**An Investigation into the Use of Mathematics**

**Support with Respect to Ethnicity and Gender**

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Abstract

As the higher education institutions in the United Kingdom are increasingly investing efforts in closing the gender gap, widening participation, and improve degree attainment of black and minority ethnic students, it is clear that Mathematics Support is an important part of this equation. However, very little data is available on engagement of students from different types of minority groups with Mathematics Support.

In this paper, we present the findings of observing three student cohorts at the University of Portsmouth, and their engagement with Mathematics Support, over a period of three years. In particular, we study the engagement of female students, and black and minority ethnic students with Mathematics Support. We trial a new approach in obtaining the data, which does not require the support providers to use questionnaires in order to captures the protected characteristics information of students attending Mathematics Support drop-in sessions, and discuss the advantages and shortcomings of this approach.

We make some interesting findings about the use of Mathematics Support by different minority groups, which can help higher education institutions to better understand their undergraduate student population, and which show the importance of Mathematics Support services in promoting equality and diversity within their institutions.

1. Introduction

The higher education (HE) institutions in the UK have increasingly been paying attention to the attendance and success on their courses of different student groups, including women, black and minority ethnic (BME) students, mature students, and students with disabilities. With the increasing presence and importance of equality charters such as Athena SWAN (since 2005) and Race Equality Charter (since 2016), and their evolvement, as well as the initiatives in widening participation to higher education, it is ever more clear that it is not only important to for the Mathematics Support providers within HE institution to understand the make-up of the student population they support, but also to provide valuable information about students’ use of Mathematics Support to their institutions.

1.1. Gender

It is well-documented that STEM subjects (Science, Technology, Engineering, and Mathematics), attract more male than female students – even though women make up the majority of students studying in the UK. For example, in 2014/15, 16.7% of students in Engineering and Technology, and 37.6% of students in Mathematical Sciences were female (Equality Chalenge Unit, 2016). At the same time, a higher proportion of female students obtain a good (first or 2:1) undergraduate degree in these areas. In 2014/15, the percentage of female students vs. the percentage of male students obtaining a good degree was 78.1% vs 71.7% in Engineering and Technology, and 74.8% vs 70.3% in Mathematical Sciences (Equality Chalenge Unit, 2016).

From this data alone, it is not clear exactly how much factors such as previous qualifications and withdrawal from/interruption of studies differ between genders, and there may be significant variations between HE institutions. However, we note that in 2012/13, the percentage of female first year undergraduate students was 16.6% in Engineering and Technology, and 38.7% of in Mathematical Sciences (Equality Chalenge Unit, 2014), and has fallen to 15% and 38.2% respectively, in 2014/15 (Equality Chalenge Unit, 2016).

In terms of Mathematics Support, it is therefore natural to ask whether women avail themselves of the available support differently than men – whether it is how they use the support, or why. A large scale multi-institutional study on student evaluation of Mathematics support found a significant association between students’ gender and the reasons they gave for use of Mathematics Support. For example, the incentive to do as well as possible in assignments and examinations emerged as the most significantly distinguishing feature (45% for female respondents as against 26% for male). Once they have engaged with Mathematics Support at their institutions, however, male and female students did not report any difference in the academic impact or in their experience of the Mathematics Support (O’Sullivan et al., 2014).

A study that looked at Mathematics undergraduates at Loughborough University found that gender did not explain a large proportion of the variance in undergraduates’ achievement, nor use of the Mathematics Learning Support Centre. The researchers noted that there are large individual differences among students, and that it is important to avoid inappropriate generalisations or stereotyping based on small differences between-groups. However, despite the evidence on women’ s mathematical performance, there remains a widespread stereotype that mathematics is a masculine discipline in which women struggle. (Alcock et al., 2014).

Stereotype threats are well-known in literature, and far-reaching in society. They can have negative effects not only on mathematical achievement and engagement of women, but any group exposed to stereotyping. They can negatively affect individuals who stereotypes assume to be less able, as well as those who feel the pressure to perform well because they belong to a group which stereotypes assume to be more able (Aronson et al., 1999).

1.2. Ethnicity

Students from BME backgrounds represent an increasing share of UK-domiciled students. As observed in (Mac anBhaird et al, 2013), between 2010-11 and 2012-13 the numbers of BME students starting full-time first degree courses increased by 7%, and those from white ethnic groups fell by 6%. Also, the share of students from low socio-economic groups entering HE has been steadily increasing in recent years.

It is important to note that student experience among different ethnic groups differs. In the National Student Survey (NSS), white students are often responding more favourably, and have always responded more favourably to the question “I have received sufficient advice and support in my studies” -- differential has varied between +1.1% and +1.6% between 2005 and 2013, and was most pronounced in Asian and black students, who answered with a negative differential of between -4.0% and -7.9%, and between -4.1 and -8.5%, respectively (Mac anBhaird et al, 2013). While Mathematics and other types of learning support are not the only type of support the students will think of when answering this question, it certainly falls into this category.

The odds of a non-white student obtaining a good degree are about half of those of a white student obtaining a good degree. The attainment gap is greater in black than in Asian students, and it is greater in Asian students than in students of Chinese, mixed or other ethnicity. This has been consistently observed in the UK since at least the beginning of this century. Furthermore, it is reported that the under-attainment of ethnic minority students is greater in women than in men (Richardson, 2015).

The Higher Education Founding Council for England (HEFCE) commissioned a report on causes of differences in student outcomes, which was published in 2015. Among the conclusions that emerged is that the clustering of student groups within the HE hierarchy is a key element of the global disadvantage which some groups face, and that low socio-economic groups and ethnic minority groups do worse when compared on a like for like basis. The report also states that prior attainment on entry to HE is the main driver of progression and performance at university, and that it is the relationship between ethnic background sub-category and socio-economic status which may be a key consideration tempering results for different ethnic groups (Mountford-Zimdars et al., 2015). In his study of under-attainment of ethnic minority students in UK higher education, Richardson finds that if entry qualifications can be regarded as a proxy for academic ability, then about half of the attainment gap is attributable to differences in academic ability, and that ethnicity in itself is almost certainly not the effective variable influencing students’ academic achievement (Richardson, 2015).

In terms of degree outcomes, black students are the lowest performing group in terms of degree outcomes. ‘Other Asian’ ethnic group students and those with other and unknown ethnic origin are also shown to do worse in relation to the proportion of degree attainment than Chinese, Indian and white students. The 2015 HEFCE report considers a range of possible factors that may cause differences in students’ HE outcomes, and groups them in four categories: (i) student experience, (ii) relationships amongst students as well as between students ant their institutional environment, (iii) psycho-social and identity factors, which might generate limitations to learning and attainment, and (iv) cultural and social capital, such as family contexts and material resources. (Mountford-Zimdars et al., 2015).

2. Methodology

The University of Portsmouth has a Mathematics Support facility, called the Maths Café. It is visited by students on courses across the University, and on all levels of study. In term-time, Maths Café runs 16 hours of drop-in sessions per week in two locations on the University campus, and in the past few years it ran between 10 and 15 hours of drop-in sessions per week in a single location in the time leading up to, and during exams. Besides the Maths Café coordinator, the tutors in the Maths Café are academics in the departemt od Mathematics, and postgraduate students.

Data was gathered on the number of students who visited the Maths Café drop-in sessions as well as the number of visits they made, and their School/Department and level of study. It is the tutors who note down students’ matriculation numbers and information. It is important to note, however, that while information is collected with care, it is not a hundred per cent correct due to possible human error (such as transposing digits in the matriculation number), missing information (no matriculation number), or inability to record information of all students at a particularly busy session.

To be able to obtain as clear as possible a picture of the gender and ethnicity breakdown of students visiting Maths Café, three years’ worth of data were compared against the records held by the University Registry. No individual students’ record was seen, instead the data was fed to the system and its breakdown by School/Department, year, gender and ethnicity was returned. Due to the nature of this process, the results are not dependent on students completing a questionnaire. However, any entries where the matriculation number is mistyped or missing, were excluded.

To be able to compare the results against the gender and ethnicity make-up of students enrolled, we limited ourselves on three entry-level cohorts of students in the Faculty of Technology, and two second-year cohorts to which they progress. It is important to note that, due to the dynamic nature of the data held by the University Registry, the numbers of students constantly change throughout the year as students withdraw or interrupt their studies, or transfer elsewhere. The cohort-related data was captured at very early point in the academic year and therefore gives slightly higher numbers of students per cohort than those observed some time after the start of the first teaching term. Another important detail is that the same student can change the ethnic category they most identify with from one academic year to another. Therefore, running the analysis on the same group of students in two consecutive years may give slightly different results.

We should also point out that the information about students who availed themselves of the forms of Mathematics Support other than the Maths café drop-in sessions, available to them at the University of Portsmouth, was not taken into the account here. This includes the Maths Café workshop sessions on specific topics, and attending bookable sessions with the Faculty of Technology Mathematics Support Tutors, who are a separate service from Maths Café. The rationale behind this decision was that the nature of the support between these forms is slightly different, and the drop-in sessions are the one form most easily accessible to any student.

2. The Results

2.1. Breakdown by ethnicity, and by gender

We considered three entry-level cohorts in the Faculty of Technology (Cohorts 1, 2 and 3) over the last three academic years. Each of the Tables 1, 2, and 3 gives the number of students in a particular cohort that used the Maths Café drop-in sessions, the number of visits they made, and the number of all students in the cohort - broken down by ethnicity, and by gender.

With respect to ethnical background, there are three categories: BME, White and Other (the latter contains, for example, students who did not wish to disclose their ethnicity). Since on the national level, research findings relate to difference in enrolment and attainment among UK-domiciled students, we also looked at UK-domiciled BME students (BME UK) separately.

Table 1: Cohort 1 (entry-level)

|  |  |  |  |
| --- | --- | --- | --- |
|  | 2014/15 | 2015/16 | 2016/17 |
| individual students | number of visits | whole cohort | individual students | number of visits | whole cohort | individual students | number of visits | whole cohort |
| No | % | No | % | No | % | No | % | No | % | No | % | No | % | No | % | No | % |
| ethnicity | BME | 12 | 55 | 44 | 49 | 94 | 43 | 16 | 52 | 45 | 37 | 103 | 49 | 18 | 53 | 48 | 48 | 97 | 49 |
| BME UK | 11 | 50 | 28 |  31 | 88 | 40 | 16 | 52 | 45 | 37 | 100 | 47 | 18 | 53 | 48 | 48 | 96 | 48 |
| White | 8 | 36 | 42 | 47 | 98 | 45 | 14 | 45 | 76 | 62 | 97 | 46 | 13 | 38 | 41 | 41 | 88 | 44 |
| Other | 2 | 9 | 4 | 4 | 26 | 12 | 1 | 3 | 1 | 1 | 12 | 6 | 3 | 9 | 12 | 12 | 14 | 7 |
| gdr | Female | 1 | 5 | 1 | 1 | 15 | 7 | 5 | 16 | 6 | 5 | 22 | 10 | 1 | 3 | 6 | 6 | 14 | 7 |
| Male | 21 | 95 | 89 | 99 | 203 | 93 | 26 | 84 | 116 | 95 | 190 | 90 | 33 | 97 | 95 | 94 | 185 | 93 |
|  | Total | 22 | 100 | 90 | 100 | 218 | 100 | 31 | 100 | 122 | 100 | 212 | 100 | 34  | 100 | 101  | 100 | 199  | 100 |

The use of the Maths Café drop-in sessions between 2014 and 2017 by students in Cohort 1 (entry-level).

Table 2: Cohort 2 (entry-level)

|  |  |  |  |
| --- | --- | --- | --- |
|  | 2014/15 | 2015/16 | 2016/17 |
| individual students | number of visits | whole cohort | individual students | number of visits | whole cohort | individual students | number of visits | whole cohort |
| No | % | No | % | No | % | No | % | No | % | No | % | No | % | No | % | No | % |
| ethnicity | BME | 18 | 60 | 50 | 68 | 181 | 41 | 35 | 57 | 106 | 68 | 196 | 42 | 15 | 37 | 42 | 31 | 176 | 37 |
| BME UK | 14 | 47 | 36 | 49 | 156 | 36 | 26 | 43 | 75 | 48 | 170 | 37 | 6 | 15 | 21 | 15 | 155 | 32 |
| White | 6 | 20 | 14 | 19 | 204 | 46 | 21 | 34 | 41 | 26 | 219 | 47 | 19 | 46 | 67 | 49 | 259 | 54 |
| Other | 6 | 20 | 10 | 14 | 54 | 12 | 5 | 8 | 9 | 6 | 47 | 10 | 7 | 17 | 27 | 20 | 44 | 9 |
| gdr | Female | 2 | 7 | 5 | 7 | 34 | 8 | 6 | 10 | 15 | 10 | 38 | 8 | 3 | 7 | 3 | 2 | 39 | 8 |
| Male | 28 | 93 | 69 | 93 | 405 | 92 | 55 | 90 | 141 | 90 | 424 | 92 | 38 | 93 | 133 | 98 | 440 | 92 |
|  | Total | 30 | 100 | 74 | 100 | 439 | 100 | 61 | 100 | 156 | 100 | 462 | 100 | 41  | 100 | 136 | 100 | 479 | 100 |

The use of the Maths Café drop-in sessions between 2014 and 2017 by students in Cohort 2 (entry-level).

Table 3: Cohort 3 (entry-level)

|  |  |  |  |
| --- | --- | --- | --- |
|  | 2014/15 | 2015/16 | 2016/17 |
| individual students | number of visits | whole cohort | individual students | number of visits | whole cohort | individual students | number of visits | whole cohort |
| No | % | No | % | No | % | No | % | No | % | No | % | No | % | No | % | No | % |
| ethnicity | BME | 11 | 42 | 33 | 36 | 44 | 26 | 10 | 30 | 38 | 46 | 28 | 20 | 6 | 23 | 20 | 20 | 31 | 22 |
| BME UK | 9 | 35 | 31 | 34  | 40 | 24 | 7 | 21 | 33 | 40 | 28 | 20 | 3 | 12 | 11 | 11 | 31 | 22 |
| White | 14 | 54 | 58 | 63 | 116 | 69 | 17 | 52 | 35 | 43 | 101 | 71 | 18 | 69 | 77 | 78 | 102 | 71 |
| Other | 1 | 4 | 1 | 1 | 7 | 4 | 6 | 18 | 9 | 11 | 14 | 10 | 2 | 8 | 2 | 2 | 10 | 7 |
| gdr | Female | 11 | 42 | 44 | 48 | 46 | 28 | 11 | 33 | 13 | 16 | 47 | 33 | 6 | 23 | 16 | 16 | 43 | 30 |
| Male | 15 | 58 | 48 | 52 | 121 | 72 | 22 | 67 | 69 | 84 | 96 | 67 | 20 | 77 | 83 | 84 | 100 | 70 |
|  | Total | 26 | 100 | 92 | 100 | 167 | 100 | 33 | 100 | 82 | 100 | 143 | 100 | 26 | 100 | 99 | 100 | 143 | 100 |

The use of the Maths Café drop-in sessions between 2014 and 2017 by students in Cohort 3 (entry-level).

With respect to gender, with the exception of Cohort 3 in 2014/15, we find that in all other cases a female students, made fewer visits in total. With the additional exception of Cohort 1 in 2015/16, a smaller proportion of female than male students in each Cohort used the Maths Café drop-in sessions.

With respect to ethnicity, in each case the proportion of BME students using Maths Café drop-in sessions was bigger than the proportion of white students. We can observe, however, that the frequency of BME students’ visits can vary significantly not only between Cohorts, but also from one year to another.

2.2. Intersectional results

Looking at the results in more detail, and intersection between gender and ethnicity, we present the same data as above, but broken down further, as given in Table 4. We can observe that BME women who used the drop-in sessions always made them with lower average frequency than students in other gender/ethnicity groups, and with the exception of Cohort 3 in 2014/15, the same holds for white women. We can see that, on the whole, both BME and white male students are using the service in proportionally greater numbers than students in other gender/ethnicity groups, but it is difficult to make a general statement about the frequency of their visits.

Table 4: Intersectional results for Cohorts 1, 2 and 3 at entry-level

|  |  |  |  |
| --- | --- | --- | --- |
|  | 2014/15 | 2015/16 | 2016/17 |
| individual students | number of visits | whole cohort | individual students | number of visits | whole cohort | individual students | number of visits | whole cohort |
| F% | M% | F% | M% | F% | M% | F% | M% | F% | M% | F% | M% | F% | M% | F% | M% | F% | M% |
| Cohort 1 (entry-level) |
| BME | 0 | 55 | 0 | 49 | 3 | 40 | 10 | 42 | 3 | 34 | 5 | 43 | 0 | 53 | 0 | 48 | 4 | 45 |
| White | 0 | 36 | 0 | 47 | 1 | 11 | 3 | 42 | 1 | 61 | 5 | 41 | 0 | 38 | 0 | 41 | 2 | 42 |
| Other | 5 | 5 | 1 | 14 | 3 | 42 | 3 | 0 | 1 | 0 | 1 | 5 | 3 | 6 | 6 | 6 | 2 | 6 |
| Cohort 2 (entry-level) |
| BME | 7 | 53 | 7 | 61 | 4 | 40 | 7 | 51 | 7 | 61 | 4 | 38 | 0 | 37 | 0 | 31 | 3 | 34 |
| White | 0 | 20 | 0 | 19 | 3 | 11 | 0 | 34 | 0 | 26 | 2 | 45 | 0 | 46 | 0 | 49 | 4 | 50 |
| Other | 0 | 20 | 0 | 14 | 1 | 42 | 3 | 5 | 3 | 3 | 2 | 8 | 7 | 10 | 2 | 18 | 1 | 8 |
| Cohort 3 (entry-level) |
| BME | 19 | 23 | 13 | 23 | 7 | 19 | 3 | 27 | 1 | 45 | 6 | 14 | 0 | 23 | 0 | 20 | 3 | 18 |
| White | 23 | 31 | 35 | 28 | 19 | 50 | 18 | 33 | 10 | 33 | 22 | 48 | 19 | 50 | 15 | 63 | 24 | 48 |
| Other | 0 | 4 | 0 | 1 | 1 | 3 | 12 | 6 | 5 | 6 | 5 | 5 | 4 | 4 | 1 | 1 | 3 | 4 |

The use of the Maths Café drop-in sessions between 2014 and 2017 by entry-level students by ethnicity and gender.

2.3. Second-year students

Looking at second-year students, however, the results change. Cohort 1 cannot easily be vertically compared, but we looked at the gender and ethnicity intersection of students enrolled on the same courses, as Cohorts 2 and 3, but a year further up. So, for example, those students represented in Table 4, who were in Cohort 2 (entry-level) in 2014/15, and have progressed at the end of that year, can be seen in Table 5 under Cohort 2 (year 2) and academic year 2015/16.

A clear pattern emerges: in the second year of studies, BME students of both genders use the Mathematics Support in proportionally larger numbers, and male BME students make more repeat visits than students in other groups (an exception is Cohort 3 in 2014/15, where we also note the number of individual students using the service was low). We can also observe a difference in the use of the service by white female students, who are now making more repeat visits.

Table 5: Intersectional results for Cohorts 2 and 3 at Year 2

|  |  |  |  |
| --- | --- | --- | --- |
|  | 2014/15 | 2015/16 | 2016/17 |
| Cohort 2 (year 2) |
|  | individual students(n=34) | number of visits(n=73) | whole cohort(n=340) | individual students(n=23) | number of visits(n=44) | whole cohort(n=425) | individual students(n=23) | number of visits(n=72) | whole cohort(n=399) |
| F% | M% | F% | M% | F% | M% | F% | M% | F% | M% | F% | M% | F% | M% | F% | M% | F% | M% |
| BME | 3 | 32 | 1 | 38 | 4 | 34 | 13 | 39 | 7 | 55 | 4 | 34 | 13 | 61 | 8 | 79 | 5 | 35 |
| White | 0 | 38 | 0 | 32 | 4 | 39 | 0 | 22 | 0 | 23 | 2 | 41 | 0 | 13 | 0 | 4 | 3 | 41 |
| Other | 3 | 24 | 3 | 26 | 3 | 16 | 0 | 26 | 0 | 16 | 2 | 18 | 4 | 9 | 1 | 7 | 4 | 12 |
| Cohort 3 (year 2) |
|  | individual students(n=13) | number of visits(n=67) | whole cohort(n=111) | individual students(n=43) | number of visits(n=142) | whole cohort(n=137) | individual students(n=23) | number of visits(n=86) | whole cohort(n=119) |
| F% | M% | F% | M% | F% | M% | F% | M% | F% | M% | F% | M% | F% | M% | F% | M% | F% | M% |
| BME | 23 | 23 | 15 | 13 | 7 | 19 | 12 | 23 | 11 | 31 | 6 | 20 | 17 | 17 | 8 | 31 | 4 | 15 |
| White | 23 | 31 | 64 | 7 | 20 | 52 | 28 | 37 | 32 | 26 | 22 | 50 | 17 | 43 | 12 | 45 | 22 | 50 |
| Other | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 4 | 0 | 3 | 0 | 5 | 4 |

 The use of the Maths Café drop-in sessions between 2014 and 2017 by second-year students by ethnicity and gender.

3. Conclusion

We believe that comparing the data collected in relation to the Maths Support with the numbers of students in particular cohorts offers a valuable insight. An example of this being done previously is (Gill and Greenhow, 2009), which also considers the gender of students who sought support in Mathematics. However, we believe that this study is unique in comparing the data for all students attending Mathematics Support against the data on cohorts they originate from, and in focusing on ethnicity as well as gender of the students.

In the sample we considered, we found that female students are not using the Mathematics Support service as much as we would expect based on anecdotal evidence and some literature, which may mean that when information is gathered by giving students a questionnaire, it is possible that women are more likely to respond than males. However, the results are in line with findings of some other sources, for example (Pell and Croft, 2008), which reports attendance at the maths suppor centre predominantly by British males with female and overseas students accounting for 10 and 7%, respectively.

In regard to the use of Mathematics Support by entry-level male students, we notice fluctuations which may be influenced by the clustering of students as discussed in (Mountford-Zimdars et al., 2015).

When comparing the results with other institutions, it is worth keeping in mind that students from ethnic minority groups are over-represented in the post-1992 institutions, such as the University of Portsmouth, and that the proportions at other institutions may look different as a result.

We believe that this area needs more research so as to better understand which student groups are under-attending and how to best reach out to them. However, based on the evidence in the literature, and experience, having a diverse tutor pool helps, as is providing an inclusive and supportive environment and striving to get as many entry-level students as possible to engage with the Mathematics Support. Our findings then indicate that in the second year of studies, students’ attitude to using the support changes, which is perhaps in part related do progression from first to second year. Finally, we believe that by gathering this type of data and sharing it with their institutions, the Mathematics Support services can provide valuable information relating to equality charters and perhaps understand and address the gaps in applications and degree attainment.

List of tables

Table 1: Cohort 1 (entry-level)

Table 2: Cohort 2 (entry-level)

Table 3: Cohort 3 (entry-level)

Table 4: Intersectional results for entry-level Cohorts 1, 2 and 3

Table 5: Intersectional results for Cohorts 2 and 3 at Year 2

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