

Mathematics instructors' awareness of accessibility barriers for disabled students

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In this paper, we discuss the results of a staff survey on accessibility barriers to participation and success for disabled students in higher education in the UK and Ireland. We focus on the range and complexity of student difficulties encountered by staff involved either in the lecturing of mathematics or the provision of Mathematics Learning Support. We report on the range of supports available to both staff and students in these situations and their varying levels of awareness and implementation of these supports. We close with a brief overview of how we intend to use the results of this survey to both increase awareness of existing appropriate supports and develop additional services to improve student accessibility.

1. Introduction

Recent decades have seen a steady increase in the numbers of disabled students who have disclosed accessibility barriers to participation and success in higher education (HE) in Ireland and the UK. This increase is also reflected among students who are studying mathematics and/or statistics or subjects with high mathematical or statistical content (Equality Challenge Unit, 2017; AHEAD Educational Press, 2018).

Students who struggle with mathematics may seek additional help directly from their instructors or avail of Mathematics Learning Support (MLS), if it is available in their institution. MLS is support provided to students in addition to their traditional lectures, tutorials and assignments and aims to give students the opportunity to succeed with the mathematical and statistical demands of their courses (Lawson *et al.*, 2012). It has grown from 'a form of cottage industry practised by a few well meaning, possibly eccentric individuals' (Kyle, 2010, p. 103) to be considered sustainable, securely embedded and valued within individual institutions (Lawson & Croft, 2015). As MLS matures into a professional service, it is reasonable to consider whether the collaborations, communities of practice and continuing professional development opportunities that have been developed support practitioners to meet the needs of the diverse student body they serve and specifically the needs of students with accessibility barriers.

While some institutions and individuals have detailed significant advances in this area (Trott *et al.*, 2013), a comprehensive review of how commonplace and standardized such services are in MLS has not yet been undertaken.

In order to investigate these issues further, the **sigma** Network for Excellence in Mathematics and Statistics Support (**sigma**) established an Accessibility Special Interest Group (SIG) in 2016. One of the SIG's priorities was to establish the main student accessibility barriers encountered by staff that are teaching mathematics or providing MLS across Ireland and the UK. To this end, the SIG developed and distributed an anonymous survey aimed at practitioners in the field. The focus of this paper is the outcomes of this accessibility survey, which we present and discuss in detail. Our main research questions are:

- What student accessibility barriers are reported by lecturing/MLS staff across Ireland and the UK?
- What is the level of support available for students with any such barriers?
- What is the level of staff awareness of such supports?

To place our findings in context, we include an overview of widening participation in Ireland and the UK, and the impact this has had on the HE student cohort. We also briefly describe MLS, its rapid growth and initial responses of the MLS community to accessibility barriers. We close by considering the lack of data on the number of students with accessibility barriers accessing MLS, outlining the future work of the Accessibility SIG to address staff awareness of accessibility barriers, as well as its development of teaching materials that can help to improve the learning experience of students with accessibility barriers.

2. Background

2.1 Widening participation

Drivers for widening access to HE exist in each of the four countries of the UK, as well as in Ireland. For example, in England, since 2006, Higher Education Institutes (HEIs) wishing to charge higher fees have been required to produce a nationally approved Access Agreement, aimed at improving the equality of opportunity for under-represented groups¹. HEIs are also required to have Access plans in: Wales (for courses to be designated for Welsh Government student support)²; Northern Ireland, for any fee-charging HEI; Ireland, where the National Access Plan³ makes a proportion of HEI funding dependent on the embedding of access considerations; and Scotland, where in 2016 the government set an agenda for future developments⁴ in widening participation, including the appointment of a Commissioner for Fair Access⁵.

In the UK, certain under-represented groups are also covered under the *Equality Act* (EA, 2010), the *Disability Discrimination Act* (DDA, 1995, 2001, 2005) and the *Special Educational Needs and Disability Act* (SENDA, 2001). The EA covers nine protected characteristics, including disability and requires institutions to:

1 <https://www.officeforstudents.org.uk/advice-and-guidance/promoting-equal-opportunities/access-and-participation-plans/>

2 https://www.hefcw.ac.uk/working_with_he_providers/he_wales_act_2015/fee_and_access_plan.aspx

3 <http://hea.ie/policy/national-access-plan/national-access-plan-2015-2019/>

4 www.gov.scot/Resource/0049/00496535.pdf

5 <https://beta.gov.scot/about/how-government-is-run/directorates/advanced-learning-and-science/commissioner-fair-access/>

- ensure students are not unjustly disadvantaged or unfavourably treated due to reasons related to disability;
- make, in a proactive manner, *anticipatory* reasonable adjustments for students to enable access;
- make reasonable *additional* adjustments if barriers remain.

Similar legal protections exist in Ireland under the DDA (2005) and the *Equal Status Acts* (ESA, 2000–2015).

In England⁶, Scotland⁷, Wales⁸ and Northern Ireland⁹, in addition to the support provided by their institution under the EA, disabled students can claim disabled students allowance (DSA). The aim is to assist students to meet some of the extra costs they may have when studying because of a mental health problem, long term illness or disability. In Ireland, in addition to the support provided by HEIs under the ESA, HEIs can claim from the Fund for Students with Disabilities on behalf of eligible students.

2.2 Impact on student population

The drive to widen participation, across all under-represented groups, has resulted in a more diverse student population in HE in both the UK and Ireland.

In the UK, disability disclosure rates have increased from 5.4% (119,545 of 2,200,175) in 2003/2004 to 11.3% (256,995 of 2,280,830) in 2015/2016 (Equality Challenge Unit, 2017). The total numbers refer to all students in the UK as per the HESA Student record, further data information and breakdown is available in the 2017 report (Equality Challenge Unit, 2017). The breakdown in 2015–2016 across the four countries was: England, 11.5%; Northern Ireland, 8.6%; Scotland, 10.1%; and Wales, 11.6%.

Categorical data can be difficult to interpret clearly, due to the presence of the *two or more impairments* category. However, the numbers can still guide us, see for example, Fig. 1. According to the Equality Challenge Unit (2017), during the period 2003–2016, there have been substantial growths in the number of students with specific learning difficulties (e.g. dyslexia, dyspraxia) and with mental health difficulties. There has also been a growth in the number of students with social communication difficulties and autism spectrum conditions. The numbers of students with sensory impairments, long standing illness and mobility issues have remained relatively flat over this period (the coding strategy was changed in 2010 which is the likely cause of some changes in these otherwise flat categories).

Table 1 outlines, in the academic year 2015/2016, disability disclosure rates as a proportion of all students (Equality Challenge Unit, 2017).

In relation to mathematically dense courses, in other words, courses with students who constitute the majority of MLS attendance, there is a comparable increase, see Fig. 2. According to the Equality Challenge Unit (2017), similar proportions of science, engineering and technology (SET) students (10.8%) and non-SET students (11.6%) disclosed themselves as disabled, although there was variation at the subject level. In SET subjects this ranged from 7.6% (engineering, technology) to 13.6% (biological sciences), with Mathematical Sciences at 9.1%. In the non-SET subjects this ranged from 9.9% (law) to 18.7% (creative arts, design).

⁶ <https://www.gov.uk/disabled-students-allowances-dsas>

⁷ http://www.saas.gov.uk/forms_and_guides/dsa.htm

⁸ <http://www.studentfinancewales.co.uk/undergraduate-students/new-students/what-financial-support-is-available/disabled-students-allowances.aspx#.WsUEYdYh08o>

⁹ http://www.studentfinanceneni.co.uk/portal/page?_pageid=54,1268430&_dad=portal&_schema=PORTAL

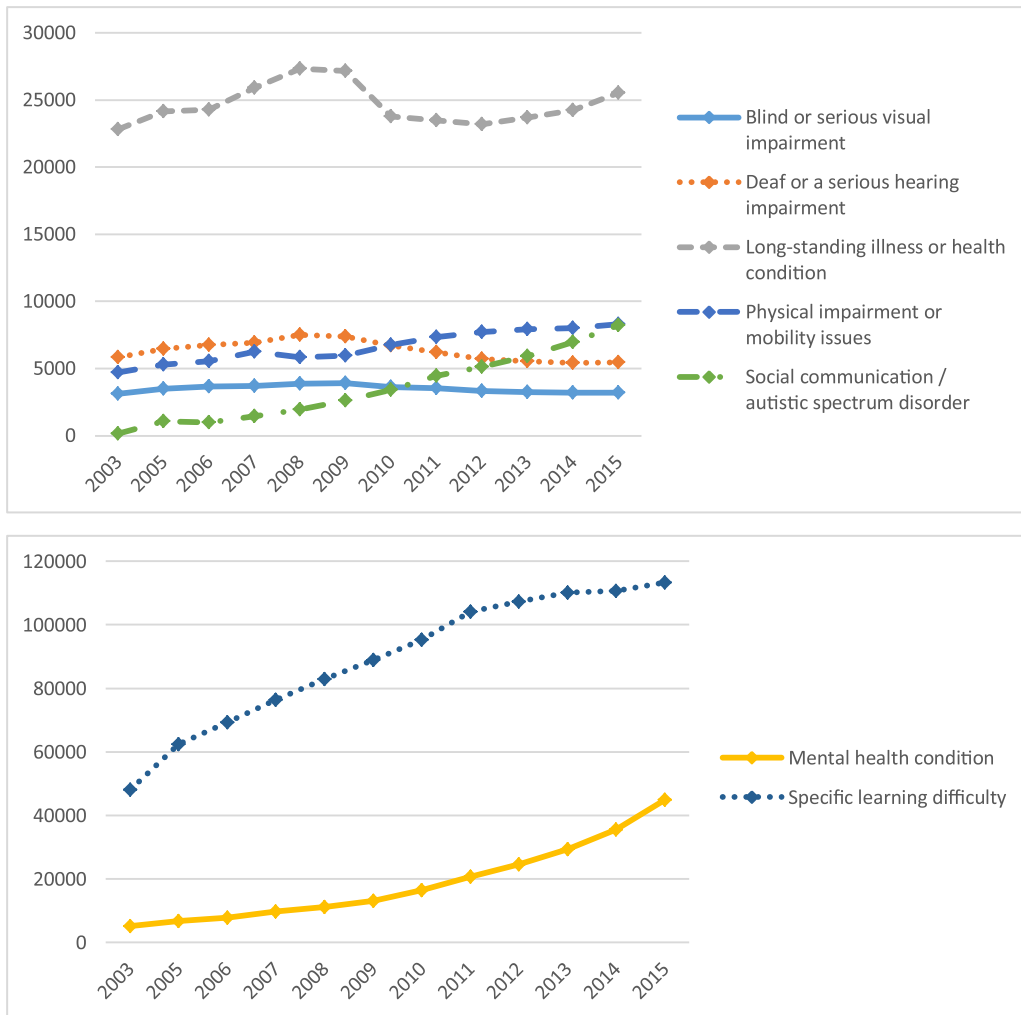


Fig. 1. Categorical breakdown of disability disclosure rates in HE in the UK from 2003/2004–2015/2016.

In Ireland, the situation is similar, though detailed comparisons are difficult due to differences in the data being recorded, see for example, Fig. 3. However, disability disclosure rates have increased from 1.1% (1410) in 1998/1999 to 5.7% (12,630) in 2016/2017 (AHEAD Educational Press, 2018). The National Access Plan (HEA, 2015) gives students with disabilities as a percentage of all *new entrants* to HE in 2015/2016 to be 6%. During the period 2009–2017, there has been increase in disclosures in most of the categories of disability. It would appear that the growth of disclosure of specific learning difficulties differs in nature to that of the UK but it is noted that Ireland breaks down this category further so the categories are not comparable. The numbers of students with sensory impairments have remained relatively flat over the 2009–2017 period.

TABLE 1. *Breakdown of disability disclosure rates in the UK*

	Number	% of disabled students	% of all students
Blind or serious visual impairment	3220	1.3%	0.1%
Deaf or series hearing impairment	5470	2.1%	0.2%
Long-standing illness or health condition	25,540	9.9%	1.1%
Mental health condition	44,900	17.5%	2.0%
Physical impairment or mobility issues	8305	3.2%	0.4%
Social communication/autistic spectrum disorder	8230	3.2%	0.4%
Specific learning difficulty	113,400	44.1%	5.0%
Two or more impairments	25,050	9.7%	1.1%
Other impairment	22,870	8.9%	1.0%

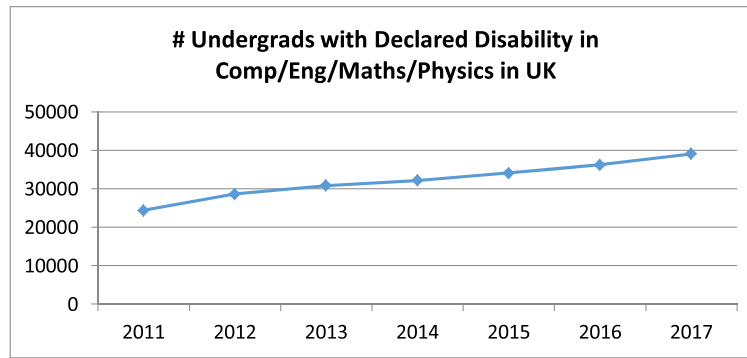


Fig. 2. Number of undergraduate students with a declared disability studying computer science, engineering, mathematics or physical sciences in the UK. [Source: ECU annual reports]

If we consider student groups who often avail of MLS (Fig. 4), we again see a similar trend. Note that Fig. 4 is not directly comparable with Fig. 2, they cover slightly different time periods and Science and Math cannot be separated from the Irish data. Regardless, they do point to similar trends.

2.3 The growth of MLS

The increased emphasis on widening participation in HE across the UK and Ireland has coincided with growth in the provision of MLS.

MLS is normally available to students through drop-in or appointments, in small groups or one-to-one (Pell & Croft, 2008). In the UK and Ireland, MLS was initially established in the 1990's independently in a few HEIs as one response to the decline in the mathematical ability of students transitioning from second-level (Gill & O'Donoghue, 2007; Lawson *et al.*, 2012).

This decline is a significant international problem, for example, the Organisation for Economic Co-operation and Development (OECD) identified it as a contributing factor in low enrolment and retention rates in science and technology courses (OECD, 1999). Croft *et al.* (2015) identify the impact on subjects outside of STEM, where proficiency in quantitative skills are essential, e.g. biosciences, psychology, economics, business, sociology and nursing. The provision of MLS expanded rapidly in both the UK and Ireland in the past few decades (Perkin *et al.*, 2012; Cronin *et al.*, 2016), and this has also been

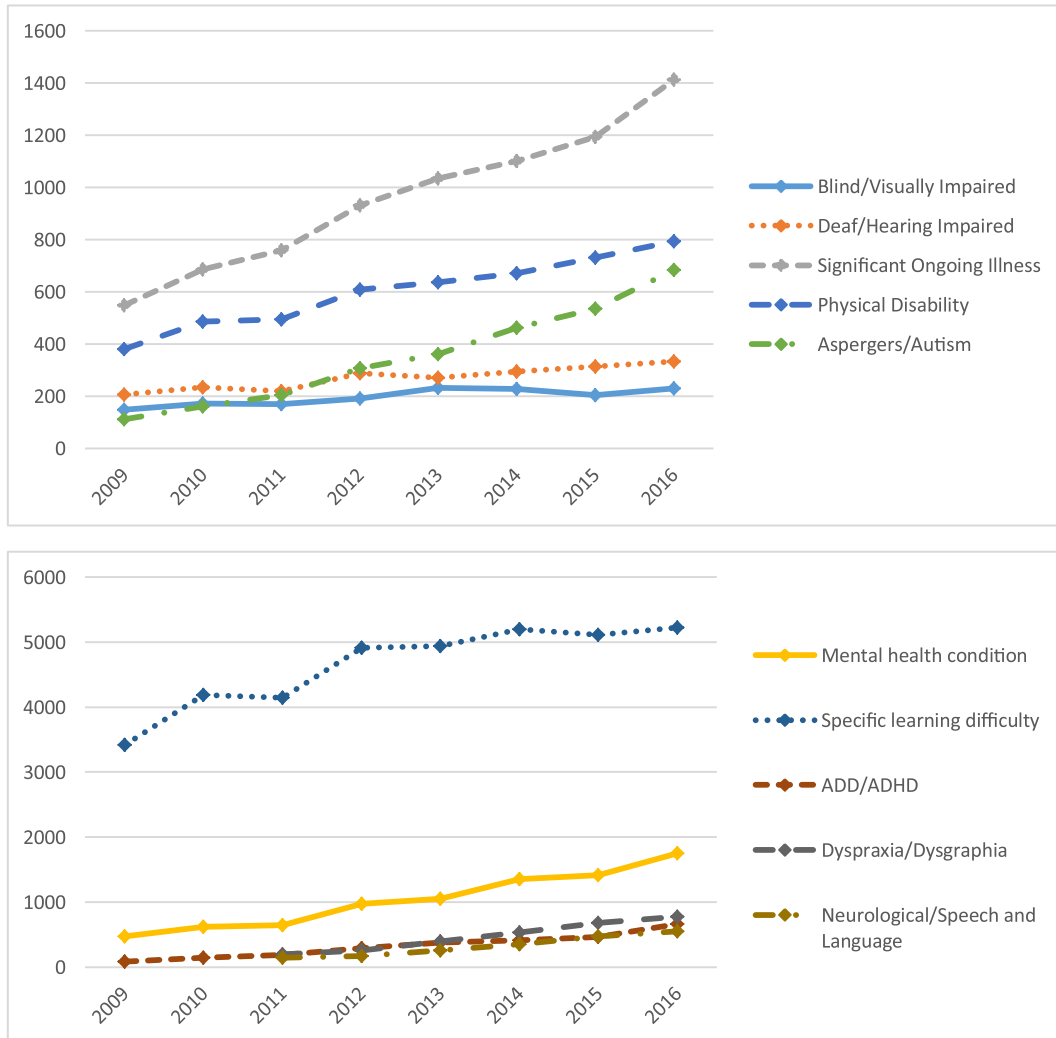


Fig. 3. Categorical breakdown of disability disclosure rates in HE in Ireland from 2009/2010–2016/2017.

reported in certain other countries such as Australia (MacGillivray, 2008). This growth is due, in large part, to the reported effectiveness of such initiatives, with increasing levels of research which indicate that MLS impacts positively on student retention and progression (Symonds *et al.*, 2007; Mac an Bhaird *et al.*, 2009). One key factor in the success of MLS in the UK and Ireland has been the establishment of networks of MLS practitioners, such as the **sigma** Network based in England and Wales, the SMSN (The Scottish Mathematics Support Network) and the IMLSN (Irish Mathematics Learning Support Network). These networks have regular conferences, workshops, meetings and publications that facilitate collaboration and the sharing of best practice. For further information on these, see, for example, www.sigma-network.ac.uk.

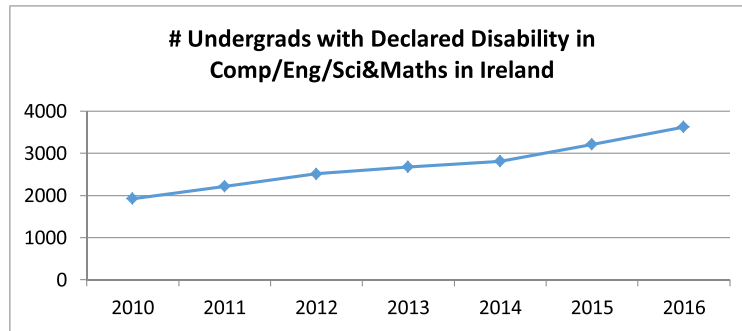


Fig. 4. Number of undergraduate students with a declared disability studying Computer Science, Engineering or Science and Mathematics in Ireland. [Source: AHEAD annual reports]

2.4 The response of the MLS community to accessibility barriers

As the proportion of students disclosing a disability has increased, the MLS community within the UK started to capture case study accounts of access barriers and to explore methods to anticipate and resolve the barriers to mathematical study. This section contains a brief outline of activities to date.

Initially, the Mathematics, Statistics and Operational Research Network (MSOR Network), a HEA Subject Centre, provided discipline-specific support from 2000 to 2012 and from 2003, the Dyslexia and Dyscalculia Interest Group (DDIG¹⁰) based within the Mathematics Education Centre at Loughborough University. DDIG brought together those working in MLS with an interest in specific learning difficulties, together with staff working in disability support services with an interest in mathematics. As well as forming the first network in this area, it organized exchanges of good practice in a series of workshops and conferences from 2004 to 2015 (see <http://www.lboro.ac.uk/departments/mec/activities/maths-statistics-support/thedyscalculiaanddyslexiainterestgroup/aboutus/> for an overview of their extensive activities to date).

Early research on accessibility, some of which is available from <http://icse.xyz/mathstore/node/126.html>, highlights the range of issues being addressed. For example, Ford (2002) considered the difficulties a student experienced in accessing mathematical studies, Trott (2003) reported on a case study of a dyslexic student and detailed interventions, Cooper (2006) presented to the MLS community the technical challenges of making mathematical text accessible, Whapples (2007) and Maddox (2007) both gave insight into the technical challenges of producing higher level maths in Braille that led to the Braille and LaTeX project, and Rowlett (2008) captured the difficulties a partially sighted student might experience in mathematics.

Best practice guides on MLS provision and conferences, such as CETL-MSOR (<http://www.sigma-network.ac.uk/cetl-msor/archive-of-cetl-msor-conference-proceedings-2006-2012/>), began to feature accessibility barriers (Lawson *et al.*, 2003; Trott, 2006). An MSOR Access Working Group ran from 2008 until 2013, and their output included the ‘Good practice on inclusive curricula in the mathematical sciences’ (Cliffe & Rowlett, 2012). This work also featured in ‘Student-centred approaches

¹⁰ <http://www.lboro.ac.uk/departments/mec/activities/maths-statistics-support/thedyscalculiaanddyslexiainterestgroup/>

in mathematics' (Robinson, 2012), along with research on methods to produce flexible and accessible learning resources in mathematics and on autism spectrum disorders and group work. HESTEM funding allowed for other significant collaborative projects, for example on Visual Impairment and STEM (Cliffe & Withington, 2013) (<http://www.hestem-sw.org.uk/project?id=14&pp=502>). 'Transitions in Undergraduate Mathematics Education' (Grove *et al.*, 2015) featured two chapters dedicated to Accessibility: 'The neurodiverse mathematics student' by Clare Trott and 'Creating an accessible learning environment: anticipating and resolving practical barriers' by Emma Cliffe.

The 2015 IMA International Conference in Glasgow, 'Barriers and Enablers to Learning Maths: Enhancing Learning and Teaching for all Learners' was the first IMA conference to focus on approaches to the teaching and learning of mathematics. This included sessions on 'Inclusive practice and learners' particular requirements' and 'Motivation and math anxiety' (<https://ima.org.uk/1326/ima-international-conference-barriers-enablers-learning-maths-enhancing-learning-teaching-learners/>). While research on mathematics anxiety is not a new phenomenon (Sheffield & Hunt, 2007), there has been a marked increase in recent years. This is evident through the number of conference sessions and papers that give attention to practical interventions for those involved in instruction. The 2015 and 2016 CETL-MSOR conferences had papers which considered how to address/overcome/tackle math anxiety, for example, Marshall *et al.* (2016), Strawbridge (2015) and Kotecha (2015). The 2016 HEA STEM conference had a session, led by Victoria Mann and Ellen Marshall, on 'Strategies for overcoming anxiety: a collaboration' (<https://www.heacademy.ac.uk/download/session-56-victoria-mann-and-ellen-marshall>).

3. Methodology

In autumn 2016, the SIG developed an online survey with three sections: most of the questions had fixed options and some gave participants the opportunity to add further comments. The first section had five questions on participants' backgrounds, and the last section included six questions that aimed to get some indication of the type of resources that participants would like to see developed. The main part of the survey, the middle section, consisted of eight questions focused on establishing the level of staff awareness of existing student accessibility barriers. These eight questions are available in Appendix A.

The survey was developed on Google Forms and reviewed by colleagues of the authors to address any issues relating to clarity etc. The final survey was disseminated through mailing lists for MLS practitioners and mathematics lecturers in the UK and Ireland in December 2016 and January 2017, with a total of 67 respondents.

3.1 Limitations of the study

The survey was conducted online and was disseminated via a number of mailing lists including **sigma**, the IMLSN and the SMSN. As such, it was only open to members of those mailing lists and not to a wider community. However, as these mailing lists are the primary source of information sharing within the MLS community, it was felt that respondents from these lists would represent many of the most engaged of those working in MLS. However, given that we did not ask respondents the name of their place of work, to preserve anonymity, it is possible that more than one respondent came from the same university, which may result in some duplication of information.

In Ireland, as well as some HEIs in the UK, MLS is typically delivered by tutors, often postgraduate students or similar, with perhaps one lecturer also involved (usually the manager/director of the

TABLE 2. *Background information on the survey respondents (n = 67)*

Country	Institution Type	Teaching role	MLS available	MLS type available
England 27 (40.4%)	College of Further Education 0 (0%)	MLS 33 (49.3%)	Yes 62 (92.5%)	Drop-in 58 (93.5%)
N. Ireland 0 (0%)	Institute of Technology 13 (19.4%)	Service Mathematics 32 (47.8%)	No 5 (7.5%)	Online 44 (71.0%)
R. of Ireland 25 (37.3%)	University 54 (80.6%)	Mathematics to Degree 16 (23.9%)		Workshops 29 (46.8%)
Scotland 7 (10.4%)		Other 8 (11.9%)		Other 18 (29.0%)
Wales 8 (11.9%)				

Mathematics Learning Support Centre (MLSC)). The mailing lists on which this survey was disseminated would not have a high proportion of these postgraduate students as members, and as such, it is likely that few, if any, completed the survey. The most likely respondents are managers/directors of MLS, along with mathematics lecturers. Although their responses are also important in terms of this study, the absence of a strong postgraduate tutor voice at times has impacted upon the reliability of the data, particularly in terms of reporting of general awareness and approaches to working with students with access barriers.

4. Results

4.1 Background

The background of the 67 respondents is given in Table 2, showing the country and type of HEI in which they work, their teaching role and the type of MLS available. Respondents could select more than one response for teaching role and type of MLS available.

Most respondents ($n = 66$, 94 responses) indicated that they had more than one current teaching role. Of the 33 that taught in a MLSC, 15 selected this option only, with the other 18 indicating that they also lectured students taking mathematics to degree level and/or service mathematics students (who are taking mathematics as part of another degree, e.g. engineering, science, economics). The 12 of the 32 respondents who indicated that they lectured service mathematics selected this option only, as did six of the 16 who said that they lectured students taking mathematics to degree level. Seven respondents indicated they lectured both groups of students. Eight responses gave other alternative roles, such as working in student support services or coordinating MLS. The 60% of Irish and 54.8% of UK respondents taught in MLS.

The 92.5% of respondents indicated that their institution provided MLS and many of these provided a range of supports, with 24 respondents selecting all three options (drop-in centres, online and workshops), and 22 selecting two of these. All but two of the 'other' options were selected in combination with the three fixed options. 'Others' included Facebook groups, general appointments, embedded classes or specific appointments for students registered with the Disability Service.

4.2 Accessibility survey

Respondents were asked: *While teaching mathematics/in MLS, have you encountered students displaying any of the following?* They were given a list of 12 options and could select 'Yes', 'Not that I am aware

TABLE 3. Breakdown of responses to question 1 from the accessibility survey

	Yes	Not that I am aware of	Uncertain what this means	Total responses
Dyslexia	54(81.8%)	12(18.2%)	0(0%)	66
Autistic spectrum disorder (ASD including Asperger syndrome)	43(65.2%)	23(34.8%)	0(0%)	66
Mental health concerns	42(63.6%)	24(36.4%)	0(0%)	66
Mathematics specific anxiety/phobia	38(61.3%)	23(37.1%)	1(1.6%)	62
Visual impairment	35(55.6%)	27(42.9%)	1(1.5%)	63
Hearing impairment	34(52.3%)	31(47.7%)	0(0%)	65
Dyscalculia	32(48.5%)	33(50%)	1(1.5%)	66
Restricted mobility/motor control	29(45.3%)	35(54.7%)	0(0%)	64
Dyspraxia	25(37.9%)	29(43.9%)	12(18.2%)	66
Fatigue and pain conditions	22(34.9%)	41(65.1%)	0(0%)	63
AD(H)D	21(33.3%)	40(63.5%)	2(3.2%)	63
Dysgraphia	7(11.3%)	28(45.2%)	27(43.5%)	62

of' or 'Uncertain what this means', as shown in Table 3. These have been re-ordered in the table in order of most commonly encountered. Of the 66 respondents to this question, only two had never encountered a student with any of the listed conditions, to the best of their knowledge, and both of these taught exclusively in MLS.

If the responses are broken down between Irish respondents and those from the UK, the picture remains largely the same, with two exceptions. The percentage of respondents who have encountered students with dyscalculia (64% for Irish respondents versus 39% for UK) and those who are unsure what is meant by dyspraxia (28% for Irish respondents versus 12% for UK).

To gain further insight, there were a number of follow-up questions. In an open question, respondents were asked to list the difficulties (from Table 3) that they encountered most often in students ($n = 61$, 82 responses). While dyslexia (39) and math anxiety/phobia (22) were most common, ASD (8), mental health concerns (6) and dyscalculia (2) were also selected, while dyspraxia, dysgraphia, fatigue, hearing impairment and restricted mobility/motor control each received a single mention. However, respondents also commented that they were 'not always given specific diagnoses', that they were 'not always aware of other disabilities' (other than anxiety) or (again in relation to anxiety) that they were 'unsure if it needs to be diagnosed but it's blatantly obvious'.

The responses to the remaining six questions are shown in Table 4. Each question required a Yes/No/Do not know response, with the last question being the only question where respondents (24) selected 'Do not Know'*. Where respondents answered 'Yes', they were asked to provide further information. When asked if they thought that students presenting with these difficulties tended to be from specific courses or disciplines, 26.2% said yes, and subsequently listed engineering (4), health/nursing (4), maths (2), biology (2), computer science/computing (2), life sciences (1) and economics (1). Others mentioned how such students are mostly 'mature learners' (Uni, Ireland), how those in Level 7 degrees are 'more likely to be dyslexic' (IoT, Ireland) or how ASD students are 'mainly from Computing courses' (Uni, England).

The questions then focused on the supports available for students presenting with these difficulties, with 35.5% stating that their MLS service made special provisions for these students. The 22 responses with further details fell into a range of categories. The majority of these responses (12) related to MLS supports, such as leaflets about managing stress or effective studying, math anxiety workshops, larger

TABLE 4. *Breakdown of responses to questions 3–8 from the accessibility survey, where respondents could answer 'yes', 'no' or 'do not know'. Each question then asked respondents to comment further if their response was 'yes'. *Indicates that the remaining responses to this question were 'do not know'*

	Yes	No	Total
Have you noticed that these students tend to be from specific courses/disciplines?	17(26.2%)	48(73.8%)	65
Are there any special provisions made in your MLS service for students with any such issues?	22(35.5%)	40(64.5%)	62
Are your tutors provided with special training for working with students with any such issues?	17(27%)	46(73%)	63
Have you ever encountered a situation in MLS where you felt unsure as to how to help a student who presents with any such issues?	25(39.7%)	38(60.3%)	63
Are you aware of support provided in your institution (outside of MLS) for students with any such issues?	53(82.8%)	11(17.2%)	64
If such external supports are provided, does your MLS service liaise with these supports?	35(55.6%)	4(6.3%)	63*

font/coloured backgrounds as needed and an informal approach where staff try to allocate additional time or a quiet room to the student in question. A number of responses related to supports outside MLS (6), such as the Disability Advisory Service, Counselling Service, Academic Skills Service or Student Well-being Team. Here, there was a marked difference between the answers of Irish respondents and those based in the UK, with only 16% of Irish agreeing that there were special provisions available in their MLS, compared with 42.9% of UK respondents.

Only 27% of respondents indicated that their tutors were provided with special training for working with students with any such issues, with no appreciable difference between countries here. There were 19 responses to the request for further details, and these suggest that most training is either given by the Disability Service staff or based on training material developed by **sigma**.

The 39.7% of respondents indicated that they had encountered a situation in MLS where they felt unsure as to how to help a student who presented with any such issues; a figure that was almost identical when responses from different countries were compared. The 22 responses gave further details, with the majority of these (14) referring to specific accessibility issues, such as anxiety ('*very difficult to assess how to help a student who is panicking . . . almost like the role of a counsellor*'), ASD ('*require a lot of time in the form of one-to-one tuition, which is difficult to provide in a busy drop in centre*'), dyslexia/dyscalculia ('*difficult to know exactly how to support the student*') and mental health concerns ('*very difficult to help. We can send them to counselling service, but we don't always know how to help them academically.*').

Other comments referred to the types of difficulties that can arise in these situations, such as students refusing to engage with specialist services or the difficulty of relying on self-disclosures alone which frequently do not occur in an MLSC.

This section of the questionnaire closed with a focus on general supports available in institutions for students presenting with such issues and how MLS liaised with them. The 82.8% of respondents were aware of support provided in their institution (outside of MLS) for students with any such issues. There was a difference between Ireland and the UK here, with 91.7% of Irish respondents aware of these supports, compared with 77.5% in the UK. The 48 responses give further details on these supports, with the majority (28) listing supports such as Disability Service, Dyslexia Support Service, Access Office,

Career Service, Counselling Service, Student Engagement Office, Student Support Service, Chaplaincy and Student Enabling Centre.

Another 14 responses gave specific details on the types of supports available from such services, such as meeting with students, scribes for lectures, sign readers, Live Scribe pens and electronic paper, screen readers, magnifiers, additional tuition, and individual learning profiles.

The 55.6% of respondents indicated that their MLS service liaises with these external supports, 6.3% selected No and a further 38.1% Do not Know. Again, there was a difference here, with 50% of Irish respondents agreeing (compared with 59% of UK) and 45.8% of Irish respondents saying they Do not Know, compared with 33.3% in the UK. The additional 33 comments with further details fell into two main categories: those describing specific liaisons or plans of action and those describing informal processes. Some respondents describe working closely with Study Support Advisors, or the Access team, with MLS staff and the other support service meeting students together or conducting workshops together or having a formal arrangement for referring students between Disability Support and MLS.

5. Discussion

Across the UK and Ireland, there has been a significant increase in both the number of students disclosing disabilities in HE and the number of these students undertaking mathematically dense programmes, as shown in Section 2 above. While there are no figures available on the number of these students using MLS (and no way to accurately measure this), there are, at the very least, more students with access barriers taking courses with mathematical requirements than before. Furthermore, anecdotal evidence from discussions at MLS conferences and on MLS emailing fora have suggested an increase in the number of students with accessibility barriers presenting to MLS. This is underlined by the fact that only 3% of respondents had never, to their knowledge, encountered a student with one of the issues listed in Table 3, and both of these respondents taught exclusively in MLS, where, in general, students need to self-disclose any issues to individual tutors. The difficulty of the rarity of self-disclosure was commented upon more than once by respondents, who noted the challenge of working with students where no formal diagnosis had been disclosed to them, as MLS workers. One noted that *'Sometimes I may think that a student has issues but I can't ask them'*, while another mentioned that this can *'lead to a feeling of helplessness on behalf of the tutor'*. More than once, the suggestion was made that some sort of system should be in operation whereby disclosures can be made by the Disability Service to MLS staff in the same way as they are currently made to lecturing staff. This would, of course, require the consent of the student in question, and seems unlikely to occur due to issues of confidentiality. However, many students may not even be aware that those working in MLS do not have access to such information, which would further impact upon self-disclosure rates.

Due to the sparsity of research involving general MLS staff and accessibility issues, there were three primary research questions that this survey aimed to answer: the main accessibility barriers encountered by lecturing/MLS staff, the level of supports for students with any such barriers and staff awareness of such supports. We were also interested in any differences that may emerge between Ireland and the UK, either in terms of awareness or supports.

This is the first time that this topic has been investigated in this way, and the survey has yielded some interesting results, many of which highlight the work that remains to be done in terms of accessibility in MLS. Overall, respondents were largely familiar with the terminology involved in the 12 access barriers on which they were asked to comment. In relation to just two of these, a significant portion of respondents said they were uncertain what it meant: dysgraphia (43.5%) and dyspraxia (18.2%).

Although 60.3% of respondents indicated that they had never encountered a problem when dealing with a student who had additional needs in MLS, this question could have been better phrased, as it did not provide respondents with an explicit 'non-applicable' option for those who have never taught in MLS. In fact, when considering only those respondents who teach in MLS, this figure drops to 50%. Despite half of those surveyed working in MLS having encountered problems, the proportion of respondents who indicated that their MLS tutors received special training for working with students with any form of disability was low, at 27%, and the majority of those who commented on this issue admitted that the training consisted of a short session within the general tutor training day. To give this some context, in 2011, **sigma** produced a guide for postgraduates who tutor in MLS, and this contained one section with advice on working with students with certain access barriers (Croft et al., 2011, p 14–18). A 2012 **sigma** report on how to set up MLS provision also contained a section on supporting neurodiversity (Mac an Bhaird & Lawson, 2012, p 22–24).

In Section 2.4, we gave an overview of the work that has been carried out by the MLS community to date. Some of the findings of this survey support the possibility that the fragmented nature of the MLS work on accessibility has not impacted on general practice, except in localized situations. The need for an initiative such as the **sigma** SIG on accessibility is also underlined by the fact that 64.5% of respondents said there was no special provision made for students within their own MLS at this time. Liaisons between MLS and other support services were largely *ad hoc* arrangements or else were poorly publicized among staff members, with numerous respondents who work in MLS stating that they do not know if their MLS works with other support services.

There are opportunities for further research related to the survey, for example, participants were asked if they had 'encountered' students displaying certain issues, so the responses received (see Table 3) do not differentiate between diagnosis/student disclosure, or indeed, if the respondent is merely making an observation. The latter may have been the case, for example, in one of the most frequently encountered difficulties reported by participants: that of math anxiety/phobia. One respondent commented '*unsure if it needs to be diagnosed but it's blatantly obvious*'. This is a possible limitation of the survey and could be investigated as part of further work.

6. Conclusion and next stage

It is clear from the results of this survey that there exists a wide range of practices in relation to student accessibility barriers. It is encouraging that there are so many services and supports in existence for students, but improvements are certainly needed in terms of awareness of how MLS can effectively and formally liaise with these services, and a more coherent approach across the sector would be beneficial.

Recommendations and actions resulting from this survey fall into three main categories: resources, training and communication. In the first category, a number of new resources are in the process of being developed, aimed specifically at those working in MLS, to explain the most common traits associated with different access barriers and suggest effective means for working with such students. These will be made freely available via the **sigma** network and widely disseminated throughout the MLS community and should hopefully go some way towards assisting tutors on the ground.

In terms of training, the importance of a formal approach towards training in accessibility barriers for MLS tutors remains paramount. Recent moves towards the standardization of tutor training lead to a natural avenue to introduce more extensive accessibility training at various levels to MLS tutors (Croft & Grove, 2016; Fitzmaurice et al., 2016). Therefore, we strongly recommend that all tutor training programmes for those working in MLS include training on working with students with accessibility barriers. In fact, the additional resources being developed by the SIG could be used in MLS tutor training.

There are also increasing calls to make the training of lecturers commonplace and/or compulsory, with the Mathematics Association of America stating that ‘Departments should provide long-term structured opportunities for acquisition and improvement of teaching skills by all who teach’ (MAA, 2003, p.3). It seems natural to include accessibility in this training. The SIG also recommends, based on survey responses, that disability support staff should be involved in the provision of all accessibility training.

Thirdly, in relation to communication, we recommend that all those involved in MLS liaise in a formal way with those working in Disability Services in their HEI and ask them to make students aware that, in general, staff working in MLS will not have access to any disability disclosures that they have made to lecturing staff. In this way, students could be encouraged to self-disclose to MLS staff where appropriate, to assist in them being provided with the optimum support possible. We believe that this combination of resources, training and communication can result in improvements in how students with accessibility barriers are served by MLS in the future.

sigma Accessibility Survey

A.1 Section B:

1. While teaching mathematics/in MLS, have you encountered students displaying any of the following?

	Yes	Not that I know of	Uncertain what this means
Dyslexia			
Dyscalculia			
Dyspraxia			
Dysgraphia			
Autistic spectrum disorder (ASD including Asperger syndrome)			
AD(H)D			
Visual impairment			
Hearing impairment			
Restricted mobility/motor control			
Mental health concerns			
Fatigue and pain conditions			
Mathematics specific anxiety/phobia			

- From the above options, please list those that you have encountered MOST OFTEN in students.
- Have you noticed that these students tend to be from specific courses/disciplines? Yes/No. If yes, please list the courses/disciplines.
- Are there any special provisions made in your MLS service for students with any such issues? Yes/No. If yes, please give details.
- Are your tutors provided with special training for working with students with any such issues? Yes/No. If yes, please give details.
- Have you ever encountered a situation in MLS where you felt unsure as to how to help a student who presents with any such issues? Yes/No. If yes, please give details.
- Are you aware of support provided in your institution (outside of MLS) for students with any such issues? Yes/No. If yes, please give details.
- If such external supports are provided, does your MLS service liaise with these supports? Yes/No. If yes, please give details.

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