users, simply knowing that support was available if needed was a motivating factor:

> I'm more confident that I know there is support there if I need it and this makes it easier when struggling with problem sheets to persevere.

The survey initially asked students to identify their preferred learning activity or opportunity from the 15 available types shown within Figure 2. Students who indicated that they were users of the mathematics support centre were asked to rate the assistance it offers to their learning of mathematics with that of the other learning activities and opportunities available to them as part of their studies. Over half indicated that the mathematics support centre was better than other learning activities and opportunities they encountered, and a further 40% felt it was no different. Interestingly in the case of the one respondent who indicated that it was 'much worse', they had previously indicated that using the centre had not only contributed to their success at university, but also their mathematical confidence and motivation.

Given these observed student views, and coupled with their usage of the centre, its perceived impact upon their success, confidence and/or motivation, there exists clear evidence that, amongst a mathematically-able cohort, there are students for which the mathematics support centre is meeting a perceived learning need. This is true even for those who are not frequent users of the centre. As we shall see in Section 5.2., we have been able to identify a series of reasons as to why the mathematics support centre is popular with the specialist, and more-able mathematics student, and as such why they choose to access it as an important component of their learning experience.

5. Discussion

5.1. Engagement and non-engagement with learning opportunities and activities

Evidence emerging from the survey shows that there is generally a high level of engagement by students with those learning activities and opportunities that involve the provision of mathematical *information* that is the same for the entire cohort. Examples include lecture notes (96%), lectures (89%) and VLE resources (57%). For the more *personalised* learning activities and opportunities, that is where students can receive guidance on their own work, ask questions, or discuss ideas, and where engagement with these forms an expected component of their studies (tutorials (60%), feedback on work (53%) and example classes (51%)) there were more moderate levels of use. The voluntary opportunities for personalised learning (departmentally organised peer support (11%), departmental drop-in sessions (9%), and lecturers' office hours (6%)) were very much less well used and valued. In all cases, the figures in parentheses show the percentage of respondents who indicated they made use of these learning activities and opportunities 'a lot'.

From the 15 learning activities or opportunities identified in Figure 2, respondents were asked to identify which was their most preferred. Lecture notes (32% of respondents) was the most popular response, and in agreement with the findings of Brown et al. (2005), some respondents even went as far as indicating that lecture notes were the only resource they needed for their learning:

> Lecture notes as they're detailed and contained everything you need.

> If I am just concerned with getting by in the module and exam preparation, my preferred form of support is my notes from lectures…

Friends were also explicitly referenced by 30% of respondents with the key reasons being that they not only offer a more readily accessible or convenient form of support,

but that they can also offer tailored or personalised explanations, and there is far less fear associated with how questions might be received when they are asked:

> Asking my friends because I often feel like I can ask them simpler questions without worrying about appearing daft. Also I feel that I can ask them more specific questions and I can talk more informally with them.

> Friends, we usually get through the work and problem sheets together and we break it down in a way that each other can understand. It is also the most accessible.

> Friends because it's not embarrassing to admit I don't know what's going on, and we work together.

The importance of friendship groups in the learning of mathematics has been noted by others [11,12], with Croft et al. [19] commenting that '*a key finding from our focus groups has been that many students value, first and foremost, the support of their peers*'. As a consequence departments, recognising the benefits of students working collaboratively on mathematical tasks have sought to establish peer assisted study support (PASS) or similar peer mentoring schemes to formalise the process of students, usually in later years, helping support those in earlier years with their mathematical learning. Whilst there are known benefits for student learning outcomes from peer support [34,35], it is interesting to note that here students specifically referred to 'friends' rather than 'peers' and this was in relation to self-organised groupings. In fact, and consistent with Goulding et al. [12], whilst students do value peer support they prefer to instigate this themselves rather than it being organised by a department:

> *…it's just a group of random people that I don't know that I've been told to be friends with, and I have nothing in common with them and I'd rather choose my own friends, even if there's less of them.*

The 47 respondents to the survey indicated a wide range of preferred learning activities and opportunities (13 different types), but exploring their reasons for these choices identifies a broader trend. Over 50% of students made some form of reference in their preferences to 'dialogue', that is opportunities to engage in some form of a discussion in relation to mathematics with others. In a number of instances, this was explicitly linked to seeking answers to questions they had:

> Tutorials, because you can have both peer and lecturer interaction, and you can ask questions about any module.

> Office hours, you can ask specific questions on a 1 on 1 format where they are always willing to help and encourage you to think for yourselves.

With this evidence of students, across all years, valuing dialogue in relation to their learning, it is perhaps a surprise to see almost a quarter of respondents citing example classes and lecturer office hours as their least preferred forms of learning support. Such sessions have been designed to provide opportunities not only for mathematical discussions to take place, but also for individual questions to be answered. For example classes, whilst one student identified that they worked as intended:

> …because you can get help on the work…and the people there (usually) know what's been covered in lectures and how to help with all of the questions you have.

For others, it was a less positive experience due to them either lacking a formal structure, or more commonly, because they do not offer the opportunities for dialogue that students are seeking:

> They're [the tutors] reluctant to answer questions for fear of giving away the answer.

> Often there are not enough people available to take time to spend working through the problem with you.

With regard to lecturer office hours, the responses are much more concerning as several students reported that they felt intimidated or uncomfortable when speaking with members of staff:

> Some lecturers make it feel patronising if you don’t understand something.

> Some seem reluctant to help and make you feel stupid.

Not all students indicated that it was the staff members themselves they found intimidating, but more the process of going to the office of a lecturer to engage in discussions about mathematics, particularly if they do not feel their knowledge is at the level they think it should be:

> Lecturer office hours [are my least preferred form of support] because I feel that I have to ask a complicated question and be up to date with everything else that I've learned until then for it to be useful, and often that isn't the case.

But there were indications that students would feel more comfortable engaging with staff members if these discussions took place in a student-space [8] rather than a staff-space:

> I don't feel comfortable to go and talk to them about issues I may have, maybe do something like the Drop In sessions but with lecturers in the MLC [mathematics student learning centre].

Although many students made reference to the importance of dialogue in their responses, there were still a number of clear reminders that amongst some, the study of mathematics can be a solitary discipline. In several responses this was linked to a lack of confidence in sharing their ideas and working with others, but in others it was a conscious choice to work independently:

> I am often too shy to ask questions at example classes, so I never seek out PASS or drop-in sessions.

> Not confident doing maths in front of others. Some people are not approachable to aid with teaching.

> I am not a sociable person. I prefer to work on problems on my own

Finally, and generally, students indicated that the timing and convenience of learning activities and opportunities were also important factors in whether or not they chose to make use of them. For some students, this choice was due to timetabling constraints or external time pressures:

> Office hours because I have to go into uni more often.

> I either don't have time or aren't available at the hours specified. . .

But for a small number of others, the speed at which they could seek a resolution of their queries was a motivating factor:

> Quicker to ask friends or watch lectures or look at lectures notes than sit in PASS sessions.
>
> Websites [are my least preferred], as it often difficult to access the required information quickly…

From our analysis, it is evident that the mathematics department-led personalised learning opportunities offered to this cohort of specialist mathematics students are not completely meeting their needs or their expectations. In particular we note issues with:

- A perceived lack of opportunities for students to engage in discussions about their own work or learning;
- A perceived lack of opportunities for students to ask questions, or a reluctance to do so, perhaps as a result of cohort sizes or a non-conducive environment;
- Students feeling intimidated or uncomfortable when engaging with members of staff;
- Some students, through choice or otherwise, not having ready access to support groups to which they can turn in support of their learning when needed;
- The timing and convenience of access to some learning opportunities.

Given these issues, there is evidence here that students are not only turning to their friendship groups, where they exist, as a means of obtaining personalised learning support, but with the availability of a mathematics support centre they, along with those who do not have established peer support groups, are also making use of this to enhance their mathematical learning. Croft & Lawson [36] argue that whilst the mathematics problem may not be solved for mathematics students, '*mathematics support provides a*

proven way of mitigating some of its worst effects'. Amongst those who indicated that they use the mathematics support centre more than other forms of support available to them we can begin to see how its use mitigates some of the issues we have noted above:

> Better than example classes because it's easier to get 1-1 help, and you aren't limited to the hour example class.
>
> Shorter wait to see a postgrad than example classes.
>
> I prefer the one to one experience provided by the Mathematics Support Centre, as it is more personal.

5.2. Understanding engagement with mathematics support

Emerging from the responses of specialist mathematics students themselves, we now go on to identify four reasons as to why they choose to use a mathematics support centre and the benefits that this offers to them and their learning experience. As we shall see, whilst several of these are characteristics of mathematics support, and as such are not unique to this cohort, there is a specific local context (Section 5.2.4) which appears to be a factor in students choosing to use this particular centre.

5.2.1. Convenient and timely

Carroll and Gill [26] report that the students visiting their centre greatly value knowing when support is available and the convenience of being able to drop in at times that suit them. Respondents here reported similar benefits noting particularly the extensive and consistent availability of support:

> It is much more consistently available than the other forms of aid.

> …[It] is on more regularly so is convenient and it is good that you can drop in at any time.

> The hours that the PhDs are there is flexible around our timetable.

But not only that, the centre was also cited as being able to provide a source of *immediate* help when students experience difficulties with their learning or understanding of mathematics.

> It's very convenient and instant help. Emailing lecturers can take a week to get help, and example classes the same.

> 1-1 contact is far superior in my opinion to re-reading lecture notes or looking for help online.

> It is much easier to speak with someone who can help me in most, if not all, my modules at the same time.

This is particularly important given the fast-paced nature of university mathematics courses or if students are facing an impending assessment deadline. However, and as Lawson et al. [25] also note, the perception of the immediacy of the mathematics support centre as a form of learning support can make it difficult to manage the expectations of students, particularly at busy times:

> Sometimes there is not enough support staff to meet the demands of the people available.

5.2.2. Personalised nature

It has long been known that one of the aspects most valued by students who make use of mathematics support centres is the one-to-one (personal) help that it allows them to access [37]. Again, this aspect was widely cited by students here:

> Personal and specific assistance and feedback.

> People are always helpful and you receive one to one help.

More broadly though, in terms of the benefits it offers to student learning, such personalised instruction has been cited as one of the "*pedagogical approaches that are linked to enhancing student learning, involvement, and engagement beyond simply making the coherence of the educational experience clear to students*" within higher education [38]. This reinforces that in order for there to be longer-term benefits to learning, the student must be an active participant in the process. As such, a student visiting a mathematics support centre merely to be 'told' the answer is clearly insufficient. A number of respondents did recognise that using the mathematics support centre offered the opportunity for:

> a more interactive way of learning.

with others going on to clarify how such an approach can actually lead to them finding the answer to their original question through their own endeavours:

> Explanations are always clear and I often get given points and find the answer on my own which increases my understanding.

We have seen (Section 4.2.3) that there is evidence of students visiting the mathematics support centre to seek reassurance of their existing mathematical abilities from tutors. Being supported through a problem on a one-to-one basis can reinforce that students

already possess the necessary mathematical knowledge and skills to be successful at a problem, and as such this helps with the development of their mathematical confidence. This process of reassurance and building confidence within students is important in the context of their overall learning experience because, as Solomon and Croft [39] argue, ‘‘*undoing’ alienation and enhancing engagement at university rests on the development of new relationships with mathematics through greater support for students’ developing confidence in independent mathematical judgement*’.

A personalised approach, however, places particular demands upon the tutor. Not only must they possess a wide mathematical understanding of the topic, but also well developed pedagogic skills to be able to lead the student through the problem using questioning, examples, and alternative explanations. Most significant is not simply ‘telling’ the student the answer. Whilst we shall discuss the skills and abilities that make for a good mathematics support tutor in Section 5.3, several respondents were quite clear that they didn’t want their visit to the mathematics support centre to simply ‘reveal’ the answer, but instead wanted the answer to develop as a result of an interactive process between themselves and the tutor. Indeed this ability to be successfully ‘led’ through a problem was one of the skills students indicated they most valued in a tutor:

> Someone who doesn't tell you the answer but guides you towards finding the answer yourself.

> The ability to guide the student to the correct answer without explaining all the details, i.e. act as a helping hand instead of giving the answer.

> Ability to explain a concept in different ways - working through examples to further students' understanding of the concept.

5.2.3. Informal and flexible learning environment

The informality of the mathematics support centre environment emerged as a common theme amongst respondents:

> Individual help on a specific question in a friendly environment.
>
> Allowed me to get expert advice without feeling the pressure.
>
> It is a nice chilled environment where the staff are more than ready to assist.

with comments then being linked to the role of the tutors in building that friendly and supportive environment. In particular the willingness of the tutors to help individual students was commonly cited:

> PGTAs [Postgraduate Teaching Assistants] are generally very helpful and eager to help the students who go.
>
> PGTAs are a great help and will consistently help you to try and understand the issue.
>
> Great guys, approachable, very intelligent.

There was also evidence that the students welcomed this environment as an opportunity to engage in informal conversations with a tutor about mathematics:

> Postgrads are really nice, if they don't know the answer they will point you in the direction of someone who does. Also nice to be able to just talk maths through sometimes.

The existence of peer communities is known to be important for non-specialist, or service users, of mathematics in encouraging their engagement with mathematics

support, particularly as a means of overcoming fear [40]. Similarly, for the specialist and more-able mathematics student Croft and Grove [5] comment that in the context of student perceptions of their mathematical learning experience the '*importance of supportive staff and peer communities should not be underestimated'*. Brown et al. [11] reported that students who had a more positive attitude towards their studies of mathematics were those who shared their ideas and problems with other students. Although there were by far more comments from students about working with a tutor, there were nevertheless a number of students who made use of the mathematics support centre as a location for working with their peers, typically on assessed tasks:

> Very helpful for problem sheets and working together on a problem.
>
> …other people are generally doing the same problem sheets are generally there too so everyone can help each other.

We have seen that the attempts organised by the mathematics department to facilitate peer learning have not been well accessed by the students, but by providing a suitable location, students are quite willing to organise their own learning communities. As Solomon et al. [8] note '*the value of providing space for students to develop their own communities of practice*' is reinforced here. However, whilst Solomon et al. [8] quite rightly argue that a quality learning experience for many students '*includes the provision of spaces and resources within those spaces which facilitate student interaction and peer support*' we have seen that for some students, the study of mathematics remains an independent pursuit. Mathematics support centres have the ability to cater for a range of student learning preferences in one common facility: they can provide a suitable space for social learning, a location for those who wish to study

independently whilst on campus, and a location where guided learning can be provided by a tutor. Indeed as one student put it:

> It strikes me as a better version of PASS/drop-in-sessions in one place.

5.2.4. Skilled, knowledgeable and approachable tutors

We have seen evidence that the interpersonal skills of the tutors working in the centre contribute to establishing its informal and welcoming nature. Their friendly manner, understanding and empathy were particularly noted by students; this is in clear contrast to the perceived approachability of some teaching staff highlighted by several respondents:

> It is another resource that can help students, and sometimes the lecturers can be a bit intimidating to talk to.

> . . .postgrads less scary than lecturers.

> A place where you can go to ask knowledgeable people who aren't lecturers. . .

Whilst Lawson et al. [25] note that '*it is of some concern that less than half the students interviewed regarded mathematics teaching staff as helpful'* our findings do not raise issues with the helpfulness of teaching staff per se, but instead highlight that some students perceive staff as intimidating and as such difficult to approach. This is an important issue as it impacts upon their opportunities to engage in dialogue as part of a mathematical community [14], which then has consequences for their sense of belonging to that community [11]. To mitigate this, a number of the specialist mathematics students in this cohort appear to be engaging in discussions with postgraduate tutors in the mathematics support centre. By doing so they recognise that

they can receive explanations that they find more understandable and by tutors they deem more approachable:

> It has people with a lot of subject knowledge, but who also have the ability to explain things in a simpler way than the lecturer sometimes can.

> Someone who can explain something in a different way than your lecturer, but who understands the content well.

> Their ability to break down complex concepts into simpler ones.

What is interesting here is that whilst students recognise the strong mathematical backgrounds of the tutors, they particularly recognise the ability of the tutors to effectively communicate complex ideas and topics. This is something very different to the findings of Walsh [41] who found that tutors were far too didactic and made the material too abstract in teaching for their mathematics support centre. The challenge of this task for the tutors should not be understated; after all, these are year 2 and year 3 students dropping in to the centre, without warning, and seeking assistance with what are advanced mathematics modules in a research-intensive university.

As Grove et al. [42] have shown, it remains rare, although by no means unique, for a mathematics support centre to offer support to specialist mathematics students beyond the first year of their studies. The usage of this centre by these students is something that has naturally developed – it has never been promoted as being available to this cohort but neither has their use of it been discouraged. The reasons for student use appear linked to the tutors themselves as students recognise that the tutors have particular, and often specialised, areas of mathematical expertise that they actively seek out:

> You have to know which staff members [tutors] are working when as they all have their specialities.

> Often you had to go at specific times/dates so the people who know your module are there.

It is easy to see how users can adopt this strategic approach to seeking support once the local context is considered. In the last two academic years, not only have all of the centre's tutors been PhD students from the mathematics department, they have also all acted as PGTAs on departmental modules. They are quite visible to undergraduates within the mathematics department, and also highly familiar with the content of what, and how, students are being taught. Further, it is now the case that there are a number of postgraduates working as tutors who were previously undergraduates within the same department themselves only a year or two ago. They may be known to centre users in a more informal capacity, but perhaps more significantly they will have studied the same mathematics modules themselves and as such will be able to use their own learning experience to assist the student.

This level of familiarity between the tutor and the student does appear to alter their relationship. There exists evidence in the survey that some of the specialist students who make use of the centre actually view the tutors as fellow students or peers:

> Having other students explain things to you is a lot less intimidating and can therefore be a lot more understanding.

> Because other students (PhDs) are always available to help and there are a variety of potential questions that can be asked.

> Postgrads who have already done it.

Not only will such a relationship further contribute to the informality of the mathematics support centre, there is also evidence that peer tutoring in a university drop-in mathematics environment can lead to enhanced outcomes for those who choose to access the support [43].

5.3. The skills that make a good mathematics support tutor

Postgraduates students working in a mathematics support centre will very much be at the beginning of their teaching careers and as such will have had perhaps only minimal training and limited experience upon which to base their practice. Whilst all tutors working in the centre described here received initial training, similar to the model described by Croft and Grove [44], it is also known that they develop their teaching skills through their practice in their centre and by being part of a community of mathematics support tutors [30].

Mulligan and Mac an Bhaird [45] comment that '*it may appear, to those not involved in MLS [mathematics learning support], that tutors simply help students when they get stuck*', however as we have seen, users have greater expectations of the process than this. They go on to note '*just because someone is good at mathematics or statistics, does not mean they will be a good MSC [mathematics support centre] tutor*'. As one of the respondents to our survey commented, it is the intersection of strong mathematical knowledge and experience, coupled with developed interpersonal skills and an empathy with what it is like to be a learner of mathematics that are the key qualities of a tutor in a mathematics support centre environment:

> The people were very helpful due to their knowledge and experience, and were also friendly and understanding.

Building upon this, respondents to the survey were asked to identify the specific characteristics that make for a good mathematics support tutor. In addition to the strong subject knowledge, ability to communicate effectively, a friendly and approachable manner, and the skills of guiding the student to find the answer without simply 'telling' already identified, empathy with what it is like to be a learner of mathematics, the ability to listen, patience, confidence in their own mathematical ability, and a genuine interest in student learning were also commonly cited:

> Ability to explain ideas in an easy to understand way. Also they should be confident and willing to help.

> . . .friendly, approachable, good at listening, explains things and supports you getting the answer without just telling you the answer. Making sure you understand it.

> Non judgmental! Not giving up and trying a different explanation when one doesn't work. Having the patience to work with the student from first principles to identify where the difficulty is.

> A good listener and not patronising if you don't understand certain things.

> Able to understand what the student is asking for help with and what they aren't understanding. . .

> Can listen to all problems, has empathy or understanding to the way you are feeling and can address it in a proper manner. . .

6. Conclusion

We began this study seeking to answer two research questions: 1) To what extent is use made of the mathematics support centre by specialist mathematics students? And, 2) what are their reasons or motivations for the usage patterns observed? In answering these questions we have shown that there exists a large cohort of learners studying single and joint honours programmes in mathematics, within a research-intensive UK university, for whom the use of a mathematics support centre is meeting a genuine learning need. These are not students in the early stages of their undergraduate studies, they are in year 2 or year 3, and neither are they students who appear to be unduly struggling with the mathematical demands of their course. Whilst there is some evidence, as other have previously noted, that students are making use of the mathematics support centre as an environment to engage in peer learning, for many they are using this opportunity to seek advice and guidance from the postgraduate tutors who work there to enhance their mathematical knowledge and understanding. A motivating factor appears to be the lack of uptake of the departmentally based opportunities, due to students feeling uncomfortable, their timing, or an insufficiently personalised experience, to engage in discussions about their mathematical learning. They are instead visiting the support centre where they can drop in at times to suit them, where they feel the environment is more conducive to a friendly and personalised experience, and where they feel part of a community amongst peers in which dialogue can freely take place. As we have seen in our consideration of the literature in the discussion above, these reasons are not unique to specialist and more-able mathematics students, they apply equally to non-specialist users of mathematics support.

There is wide recognition of the personal qualities of the postgraduate tutors in not only creating a learning environment within the centre that students find relaxing

and welcoming, but that they also possess the subject knowledge and pedagogic skills to enhance their learning. The fact that tutors also act as graduate teaching assistants on the mathematics modules for which students are seeking help, or that they themselves have studied these same modules previously, do appear to be specific factors that encourage use of the centre by the specialist mathematics students in the case we describe here. This is different to the situation which might be experienced by non-specialist students struggling with mathematical concepts taught by their home department who then choose to engage with mathematics support. In some instances centre users appear to consider the tutors as their mathematically more experienced peers. Whilst we can only speculate, the small proportions of centre users from disciplines outside of mathematics might imply that postgraduates, or postgraduates taken solely from a research-intensive mathematics department, may not be the appropriate tutors for all learners. This is an area that merits further study.

Our findings do have a much broader significance. They show the value that students place upon dialogue with others as a means of supporting or enhancing their mathematical learning and understanding. However even where departments provide a range of different opportunities for students to engage in mathematical dialogue with others, not all students will access these and this choice can often be a deliberate and considered one rather than as a result of a lack of interest or commitment. A lack of alignment with their preferred learning style was the reason given by 30% of respondents for their non-use of some learning opportunities, and feeling uncomfortable with a particular approach, or their own lack of confidence, were reasons given by others. As such, whilst it may appear that departments can streamline the learning opportunities they offer, students prefer to learn mathematics in different ways, and so catering for this variety of student learning approaches will continue to be important.

A mathematics support centre has the ability to successfully cater for students with a variety of preferred learning styles: those who wish to learn mathematics in a social way, i.e. with their peers, those who wish to learn independently in a relaxed and informal environment, and those who wish to engage in dialogue and seek expert guidance from skilled and knowledgeable tutors. Even amongst those who are not regular users of the mathematics support centre there exists evidence that some engagement with it impacts upon their perception of success whilst at university, and in some instances provides them with the confidence and motivation to engage by asking questions and seeking wider help with their mathematical learning. This is indicative of the powerful nature of mathematics support – one student visit may be sufficient to resolve a fundamental issue acting as a 'block' in a particular module or it might provide the confidence needed to support their learning. It is clear that, for a range of reasons, the mathematics support centre can meet an important learning need for the specialist and more-able mathematics student.

7. Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Tables

	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18*
Total Visits: All Disciplines	482	571	875	793	980	615
Total Visits: Mathematics Only	163	294	425	354	786	526
Percentage of Mathematics Visits	33.8%	51.5%	48.6%	44.6%	80.2%	85.6%

Table 1. Total visits to Mathematics Support Centre by Academic Year. Note, all students who did not provide either their ID number or Programme of Study have been disregarded. 2017/18 represents only a partial dataset.

		2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Year 1	Number of visits	105	110	126	94	130	107
	Number of students	44	34	22	13	48	32
	Proportion of total visits	64.4%	37.4%	29.6%	26.6%	16.5%	20.3%
Year 2	Number of visits	53	99	214	130	307	182
	Number of students	8	29	27	25	73	47
	Proportion of total visits	32.5%	33.7%	50.4%	36.7%	39.1%	34.6%
Year 3	Number of visits	0	59	75	116	319	180
	Number of students	0	16	30	22	84	53
	Proportion of total visits	0%	20.0%	17.6%	32.8%	40.6%	34.2%
Other	Number of visits	5	26	10	14	30	57
	Number of students	4	11	6	5	21	15
	Proportion of total visits	3.1%	8.8%	2.4%	4.0%	3.8%	10.8%
Totals	Number of visits	**163**	**294**	**425**	**354**	**786**	**526**
	Number of students	**56**	**90**	**85**	**65**	**226**	**147**

Table 2. Usage of the mathematics support centre by specialist mathematics students only. Note, the 'Other' category includes those specifying as MSci (Year 4), Postgraduate or Foundation Year students along with those whose identity was 'unspecified' or 'unknown'.

		Influenced mathematical confidence and/or motivation?				**Totals**
		Yes	**No**	**Unsure**		
Contributed to success at university?	**Yes**	11	4	3		**18**
	No	0	2	0		**2**
	Unsure	2	2	1		**5**
Totals		**13**	**8**	**4**		**25**

Table 3: Student views of the impact of using the mathematics support centre upon their confidence/motivation and success (n = 25).

Figures

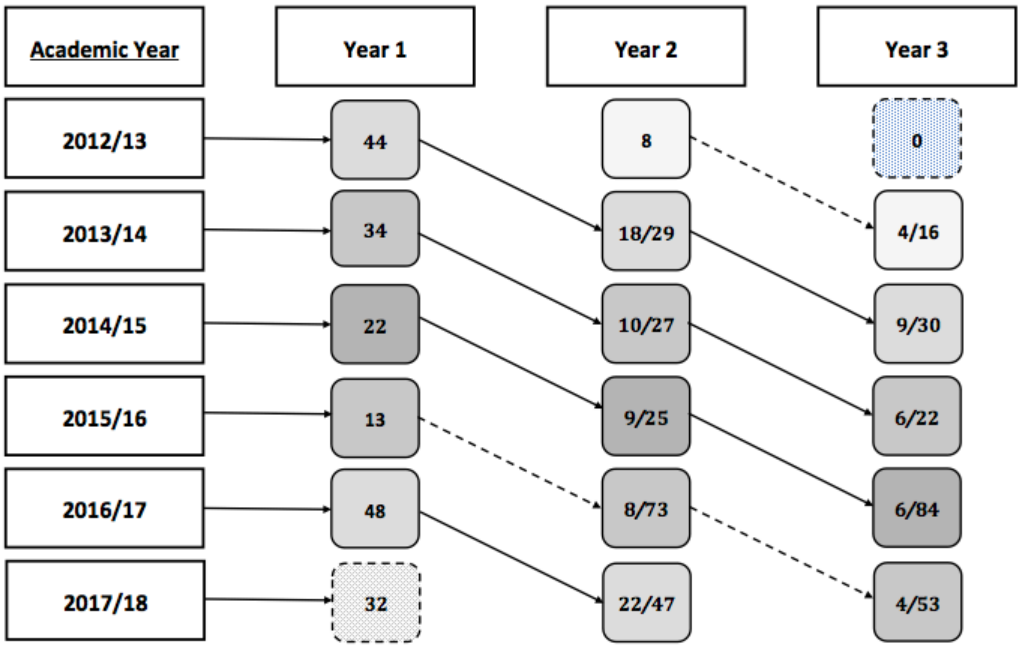

Figure 1. The number of unique visits to the mathematics support centre by specialist mathematics students. Where shown as a fraction, the total number of unique visitors forms the denominator; the numerator represents those unique students who also used the centre in a previous academic year and as such are return users *between* academic years.

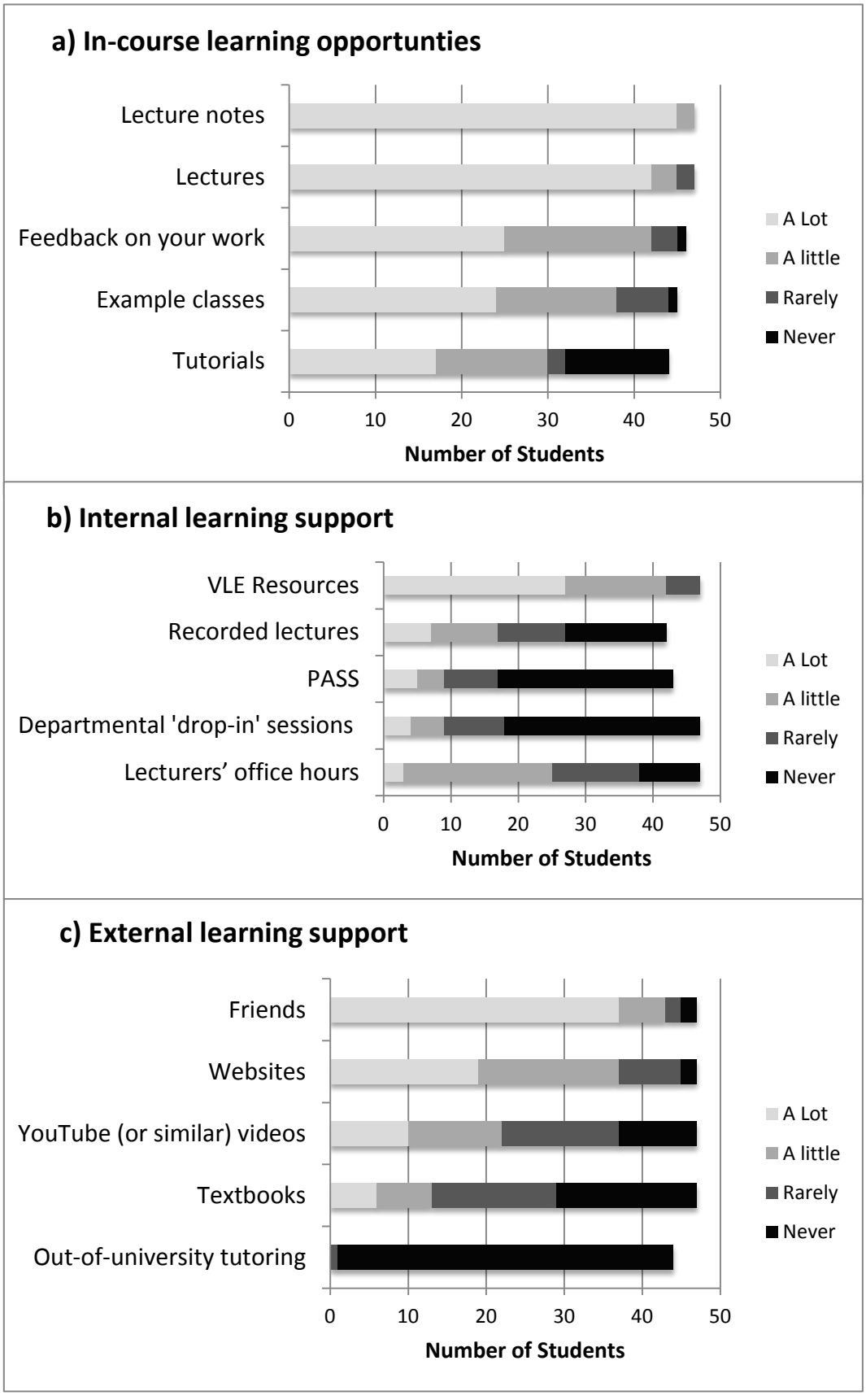
a) In-course learning opportunities
Lecture notes
Lectures
Feedback on your work
Example classes
Tutorials
0
10
20
30
40
50
Number of Students
A Lot
A little
Rarely
Never
b) Internal learning support
VLE Resources
Recorded lectures
PASS
Departmental 'drop-in' sessions
Lecturers' office hours
0
10
20
30
40
50
Number of Students
A Lot
A little
Rarely
Never
c) External learning support
Friends
Websites
YouTube (or similar) videos
Textbooks
Out-of-university tutoring
0
10
20
30
40
50
Number of Students
A Lot
A little
Rarely
Never

Figure 2: What learning opportunities and resources do specialist mathematics students access to aid their learning of mathematics whilst at university? Note. N/A (not applicable) responses have been removed to aid clarity of presentation (n=47).