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## Adult Learners and Mathematics Learning Support

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### Abstract

The provision of some level of Mathematics Learning Support (MLS) is now standard in the majority of Higher Education Institutions in Ireland, the UK, and in many other countries. This provision is, in part, a response to the large numbers of students entering Higher Education who do not have the mathematical skills required and this cohort includes a significant number of adult learners. Research indicates that these students have different motivations and approaches to learning than traditional age learners. This paper considers the analysis of a large scale student evaluation of Mathematics Learning Support in Ireland. In particular, it presents the responses and engagement levels of adult learners and compares these to those of traditional students. The findings are key to ensuring best practice in the provision of MLS for the wide variety of students who engage with it.

Keywords: adult learners, engagement, evaluation, mathematics learning support

### Introduction

The availability of some form of Mathematics Learning Support (MLS) is now what students can expect to find in the majority of Higher Education Institutions (HEIs) in Ireland and the UK. MLS is also available in HEIs internationally, for example in Switzerland, Canada and Australia (Gill et al., 2008; Perkin et al., 2012). MLS has been defined as a facility offered to students which is surplus to their traditional lectures and tutorials, the purpose of which is to

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offer non-judgemental and non-threatening one-to-one support with mathematics (Ní Fhloinn, 2007; Lawson et al., 2003; Elliot and Johnson, 1994).

The main reason for the establishment and significant growth of MLS was to tackle the well documented ‘Mathematics Problem’. One of the ways O’Donoghue (2004) defines the ‘Mathematics Problem’ refers to the mathematical preparedness of incoming students in terms of their mathematical shortcomings or deficiencies at the university interface. Significant numbers of students entering HEIs are deemed at-risk of failing or dropping out because they do not appear to be appropriately prepared for mathematics in HE and often exhibit very weak mathematical backgrounds. This ‘Mathematics Problem’ is common place in HEIs in Ireland, the UK and internationally (Gill et al., 2010; Lawson et al., 2012). These at-risk students are the main target of MLS.

One benefit of the economic downturn has been the welcome increase in adult learners returning to HE (Golding and O’Donoghue, 2005). In the Dublin Institute of Technology (DIT), adult learners constituted one fifth of the attendants at the Mathematics Learning Support Centre (MLSC) in its opening year (Ní Fhloinn, 2007). In 2012 adult learners accounted for 15.3% of full time students enrolled in HE in Ireland and 21% of full and part time students. Faulkner et al. (2010) stated that the presence of so many adult learners is one contributing factor to the increased numbers of at-risk students in first year courses.

In order to establish best practice in the successful provision of MLS, it is essential that it is comprehensively evaluated on a regular basis (Matthews et al., 2012). For example, quantitative research suggests that appropriate engagement with MLS can have a positive impact on student retention and progression (Lee et al., 2008; Mac an Bhaird et al., 2009). One of the initial aims of the Irish Mathematics Learning Support Network (IMLSN), which was established in 2009, was to conduct a large scale survey of student opinion on MLS. A full report on this survey was published in November 2014, and is available from <http://epistem.ie/wp-content/uploads/2015/04/IMLSN-Report-16102014Final.pdf>. There is some overlap between the final report and results presented in this paper (submitted June 2014).

Given the increasing proportion of adult learners in mathematics in first year courses, it was considered key that they should be identifiable in the survey so that their responses regarding the evaluation of MLS could be studied in detail. A chi-square test for independence carried out on the data collected indicated a statistically significant association existed between type of student (i.e. adult learners or traditional learners) and whether a student used MLS ( $p < 0.001$ ), thus demonstrating that adult learners were more likely to seek support than traditional age learners. Further investigation however demonstrated that 38% of the adult learners surveyed never accessed MLS in their institutions. The authors decided to investigate the underlying reasons behind these findings further.

The main research questions we are trying to address are:

1. What are the motivational factors of adult learners who seek MLS?
2. Why do some adult learners of mathematics not seek MLS?

### **Literature review**

There is a concern that a lack of preparation in mathematics can lead to increased failure rates and low self esteem (Symonds et al., 2007) in HEIs. Aligned with that is a worry of impeding students in the study of other disciplines, e.g. engineering, science (Pell and Croft, 2008; Gill, 2006). Many students arrive in their HEI having chosen mathematics-intensive courses unbeknownst to themselves (FitzSimons and Godden, 2000). Most degree programmes, even non-specialist mathematics degrees, contain some mathematics and/or statistics component, as prospective employers require graduates to be proficient in mathematics, with some even setting numeracy tests as part of their selection process (Lawson et al., 2003). The mismatch

between the knowledge of many students and the expectations of HEI teachers is one contributory factor to the problem and this mismatch arises partly through the increase in diversity of the backgrounds of students (Lawson et al., 2003; Faulkner et al., 2010). Diversity in the standards of teaching and class size in HEIs tend to exacerbate the situation (Lawson et al., 2003; Gill, 2006).

One of the key responses to the 'Mathematics Problem' was the opening of Mathematics Learning Support Centres (MLSCs) to attempt to deal with the mathematical shortcomings of students (Pell and Croft, 2008; Gill, 2006). In 2004 in the UK it was reported that 62.3% of 106 surveyed universities offered some form of MLS (Pell and Croft, 2008, p. 168). In 2012, this number had jumped to 85% (Perkin et al., 2012). In 2008, an audit carried out by the Regional Centre for Excellence in Mathematics Teaching and Learning (CEMTL) in Ireland demonstrated that 13 out of 20 HEIs provided MLS in some form (Gill et al., 2008). Seven years later, it is believed that this number is much higher. Most MLSCs are committed to servicing the needs of traditional and non-traditional (i.e. international and adult learners) students (Ní Fhloinn, 2007; Gill and O'Donoghue 2006). Carmody and Wood (2005) reported on the benefits of a drop-in MLSC for easing the transition to HE for first-year students. The drop-in centre caters for students from all faculties and has become a meeting place for collaborative learning. Tutors use a variety of teaching methods and resources, which is easier to do in a one-to-one situation than in front of a large class. Engagement with MLS has been shown (through mostly quantitative research) to impact positively on mathematics performance and grades and retention (Burke et al., 2012; Mac an Bhaird et al., 2009; Pell and Croft, 2008; Symonds et al., 2007). Pell and Croft (2008) state that while MLS is provided first and foremost for 'at-risk' students, it is more often the case that users tend to be high achievers working to attain high grades, a view supported by Mac an Bhaird et al. (2009) who have also shown that many 'at-risk' students still do not engage with MLS.

An Adult Learner, or Mature Student, is classified in the Republic of Ireland as a student that is 23 years of age or older on 1st January of the year of registration to HE (Ní Fhloinn, 2007). Entry for adult learners who have not got the minimum requirement for entry to their chosen course of study is usually gained via interview and is based on a number of factors including life experience and motivation, in addition to prior qualifications. Faulkner et al. (2010) studied the student profile in service mathematics programmes at the University of Limerick (UL) since diagnostic testing began there in 1997. The increase in adult learners of mathematics in these modules was quite pronounced. In 1997 there was one registered in Science and Technology Mathematics, two of the biggest service mathematics modules provided by this university; in 2008, there were at least 55 adult learners. This statistic is supported by Gill (2010) who states that in 2009/10, adult learners in UL constituted 14% of the entire cohort, an increase of 49% on the previous year. In 1997, 30% of students in one service mathematics modules at UL were deemed to be at-risk. Fast forward to 2014 and 66% of students in the same module are categorised as at-risk.

Adult learners of mathematics who return to education constitute a heterogeneous cohort. For example, participants on the 'Head Start Maths' bridging programme at UL range from 23 to over 45 years of age. A significant number of the students on the programme in 2008 had not studied mathematics in any formal sense for up to 20 years and 30% of participants had not taken the Leaving Certificate (LC) examination (Gill, 2010). The LC is the terminal examination taken by pupils at the end of secondary school in Ireland. Mathematics is compulsory for students and can be taken at three levels: Higher (HL), Ordinary (OL) and Foundation (FL). In DIT, Ní Fhloinn (2007) outlines how adult learners fall into the full-time, part-time or apprenticeship categories, with each type of student presenting with different characteristics and issues relating to their preparation, their approach to learning mathematics and confidence issues. It can be very difficult for students to catch up with forgotten fundamentals and keep up with current studies simultaneously (Gill, 2010; Lawson et al., 2003).

Diez-Palomar et al. (2005) and O'Donoghue (2000) acknowledge the difference between adult learners of mathematics and traditional learners. Adult learners carry with them an abundance of experiences that need to be considered in pedagogical practices. This view is supported by Tusting and Barton (2003) who add that adult learners have different motivations for studying than traditional learners and are more inclined to be autonomous and reflective learners. The decision to return to education has generally been their own decision and a deliberate one (FitzSimons and Godden, 2000). Though adult learners may lack confidence in their own abilities, they tend to be highly motivated (Ní Fhloinn, 2007; FitzSimons and Godden, 2000). Traditional lectures and assessments are not conducive to learning for many adult learners (Gordon, 1993 cited in FitzSimons and Godden, 2000) so many rely on MLSCs for support. In 2009/10 adult learners of mathematics at UL constituted 54% of the attendance at the drop in centre, even though they represented just 14% of the entire student population (Gill, 2010).

While the importance of research in the teaching and learning of mathematics among adult learners has been duly recognised in recent years (Coben, 2003) it remains an 'under theorised and under researched' area (Galligan and Taylor, 2008, p. 99). Furthermore, research conducted on the teaching and learning within MLSCs is sparse (Galligan and Taylor, 2008).

### Methodology

The IMLSN was established in 2009, and its guiding principles are similar, on a smaller scale, to the leading experts in the provision of MLS, the **sigma** (The Centre of Excellence in Mathematics and Statistics Support) network (<http://sigma-network.ac.uk/>) based in England and Wales. The IMLSN aims to support individuals and HEIs involved in the provision of MLS in Ireland. Once set up, the network decided it should promote the benefits of MLS to both staff and students on an institutional, national and international basis and agreed that a student survey was the best approach initially. The IMLSN asked the panel of researchers listed on this paper to undertake this student survey.

Student questionnaires are commonly used in the evaluation of MLS services (Lawson et al., 2003) in individual HEIs, so it was decided to create a student survey that could be used in all HEIs which provide MLS. HEIs who already distributed questionnaires on MLS were invited to submit them to the committee; these were amalgamated and a communal questionnaire was formed as a result. This questionnaire was piloted in 4 HEIs with 100 students and subsequently refined based on analysis of the findings and expert statistical advice.

The resulting questionnaire (See Appendix I) had 17 questions, a combination of open questions and questions which required a response on a 5-point Likert scale. There were three main sections: Section A determined the students' backgrounds; Section B focused on users of MLS; and Section C focused on non-users of MLS. First year service mathematics classes have the largest percentage of at-risk students and are the main target of MLS in terms of student retention and progression, so it was decided to issue the questionnaire to these cohorts only. Service mathematics refers to users of mathematics (e.g. engineering, science, business), rather than mathematics specialists (e.g. pure or applied mathematicians) (Burke et al., 2012). Evaluation sheets are usually distributed within MLSCs but this can lead to bias as users already rate the MLSC to some extent if they attend it (Lawson et al., 2003). With this in mind, it was decided that the questionnaire should be issued in mathematics lectures to get a blend of user and non-user feedback and to reduce bias. The questionnaires were anonymous and there were no identifying characteristics. The questionnaire was issued to members of staff involved in the provision of MLS in HEIs in Ireland and they were asked to distribute paper copies in first year service mathematics lectures during the second semester of the 2010-11 academic year.

The HEIs surveyed were Universities and Institutes of Technology (IoTs), and these have different and complementary roles and missions within HE in Ireland. At undergraduate level Universities focus on Level 8 (Honours Degree programmes), and IOTs emphasise career-focused HE offering Level 8 programmes but also Level 7 (Ordinary Degrees) and Level 6 (Higher Certificates) programmes. IOTs also have a larger proportion of adult learners and students from disadvantaged areas and are stronger than the Universities in part-time and flexible provision (<http://www.heai.ie/en/node/981>). In the IOTs that participated in the survey, the ratio of Level 8: 7: 6 students was 49:39:12% which is similar to the 53:38:9% proportion of Level 8: 7: 6 students in IOTs nationally in the 2011-12 academic year. There are 7 universities and 13 IOTs in the Republic of Ireland. All institutions were invited to take part in the study by contributing their current evaluation methods and/or distributing the resulting survey to their students. 5 universities and 4 IOTs volunteered to take part, culminating in 1633 responses, 13.5% of whom were adult learners.

Two graduate students were hired to input the data into SPSS, and SPSS was also used to analyse the quantitative data. NVivo was used to analyse the qualitative data. A general inductive approach was used to analyse the data guided by the specific research questions (Thomas, 2003). Data was read and analysed by two researchers independently, one from this panel of researchers and an external person to identify emerging themes. Further details on the analysis to date for all respondents (traditional students and adult learners combined) can be found in (Mac an Bhaird et al., 2013 and Ní Fhloinn et al., 2014).

## Results

In Section A of the survey questions were asked which focused on students’ backgrounds. Of the 1633 respondents, there were 221 (13.5%) adult learners, 73% of these were male and 91% were full-time students. In terms of students’ mathematical background, they were given the 4 options outlined in Table 1. Generally, a minimum of OL mathematics would be needed for most service mathematics courses in HEIs and this is reflected among respondents (18 of the 1546 students who provided their LC results in the survey had studied mathematics at FL). If they had not taken the LC, then they could select the Other option.

Table 1.  
*Mathematical Backgrounds of Adult and Traditional Learner Respondents*

Higher Level LC	Ordinary Level LC	Foundation Level LC	Other/N/A	Missing	Total
37.1% (516)	60.7% (843)	0.6% (9)	0.9% (12)	0.6% (9)	Traditional Learners (1389) *
9% (20)	67.4% (149)	4.1 % (9)	14.1% (31)	5.4% (12)	Adult Learners (221)

\*Out of 1633 responses, 1389 identified themselves as not being adult learners, 1 was an exchange student and 22 did not tick any box.

A lower percentage of adult learners (than of the traditional learner respondents) had taken HL, and higher percentages (compared with the traditional age students) in the remaining three categories, with the majority studying mathematics at OL.

When the breakdown of the disciplines that students were in was considered, we found, for most discipline areas, the proportion of adult learners was in line with the proportions of the traditional learner respondents, see Table 2.

Table 2.  
*Degree Programmes of Adult Learners and of Overall Survey Respondents*

Subject	No. of Adult Learners	%	No. of Traditional Learners	%
Science	80	36.2	494	35.6
Engineering	50	22.6	183	13.2
Business	55	24.9	418	30.1
Arts	7	3.2	58	4.2
Education	6	2.7	83	6
Computing	23	10.4	148	10.7
Health Sciences	0	0	4	0.3
Total	221	100.0	1388*	100.0

\*1 exchange student and 12 missing data

Section B of the questionnaire focused on MLS users. The majority of adult learners 136 (61.5%) availed of MLS, compared to only 32.2% of traditional learners. A Chi-Square Test for independence indicated a statistically significant association exists ( $p < 0.001$ ) between type of student (i.e. Adult or traditional learner) and whether a student uses MLS: adult learners were more likely to seek MLS than traditional learners. In terms of gender 68.3% of female adult learners compared to 43% of female traditional learners used MLS, and 59.4% of male adult learners in comparison to 23.3% of male traditional learners availed of MLS.

The mathematical backgrounds of both users and non-users of MLS among the adult learner sample were very similar, and the percentage breakdown was close to that of the adult learner population (See Table 1). When we considered subject discipline, the proportions of adult learners using MLS was very similar to the proportions of overall adult learners in each subject discipline (See Table 2).

Students who availed of MLS were asked, in an open-ended question, to comment on why they first decided to use MLS. There were 577 comments from attendees which were coded using GIA and the majority fell into 6 main categories as outlined in Table 3. This table contains comments from 122 of the 136 adult learners who responded.

A comparison of the frequency of responses in each category given by adult learners compared with traditional learners provides some interesting differences. The frequency of responses from adult learners showed they are much more likely to make comments indicating that they:

- look for help as they have a long time away or suggesting poor confidence in their mathematical ability (19.67% as against 3.96% for traditional learners),
- seek general extra help (38.52% as against 15.17% for traditional learners),
- are struggling (9.02% as against 3.74% for traditional learners).

Table 3.  
*Frequency of Adult Learner Reasons for Using MLS*

Categories of comments	Frequency of comments (n=122)	Sample comments
Extra help	38.52%	“Needed help with maths”, “I had gone to the tutorials and still had trouble with a particular area”, “I wanted help with a Mathematics Problem and to understand where I was going wrong”, “Because the pace of the main lectures were too fast and I wasn’t keeping up”, “I had to catch up on missed lectures”
Background/Ability: Comment about being away from Maths for a while prior to entry (from mature students) or comment suggesting poor confidence in maths ability	19.67%	“Hadn’t done maths in ages so I needed extra help”, “Because I haven’t studied maths in ten years and really felt quite daunted by the thoughts of returning to study maths”, “Coming back to study after a long break, needed all the help at hand!”, “Because I am not great at maths”
Assignments/Exams: Looking for help with specific aspect of coursework assessment during the semester (upcoming test, assignment) or attending for revision or preparation for end of term examinations	13.93%	“Struggling with maths assignments”, “I was stuck on understanding a part of an assignment and was spending a lot of time trying to figure it out”, “To help with revision”
Struggling	11.48%	“I was struggling with the subject”, “Was lost with maths”
Improve Understanding: Positive comments about attending to try to improve or gain better understanding	5.74%	“Because I thought it will be a great idea to use drop-in clinic if I want to get good grades”

In contrast, the frequency of responses from adult learners shows they are much less likely to make comments indicating that they:

- seek help specifically to get assistance with particular coursework assessment or revision for tests (13.93% as against 47.47% for traditional learners)
- attend MLS to improve or gain better understanding (5.74% as against 18.24% for traditional learners).
- state they find mathematics difficult (2.46% as against 11.43% for traditional learners).

MLS users were asked to rate, on a 5-point Likert scale, the specific services available in their HEI and they were also given the opportunity to comment. The main support offered was a drop-in centre, so we focus on that support in this paper. The distribution of ratings and responses from adult learners for the other services (e.g. ICT supports, workshops, support tutorials) are in line with that of the overall cohort.

All nine HEIs had a drop-in centre and 519 users rated them. 119 were adult learners and 89% of these rate it as worthwhile. There were 244 additional comments, 57 from adult learners and coding of responses placed them into the following three main categories (Table 4):

Table 4.  
*Adult Learner Rating of MLS Services*

Categories of comments	Frequency of comments (n=57)	Sample comments
Satisfaction with service	38.5%	“Very helpful – I am even starting to enjoy maths now”, “Would not have a clue what I was doing if it was not for support”
Physical Resources	40.4%	“Class size was small for the amount of students”, “If there were more opening hours and people available as it is very busy”, “Sometimes a long waiting time; too busy”
Quality of Tutors	17.3%	“Always as helpful as they can be with the exception of one of the tutors who tends to be very rude and arrogant”.

20 (38.5%) responses related to satisfaction levels with the service provided, 19 of which were positive. 23 (40.4%) comments related to the physical resources, including staff and contact hours of the centres. Without exception, all comments stated that all of the above should be extended. 9 (17.3%) related to the quality of tutors; 5 positive, 1 negative and 3 which were positive and negative simultaneously.

In Questions 11-15, MLS users were asked about their perception of the impact of MLS on various aspects of their education, the questions had a 5-point Likert scale and they could also comment on their answers. Students were asked to rate the impact MLS had on their confidence. 539 users responded, 125 were adult learners and 66.4% of these rated the impact as helpful in comparison to 52.3% of traditional learner users. There were 106 additional comments, 21 from adult learners with 20 of these positive, “It has helped me a lot. I don’t need to struggle alone to figure out things that I don’t understand”, “Still find it difficult but have a better understanding of maths”. For traditional learners, approximately 71% of comments were positive.

Students were also asked if MLS had impacted on their mathematics performance in tests or examinations to date. There were 534 responses, 122 from adult learners and 61.5% of these stated that it had an impact, in comparison to 52.8% of traditional learner users. There were 103 additional comments, 21 by adult learners, 16 of which were positive (93% of comments from traditional learners were positive), for example: “I would have failed if the extra help had not been there”.

Students were asked to rate how MLS had helped them cope with the mathematical demands of their courses. There were 527 responses, 120 from adult learners and 72% of these indicated that MLS had been helpful in comparison to 62.5% of traditional users. There were 55 additional comments, 14 from adult learners, 12 of which were positive, for example “It has been a huge help”, “Wouldn’t be able to do maths without all the extra services and wouldn’t have a hope of passing the year”. One of the (two) negative comments stated “Some of the tutors in the centre might be good at understanding maths but not good at teaching it”.

In Question 11 students were asked if they had ever considered dropping out of their studies for mathematics-related reasons. 128 of the 136 adult learners answered this question with 25 (19.5%) stating that they did consider dropping out, this is a smaller proportion to that of the traditional student population (22.8%). Question 12 asked (those who answered yes to Question 11) if MLS had been a factor in them not dropping out. 22 of the eligible 25 adult learners answered and 17 (77%) of these stated that MLS was an influencing factor in their decision not to drop out (compared to 54.3% of the traditional learner cohort). Additional comments included: “Greatly. It has given me the confidence to turn maths as my worst



subject into one of my best” and “Encouraged me to trust that my worries were normal and that practice would improve me”. 8 students left comments stating that they never considered dropping out because of the MLS that was available to them, “Never felt the need because of the support provided” and “No, but did worry about failing maths before using these facilities”.

Section C of the survey focused on students who had not availed of MLS. 85 (38.5% of) adult learners (compared with 67.8% of traditional learners) stated that they did not use the MLS facilities provided in their institution. In Question 16, non-attendees were asked to select from 7 fixed options, as to why they did not avail of MLS. For adult learners, the frequency of response in each category is interesting when compared with the traditional 941 students who did not use MLS, see Table 5 (note that students selected more than category).

Table 5.  
*Frequency of Reasons for Not Using MLS Between Adult Learners and Traditional Students*

Category of response	% of Adult Learners who did not avail of MLS (n=85)	% of traditional students who did not avail of MLS (n=941)*
I do not need help with Maths	43.53%	49.4%
The times do not suit me	43.53%	27.8%
I did not know where it was	5.88%	18.6%
I hate Maths	3.53%	16%
Other	15.29%	12.6%
I was afraid or embarrassed to go	8.24%	11.8%
I never heard of the MLSC	15.29%	7.8%

\*1609 answered the question ‘Have you used any of the Maths Learning Support Centre’s services?’, 583 answered ‘yes’, 1026 answered ‘no’, 24 gave no reply.

In terms of individual respondents, it is worth noting that of the 85 adult learners who did not avail of MLS, 43.53% of these stated that they did not need help. In comparison, for the 941 (67.8%) traditional learners who did avail of MLS, 49.4% of these stated that they not need help. We can see in Table 5 that a larger percentage of responses from adult learners stated that the times did not suit and that they had not heard of the MLSC. The proportions of adult learners responding that they hated mathematics, did not know where MLS was or were afraid or embarrassed to go, were much lower than in the traditional cohort.

There was an opportunity to provide additional comments on responses given to Question 16 and 34 adult learners did so. 20 comments stated that they did not need help or were able to work it out by themselves; 8 comments stated that the session timings did not suit them due to timetable or living circumstances; 2 stated that they never heard of the MLSC services; 2 comments related to a reluctance to attend: “Just felt a bit uncomfortable; felt the questions I had may seem a bit irrelevant”. These responses were consistent with overall student comments.

In Question 17, non-users of MLS were asked to comment on what would encourage them to use the MLS facilities. The responses were coded into categories using GIA and Table 6 below gives the breakdown of responses from the 41 adult learners who answered. Compared with the traditional student responses, adult learners were more likely to comment that they would access MLS if they needed. They were less likely to comment on resources/location or the need for student feedback or advice as reasons that would encourage them to engage with MLS. No adult learners mentioned examinations or results as a prompt for them to access MLS.

Table 6.

*Frequency of Comments from Adult Learners who are Non-Users of MLS about What Would Encourage Them to Engage with MLS*

Category	% of Responses (n=41)
Go if needed	46.34%
Results/Exams	0%
Better times	19.51%
More Information	19.51%
Resources/Location	4.88%
Advised to go	2.44%
Student Feedback	2.44%
Miscellaneous	4.88%

### Discussion and conclusion

In this paper we have considered the data concerning adult learners in our large-scale student evaluation of MLS. We also compared, where possible, these results with from the traditional learners. Our two main research questions were:

1. What are the motivational factors of adult learners who seek mathematics learning support (MLS)?
2. Why do some adult learners of mathematics not seek MLS?

When we considered the backgrounds of the respondents, we did not find a significant difference between adult learners and the traditional learner cohort in terms of the disciplines that they were studying. This will be investigated further in the next stage of our analysis when we consider the breakdown of results in terms of the individual institutions that respondents attended. However, as one would expect, adult learners did present with a wider range of mathematical backgrounds than the traditional cohort, with a smaller proportion taking HL and a higher percentage taking OL. This is consistent with research elsewhere, e.g. Gill (2010).

When students who engaged with MLS were considered, there was a statistically significant association (Chi-Squared Test,  $p < 0.001$ ) between student type (i.e. adult learners or traditional) and whether a student uses MLS, demonstrating that adult learners are more likely to seek support than traditional learners. This supports other research, e.g. Ni Fhloinn (2007) who states that adult learners in DIT seek support much earlier than traditional learners, even as early as the first day of term. However, in our study, we found no significant difference in the mathematical backgrounds of adult learner users and non-users of MLS.

Partial answers to our first research question are provided when the reasons why students engaged with MLS were investigated. Analysis suggests that adult learners in our study were more likely than traditional students to mention the following reasons for engaging: having been a long time away from education; poor confidence in their mathematical ability; seeking general extra help; struggling with mathematics. In contrast, adult learners were much less likely than traditional students to mention the following reasons: to get help with specific coursework assessment or as revision for tests; to improve or gain better understanding; to state they find mathematics difficult. Being an adult learner, having not studied mathematics in any formal sense for a long time lends itself to having gaps in knowledge due to forgotten or perhaps never learned material. Lawson (2008) states that some students avoid support due to a fear of embarrassment or feeling that they just have too many mathematical problems to deal with. This gap in knowledge appears to act as an impetus rather than an obstacle for the adult learners in our study to engage with support “As I have been out of the education system for many years I felt I needed the extra support”. These adult learners were motivated to engage because of their worry about gaps in their mathematical knowledge and the length of time they had been away from studying mathematics “As a mature student I needed a

refresher". Wolfgang and Dowling (1981) may partially explain this finding as they maintain that traditional and adult learners have different motivations and approaches to study. Safford (1994, p. 50) supports this stating that while adult learners may carry 'intellectual baggage', they are generally self-directed and making the decision to return to education implies a motivation for change and growth.

A significantly smaller proportion of adult learners did not avail of MLS when compared to the overall cohort. In terms of our second research question, we considered the reasons given by students for non-engagement with MLS. According to Ashcraft and Moore (2009) avoidance is often the consequence of mathematically anxious students. Bibby (2002) reports that math anxiety and shame of own mathematics ability are reasons that students fail to seek help with mathematics. In a study carried out by Grehan et al (2011, p. 79) at NUI Maynooth, the reasons divulged for lack of engagement with MLS included 'fear; lack of personal motivation; the anonymity of large classes; and to a lesser extent the lack of awareness of support services'. Symonds et al. (2008) list a fear of embarrassment and a lack of information regarding the whereabouts of the mathematics support as reasons why students do not engage. Our findings largely contrast with those just mentioned. The largest proportion of responses from both adult learners and the overall cohort who did not engage with MLS indicated that they simply did not need to: "Good service for students – just didn't need to avail of it"; "I would definitely find time to attend if I needed to". It is reassuring that many of those who do not utilise the resources provided simply do not feel the need. 5.88% of adult learners who had not engaged with MLS stated that they did not know where it was and 15.29% had not heard of the support. 8% stated that they were afraid or embarrassed to go "Just felt a bit uncomfortable, felt the questions I had may seem a bit irrelevant". As we discussed earlier, fear and embarrassment were more of a motivation to attend rather than not attend MLS. 43.53% of adult learners who did not engage with MLS stated that the times were unsuitable. These statistics are enlightening as they have implications for MLS practitioners in terms of marketing and advertisement of services and extension or alteration of opening hours to maximise participation for those who require additional help.

Overall, respondents were very positive about the MLS experience they received in their institution, with adult learners especially so, e.g. users of MLS reported increased confidence in the mathematical abilities and finding it easier to cope with the mathematical demands of the courses "I've had a fear of maths all my life so with MLC help I've become more confident". It is clear from the comments that MLS provides a mathematical lifeline, so to speak, for many adult learners: "I would be seriously lost without the MSC and the extra maths classes ran. Now I actually like maths"; "Excellent and I credit the help I receive here to me passing all my maths tests so far".

Many of the comments highlighted the important role of MLS tutors. Lawson (2008) states that students attend MLSCs precisely because they offer emotional and MLS to students who suffer from mathematics anxiety. FitzSimons and Godden (2000), and Safford (1994) recommend the provision of this warm supportive environment in which individual needs are met and adult learners of mathematics can thrive. The quality of staff is crucial to the success of MLS (Lawson, et al., 2003) and in particular in relation to the education of adult learners (FitzSimons & Godden, 2000). Gill (2006) states that the one-to-one attention students receive in MLSCs is most highly favoured. Some of the responses in this study referred to how they preferred the teaching approach used in the MLSCs to those in their regular tutorials "People in the MLSC explain the questions or doubts you have the way the people in the tutorials should".

However, Lawson et al. (2003) states that not everyone will make a good MLS tutor and this is reflected by the small number of negative comments about certain MLS tutors, e.g. "Possibly some training in social skills for some of the tutors". Benn (1994) encourages teachers to tread carefully when dealing with Mature Students of mathematics as it will influence how students perceive the subject. It is in the nature of MLS evaluation that both positive and negative comments can be used constructively. To this end, the IMLSN is in the

process of developing MLS tutor training materials which will be used in the academic year 2015/16 to help ensure best practice in the recruitment and training of tutors across all institutions in Ireland. There were some other negative comments, e.g. in relation to the timing of the drop in centre or classes, the volume of students in attendance and hence the lack of one-to-one attention at busy times: “It’s sometimes very crowded and the instructors cannot get to you”, “Sometimes the wait for assistance is 30-45 minutes”. These findings resonate with those of Lawson et al. (2003) who state that MLSCs are inclined to be very busy at certain times, such as at examination time, and there will be waiting times as a result. Again, these comments were not standard across the survey and will be of more relevance to the individual institutions when further analysis is presented.

It is very difficult to claim that MLS is responsible for increases in retention or student success rates in mathematics (Lawson et al., 2003). Mac an Bhaird et al (2009) tell us that we cannot take full credit as a number of factors are in play when it comes to student progress such as motivation etc. However, the findings from this study indicate a high level of satisfaction with the services provided by the MLSCs throughout Ireland, and many adult learners indicated that MLSCs are responsible for their not dropping out of their studies. “It was a very valuable experience, whereby without it I would have certainly failed.”

## References

- Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current directions in Psychological Science*, 11, 181-185.
- Ashcraft, M. H., Moore, A. M. (2009). Mathematics anxiety and the affective drop in performance. *Journal of Psychological Assessment*, 27, 197-205.
- Benn, R., (2000). Mathematics: Certainty in an uncertain world? In D. Coben, J. O'Donoghue, G. E. FitzSimons (Eds.) *Perspectives on adults learning mathematics: Research and practice* (pp. 109-118). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Bibby, T. (2002). Shame: An emotional response to doing mathematics as an adult and a teacher. *British Educational Research Journal*, 28(5), 705-721.
- Burke, G., Mac an Bhaird, C., O'Shea, A. (2012). The impact of a monitoring scheme on engagement in an online course. *Teaching Mathematics and its Applications*, 31(4), 191-198.
- Carmody, G., Wood, L. (2005) Bridging the gap for first year students with the use of peer tutoring. In M. Horne, B. Marr (Eds.) *Connecting voices in adult mathematics and numeracy: practitioners, researchers and learners* (Proceedings of the Adults Learning Mathematics (ALM) 12th annual international conference, pp. 76-81). Melbourne: ACU National.
- Coben, D. (2003). *Adult numeracy: Review of research and related literature*. London: National Research and Development Centre (NRDC).
- Diez-Palomar, J., Gimenez Rodriguez, J., Garcia Wehrle, P. (2005) Adults' dialogic productive mathematical interactions in the classroom. In M. Horne, B. Marr (Eds.). *Connecting voices in adult mathematics and numeracy: practitioners, researchers and learners* (Proceedings of the Adults Learning Mathematics (ALM) 12th annual international conference, pp.97-103). Melbourne: ACU National.
- Benn, R. (1994) Mathematics: Breaking down the barriers. In D. Coben (Ed.), *Proceedings of the 1st Inaugural Conference of Adults Learning Mathematics* (pp.24-29). Retrieved from <http://www.alm-online.net/images/ALM/conferences/ALM01/proceedings/ALM01-proceedings-p24-29.pdf?7c979684e0c0237f91974aa8acb4dc29=1nq6kn4hq32cacibkun7m6neb6>.
- Elliot, S. & Johnson, S. (1994). Adult learners in Higher Education; Academic Maths Support. In D. Coben (Ed.), *Proceedings of the 1st Inaugural Conference of Adults Learning Mathematics* (pp. 85-89). Retrieved from <http://www.alm-online.net/images/ALM/conferences/ALM01/proceedings/ALM01-proceedings-p85-89.pdf>.
- Faulkner, F., Hannigan, A., Gill, O. (2010). Trends in the mathematical competency of university entrants in Ireland by Leaving Certificate mathematics grade. *Teaching Mathematics and its Applications*, 29, 76-93.
- Fitzsimons, G. E., & Godden, G. (2000). Review of research on adults learning mathematics. In D. Coben, J. O'Donoghue, G. E. FitzSimons (Eds.) *Perspectives on adults learning mathematics: Research and practice* (pp. 13-45). Dordrecht, The Netherlands: Kluwer Academic Publishers.

- Galligan, L., Taylor, J. A. (2008) Adults returning to study mathematics. In H. Forgasz, A., Barkatsas, A. Bishop, B, Clarke, S. Keast, W. Seah, P. Sullivan (Eds.) *Research in Mathematics Education in Australasia 2004 – 2007* (pp. 99–118). Sense Publishers: Rotterdam.
- Gill, O. (2006). *What Counts as Service Mathematics? An Investigation into the 'Mathematics Problem' in Ireland*. (Unpublished doctoral dissertation). Department of Mathematics and Statistics, University of Limerick, Limerick.
- Gill, O., Johnson, P., & O'Donoghue, J. (2008) *An audit of mathematics support provision in Irish third level institutions*. CEMTL: University of Limerick.
- Gill, O. (2010) Evaluating the impact of a refresher course in mathematics on adult learners. In H. Christen, J. Diez-Palomar, J. Kantner, C.M. Klinger (Eds.). *Maths at Work – Mathematics in a changing world* (Proceedings of the Adults Learning Mathematics (ALM) 17th annual international conference, pp. 37-46). Oslo: Vox, ALM.
- Gill, O., O'Donoghue, J. (2006) Mathematics support for Adult Learners. In V. Seabright, I. Seabright (Eds.) *Crossing borders – research, reflection and practice* (Proceedings of the Adults Learning Mathematics (ALM) 13th annual international conference, pp. 43-53). Queens' University Belfast: ALM, CAMET.
- Gill, O., Mac an Bhaird, C., Ní Fhloinn, E. (2010). The Origins, Development and Evaluation of Mathematics Support Services. *Irish Mathematical Society Bulletin*, 66, 51-64.
- Golding, G., O'Donoghue, J. (2005) Using topic maps to support adults' mathematics learning. In M. Horne, B. Marr (Eds.) *Connecting voices in adult mathematics and numeracy: practitioners, researchers and learners* (Proceedings of the Adults Learning Mathematics (ALM) 12th annual international conference, pp. 120-128). Melbourne: ACU National.
- Grehan, M., Mac an Bhaird, C., O'Shea, A. (2011). Why do students not avail of mathematics support? *Research in Mathematics Education*, 13(1), 79-80.
- Lawson, D. (2008). Mathematics Support Centres: Who uses them and who doesn't? Why not? Keynote presentation at the 3rd Irish workshop on Mathematics Learning and Support Centres, NUI Maynooth.
- Lawson, D., Croft, A.C., & Halpin, M. (2003). *Good Practice in the Provision of Mathematics Support Centres (2nd ed.)*. Birmingham: LTSN Maths, Stats and OR Network. Retrieved from [www.mathcentre.ac.uk/resources/guides/goodpractice2E.pdf](http://www.mathcentre.ac.uk/resources/guides/goodpractice2E.pdf).
- Lawson D., Croft, T., & Waller, D. (2012) *Mathematics support past, present and future. Innovation, Practice and Research in Engineering Education*. Retrieved from [http://www.academia.edu/2715773/Mathematics\\_support\\_past\\_present\\_and\\_future](http://www.academia.edu/2715773/Mathematics_support_past_present_and_future).
- Lee, S., Harrison, M., Pell, G., & Robinson, C. (2008). Predicting performance of first year engineering students and the importance of assessment tools therein. *Engineering Education*, 3(1), 44-51.
- Matthews, J., Croft, T., Lawson, D., & Waller, D. (2012) *Evaluation of mathematics support centres: a review of the literature. Loughborough: sigma*. Retrieved from <http://www.mathcentre.ac.uk/resources/uploaded/52487-evaluation-of-msc-7.pdf>.
- Mac an Bhaird, C., Morgan, T., & O'Shea, A. (2009). The impact of the mathematics support centre on grades of first year students at the National University of Ireland Maynooth. *Teaching Mathematics and its Applications*, 28(3), 117-122.
- Mac an Bhaird, C., Ní Fhloinn, E., Fitzmaurice, O., & O'Sullivan, C. (2013). Student Non-Engagement with Mathematics Learning Supports. *Teaching Mathematics and its Applications*, 32, 191-205.
- Ní Fhloinn, E. (2007) Assisting adult learners within a maths learning centre. In T. Maguire, N. Colleran, O. Gill & J. O' Donoghue (Eds.) *The Changing Face of Adults Mathematics Education: Learning from the Past, Planning for the Future* (Proceedings of the Adults Learning Mathematics (ALM) 14th annual international conference, pp. 233-240). Limerick: University of Limerick, ALM.
- Ní Fhloinn, E., Fitzmaurice, O., Mac an Bhaird, C., & O'Sullivan, C. (2014). Student perception of the impact of mathematics support in higher education. *International Journal of Mathematical Education In Science And Technology*, 45(7), 953-967 doi: 10.1080/0020739X.2014.892161
- Ní Fhloinn, E., Fitzmaurice, O., Mac an Bhaird, C., & O'Sullivan, C. *Gender differences in the level of engagement with mathematics support in higher education in Ireland*, to appear.
- O'Donoghue, J. (2000). Perspectives in teaching adults mathematics. In D. Coben, J. O'Donoghue, & G. E. FitzSimons (Eds.) *Perspectives on adults learning mathematics: Research and practice* (pp. 229-234). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- O'Donoghue, J. (2004). *An Irish perspective on the "Mathematics Problem"*. Plenary lecture at Irish Symposium for Undergraduate Mathematics Education 2 (ISUME2), University College Dublin.

- Pell, G. & Croft, T. (2008). Mathematics support—support for all? *Teaching Mathematics and its Applications*, 27(4), 167-173.
- Perkin, G., Lawson, D., & Croft, T. (2012) *Mathematics learning support in Higher Education: the extent of current provision in 2012*, Loughborough: sigma. Retrieved from <http://www.mathcentre.ac.uk/resources/uploaded/52789-mls-in-uk.pdf>.
- Safford, K. (1994) Introduction to Algebra for Adult Students, In D. Coben (Ed.), *Proceedings of the 1st Inaugural Conference of Adults Learning Mathematics* (pp.40-50). Retrieved from <http://www.alm-online.net/images/ALM/conferences/ALM01/proceedings/ALM01-proceedings-p40-50.pdf?7c979684e0c0237f91974aa8acb4dc29=1nq6kn4hq32cacibkun7m6neb6>
- Singh, E. (1993). The political dimension of adult numeracy: Conclusions of a survey into attitudes to mathematics. In C. Julie, D. Angelis, & Z. Davis (Eds.) *Political Dimensions of Mathematics Education 2: Curriculum Reconstruction for Society in Transition* (pp. 335-341). Cape Town: Miller Maskew Longman (Pty) Ltd.
- Symonds, R., Lawson, D., & Robinson, C. (2007). The effectiveness of support for students with non-traditional backgrounds. *Teaching Mathematics and its Applications*, 26(3), 134-144.
- Symonds, R., Lawson, D., & Robinson, C. (2008). Promoting student engagement with mathematics support. *Teaching Mathematics and its Applications*, 27(3), 140-149.
- Thomas, D. R. (2003). *A general inductive approach for qualitative data analysis*. Retrieved from <http://www.frankumstein.com/PDF/Psychology/Inductive%20Content%20Analysis.pdf>.
- Tusting, K., & Barton, D. (2003). *Models of Adult Learning: A Literature Review*. Leicester: National Research and Development Centre for Adult Literacy and Numeracy.
- Wolfgang, M.E., & Dowling, W.D. (1981). Differences in motivation of adult and younger undergraduates. *Journal of Higher Education*, 52(6), 640-648.

## Appendix I: Sample mathematics learning support survey

This appendix contains a sample from one institution of the questionnaire used. All questions with the exception of Question 10 were identical in all HEIs in which the questionnaire was distributed. The structure of Question 10 was the same as the sample shown here but the list of supports and names used to describe the supports which the students were given in Question 10 was localised to take account of the specific supports offered in that HEI and the names they are given there. The only other variation in the questionnaire was the localisation of the name given to MLS in that HEI – for example in one HEI the provider of MLS is known as the MLSC (Mathematics Learning Support Centre), in another it is known as the MLC (Mathematics Learning Centre) and in another it is known to the students as CELT Mathematics Services.

### Mathematics Learning Support Survey

We are looking for your feedback on the Mathematics Learning Support Centre (MLSC) and its services. This evaluation is designed to help us to improve the MSC for you and other students. Even if you have not used the MLSC’s services, your feedback is important.

#### Section A

1. Degree Programme:
2. Year: **Certificate 1st year      2nd year      3rd year      4th year      Postgrad**  
 Student Category: **Full-time      Part-time**
3. Gender: **Male      Female**
4. Leaving Certificate Mathematics Level (if applicable):  
**Higher      Ordinary      Foundation**  
**Other**
5. Leaving Certificate Mathematics Grade (if applicable):
6. **Leaving Cert 1991 or before:** A      B      C      D      E      Other
7. **1992 or after:** A1    A2    B1    B2    B3    C1    C2    C3      D1    D2  
 D3      Other
8. If you started off doing Leaving Certificate Higher Level Mathematics, but changed to Ordinary Level, roughly when did that happen? (Please circle)  
**Before Christmas in 5th year      Before the end of 5th year**  
**Before Christmas in 6th year      After the Mocks in 6th year**  
**year      N/A**
9. Are you registered as a mature student? **Yes      No**
10. Have you used any of the Maths Learning Support Centre’s services (drop-in centre, support workshops, online courses)?  
**Yes      No**

**If YES, please proceed to Section B.**

**If NO, please proceed to Section C.**

#### Section B (Students who used the MLSC)

11. Why did you first decide to use the MLSC or its services?
12. Being as honest as you can, rate the following services that you have used below on a scale of 1 to 5 where 1=Not at all Worthwhile and 5=Extremely Worthwhile

##### Drop-In Centre

1      2      3      4      5      N/A

Comments/Suggestions:

##### Online Courses

1      2      3      4      5      N/A

Comments/Suggestions:

##### Workshops

1      2      3      4      5      N/A

Comments/Suggestions:

1. Did you ever consider dropping out of your course/college because of mathematical difficulties?

**Yes                      No**

Comments:

13. If yes, has the MLSC influenced your decision not to drop out?

**Yes                      No**

Comments:

14. Rate how the MLSC has helped your confidence in maths on a scale of 1 to 5 where 1=Not at all

15. Helpful and 5=Extremely Helpful

**1                      2                      3                      4                      5**

Comments:

16. 14. Rate how the MLSC has impacted on your maths performance (in exams/tests) so far on a scale of 1 to 5 where 1=No impact at all and 5=Has had a large impact

**1                      2                      3                      4                      5**

Comments:

17. Having used some of the MLSC's services, rate on a scale of 1 to 5 how you feel the MLSC has helped you cope with the mathematical demands of your course where 1=No help at all and 5=Has been a huge help

**1                      2                      3                      4                      5**

Comments:

**Any other comments or suggestions about the MLSC Services would be very valuable!**

**Section C (Students who did not use the MLSC)**

18. If you did not use the MLSC, why not? Tick as many reasons as apply:

- I do not need help with Maths
- I never heard of the Mathematics Learning Support Centre
- I did not know where it was
- The times do not suit me
- I was afraid or embarrassed to go
- I hate Maths
- Other (please specify):
- Comments:

19. What would encourage you to use the MLSC and its services if you needed to?

**Any other comments or suggestions about the MLSC Services would be very valuable!**