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in Mathematics and Science Teaching and Learning

An Irish Mathematics Learning Support Network (IMLSN) Report on Student Evaluation of Mathematics Learning Support: Insights from a large scale multi-institutional survey

Authors and Editors:
Ciarán O'Sullivan, Ciarán Mac an Bhaird, Olivia Fitzmaurice and Eabhnat Ní Fhloinn

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IMLSN
IRISH MATHEMATICS LEARNING SUPPORT NETWORK

T&L NATIONAL FORUM
FOR THE ENHANCEMENT OF TEACHING AND LEARNING IN HIGHER EDUCATION

An Irish Mathematics Learning Support Network (IMLSN) Report on Student Evaluation of Mathematics Learning Support: Insights from a large scale multi-institutional survey

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In order to facilitate timely dissemination of the results of this survey, a number of papers based on some elements of this report have already been published or submitted for publication, each focusing on a particular theme. We are extremely grateful to the publishers and editors of the 3 journals involved Teaching Mathematics and its Applications: An international journal of the IMA (publisher Oxford University Press, editors Chris Sangwin, Duncan Lawson and Anne Watson), International Journal of Mathematical Education in Science and Technology (publisher Taylor & Francis, editor Martin Harrison) and Adults Learning Mathematics – An International Journal) for agreeing to allow us to include similar research in this report and would like to acknowledge that some of our results were presented for the first time in the following papers: Ní Fhloinn et al. (2014), Mac an Bhaird et al. (2013), Fitzmaurice et al. (to appear). As a result, copyright of the relevant tables and figures is in the ownership of the journals involved (see Appendix C for details).

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Foreword

The National Centre for Excellence in Mathematics and Science Teaching and Learning (NCE-MSTL) is delighted to make this report available to the wider community of STEM educators and stakeholders in Ireland. This large scale evaluation of students' views on Mathematics Learning Support (MLS) in Irish Higher Education is unique in its scope and its attention to users and non-users of MLS services.

Mathematics Learning Support (MLS) in all its manifestations in Higher Education internationally is a response to the well documented 'Mathematics Problem'. Mathematics is now widely acknowledged as having a special underpinning role for the STEM disciplines and as such merits special attention. It is worth making the point that the special attention mathematics receives under MLS clearly serves a dual function and benefits mathematics learning and STEM education. In this way MLS makes an impact for the better on high priority issues in mathematics and STEM education such as access, transition, retention, and engagement.

In this study the authors use a customised survey instrument to survey students from nine HEI's in Ireland who interact with Mathematics Learning Support Centres (MLSC). Uniquely, they focus on users and non-users of services and their views. This present report, the first of its kind in Ireland, contains a wealth of interesting data and analyses. And as the authors point out (p. 9):

> Among these findings are reasons given by students who availed of MLS as to why they did so and the impact they reported MLS had on them. Equally importantly, the report presents findings by students who did not avail of MLS such as their reasons for not availing of MLS and what they reported would encourage them to do so.

Ireland has been at the forefront of research and practice in this emerging field of MLS in Higher Education through the work of members of The National Centre and the Irish Mathematics Learning Support Network (IMLSN) who commissioned this report. The National Centre has supported the work of the IMLSN since its inception in various ways, financially and otherwise, but mainly through advice and staff input. The National Centre is pleased to acknowledge the role of Dr Olivia Fitzmaurice, member of the NCE-MSTL Steering Committee, as one of the authors of this report.

The National Centre has an active policy of publishing important findings from its research and collaborations on teaching and learning in STEM disciplines. Towards this end the National Centre publishes reports and occasional papers of merit under its own imprint. This report, the fourth in its **Occasional Publications Series**, is worthy of wider attention.

John O'Donoghue, Professor (Emeritus) Mathematics Education
Associate Director, NCE-MSTL

Sibel Erduran, Professor of STEM Education
Director, NCE-MSTL

Acknowledgements

This report and survey has been possible only through the hard work and collaboration of a wide number of people, all of whom we would like to thank.

To start, we would like to thank the 1633 first year students from across nine Higher Education Institutions (HEIs) who took the time and effort to fill out our questionnaire. We also appreciate the contributions of the following individuals who ensured that the questionnaires were distributed in their institutions, collected and returned to the committee:

Huizhong Wu-Appleby, Dublin City University (DCU); Colm McGuinness, Institute of Technology (IT) Blanchardstown; Diarmuid Ó Sé, IT Carlow; Ciarán O'Sullivan, IT Tallaght; Joan Cleary, IT Tralee; Kevin Jennings, National University of Ireland Galway (NUIG); Ciarán Mac an Bhaird, National University of Ireland Maynooth (NUIM); Nuala Curley, University College Dublin (UCD); and Olivia Fitzmaurice, University of Limerick (UL).

We are grateful to the All-Ireland Society for Higher Education (AISHE) and the National Learning Digital Repository (NDLR) who provided some funding which allowed us to get assistance with data input and initial data analysis. We would like to thank Theresa Melican (UL) for her assistance with the data input and Siobhán Connolly (NUIM) for her preliminary data analysis. We also appreciate the continuous support and expert advice from the National Centre for Excellence in Mathematics and Science Teaching and Learning (NCE-MSTL), they were especially instrumental in the final production of this document. We acknowledge and thank the National Forum for the Enhancement of Teaching and Learning in Higher Education for their advice and interest, and their support for the official launch of this report.

The editors would also like to acknowledge those who made contributions to the creation of the survey. In particular, Professor Ailish Hannigan (UL), Dr. Jean Saunders (UL), Dr. Ann O'Shea (NUIM), Dr. Sinéad Breen (St. Patrick's College Drumcondra), Dr. Joan Cleary (IT Tralee) and Dr. John Keogh (IT Tallaght).

We thank the following people who agreed to read the report prior to publication for offering their time and expertise. We especially appreciate their insight and constructive suggestions: Diarmuid Ó Sé, Tim Crawford, Terry Maguire, Anthony Cronin and Ann O'Shea. In particular, we thank Professor John O'Donoghue (NCE-MSTL) for his observations and for contributing the foreword. Professor O'Donoghue's guidance and expert advice to all involved in the provision of MLS in Ireland and further afield has been invaluable.

Finally, the editors would also like to acknowledge the work of fellow members (past and present) of the committee without whom the report would not have been possible. These include Diarmuid Ó Sé (IT Carlow), Tim Crawford (Queen's University Belfast, QUB), Páraic Treacy (UL), Gráinne Burke (NUIM), Kevin Jennings (NUIG) and Niamh O'Meara liaison from the NCE-MSTL.

In order to facilitate timely dissemination of the results of this survey, a number of papers based on some elements of this report have already been published or submitted for publication, each focusing on a particular theme. We are extremely grateful to the publishers and editors of the 3 journals involved Teaching Mathematics and its Applications: An international journal of the IMA (publisher Oxford University Press, editors Chris Sangwin, Duncan Lawson and Anne Watson), International Journal of Mathematical Education in Science and Technology (publisher Taylor & Francis, editor Martin Harrison) and Adults Learning Mathematics – An International Journal) for agreeing to allow us to include similar research in this report and would like to acknowledge that some of our results were presented for the first time in the following papers: Ní Fhloinn et al. (2014), Mac an Bhaird et al. (2013), Fitzmaurice et al. (to appear). As a result, copyright of the relevant tables and figures is in the ownership of the journals involved (see Appendix C for details).

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Executive Summary

In this section we provide a summary of the main outcomes of this survey on Mathematics Learning Support (MLS), for full and further information we refer the reader to the relevant part of the report.

What is the IMLSN?

The Irish Mathematics Learning Support Network (IMLSN) was established in 2009 to promote MLS and support individuals and HEIs involved in the provision of MLS in Ireland. The IMLSN has an elected voluntary committee whose members are drawn from a range of HEIs from around the island of Ireland. The IMLSN website (http://supportcentre.maths.nuim.ie/mathsnetwork) has a full list of our activities (including workshops, developing resources and materials, and the latest news from the national and international MLS community).

What this report is about?

Large numbers of students entering Higher Education (often referred to as third level education) take some level of mathematics as part of their degrees, and it is widely reported that a considerable minority of these students demonstrate a lack of the basic mathematical skills that they require to succeed. A common response has been the establishment of MLS to give students the opportunity to reach the levels required. Research has shown that in general, although the supports appear to impact positively on students who avail of them, a significant number of students do not engage appropriately. Accurate evaluation of MLS is crucial to determine best practice for practitioners and to promote (to both students and relevant personnel) the benefits of using and providing MLS. The IMLSN decided to conduct a large scale survey evaluating first year service mathematics students' opinions on MLS. The survey was given both to students who availed of MLS and those who had not. This report presents the findings from this large scale survey carried out at nine HEIs in Ireland. Among these findings are reasons given by students who availed of MLS as to why they did so and the impact they reported MLS had on them. Equally importantly, the report presents findings by students who did not avail of MLS such as their reasons for not availing of MLS and what they reported would encourage them to do so.

The Study

Literature review

As part of the study, a thorough literature review of the reasons for the establishment of MLS and how MLS should be evaluated was undertaken. Firstly, the reasons for the increasing numbers of students entering HEIs who take some level of mathematics or statistics as part of their degrees was considered. Secondly, consideration was given to the well documented problem (often labeled the 'Mathematics Problem') of significant numbers of these students demonstrating a lack of the basic mathematical skills that they require to succeed. This problem is commonplace in HEIs in Ireland, the UK and elsewhere. Thirdly, the various responses from HEIs to this problem (including the provision of MLS which is available in the majority of HEIs in Ireland and the UK) was considered. Finally, literature on international best practice in the evaluation of MLS (with systems of qualitative and or quantitative evaluations now commonplace in the wider MLS community) was reviewed.

Research instrument

Following the literature review regarding the evaluation of MLS, we received expert advice on the design and analysis of questionnaires. It was then decided to develop an anonymous paper-based questionnaire as the appropriate research instrument. It was also decided, based on the literature review, to target only first year service mathematics students. Samples of questionnaires already in use within HEIs to assess MLS were collected from IMLSN members, these questionnaires were amalgamated, and a pliot questionnaire was developed. This pilot questionnaire was piloted with 100 students from 5 different HEIs (3 Universities and 2 IoTs). This pilot questionnaire was modified and the finalised questionnaire was reviewed and approved by Professor Ailish Hannigan (Statistical consultant to the NCE-MSTL). This questionnaire was anonymous and paper-based; there were 17 questions in total, with a variety of multiple-choice, five-point Likert-scale, and open-ended questions. The questionnaire had three main sections. The first section was to gather information regarding the respondents' background and was to be completed by all students. Students then completed one of the remaining two sections depending on whether they had availed of MLS or not. Users of MLS completed a section to indicate their levels of satisfaction with the services provided and to investigate their perception of the impact that MLS had on their mathematics education. Non-users of MLS completed a section which investigated the reasons why they did not engage with MLS. The full survey questionnaire can be seen in Appendix A.

Data collection

The questionnaire was issued in February 2011 to representatives involved in the provision of MLS within HEIs on the island of Ireland. They were invited to arrange for it to be issued during the second semester of the academic year 2010-11 to any first year students who were studying at least one service mathematics module. The decision to have the paper-based questionnaire issued in the appropriate lectures was made in order to get a blend of users and non-users. 1633 completed questionnaires were received from nine HEIs all in the Republic of Ireland. The nine comprised five Universities and four IoTs, out of a total of seven Universities and fourteen IoTs (Higher Education Authority, 2013). The Universities involved were DCU, NUIG, NUIM, UCD and UL. The Institutes of Technology involved were IT Blanchardstown, IT Carlow, IT Tallaght and IT Tralee. Acknowledging that the manner in which the data was collected was dependent on local factors we do not claim that the results of this survey are representative, but they do give an invaluable first insight on the state of MLS on a large scale.

Data analysis

The large quantity of quantitative and qualitative data from the completed surveys was then inputted into SPSS. The quantitative data was analysed using SPSS. The qualitative data obtained from the open questions was analysed using General Inductive Analysis (GIA) (Thomas, 2006) and Grounded Theory. This approach allows the theory to emerge from the data itself with initial coding of the quantitative data giving rise to labels, with subsequent coding grouping these labels into concepts, categories and themes. Members of the report team worked in pairs, firstly carrying out the coding process independently and then comparing their coding results for verification and to ensure reliability.

In order to facilitate timely dissemination of the results of this survey, a number of papers based on some elements of this report have already been already been published or submitted for publication, each focusing on a particular theme. We are extremely grateful to the editors of the journals involved for agreeing to allow us to include similar research in this report and would like to acknowledge that some of our results were presented for the first time in the following papers: Ní Fhloinn et al. (2014), Mac an Bhaird et al. (2013), Fitzmaurice et al. (to appear). As a result, copyright of the relevant tables and figures is in the ownership of the journals involved (see Appendix C for details).

The main findings from the analysis of the report are considered below.

Main findings

Profile of students surveyed

- 1633 first year service mathematics students from 9 HEIs participated, 1201 from 5 Universities and 432 from 4 Institutes of Technology (IoT).
- Students were from 6 disciplines of study: Science (583), Engineering (171), Computing (236), Business (484), Arts (67), and Education (90).
- 42% of respondents were female and 58% were male.
- 13.5% of respondents were classified as Mature Students.
- In terms of prior mathematical attainment 34% indicated they had completed Higher Level (HL) Leaving Certificate[1] (LC) mathematics, 63% Ordinary Level (OL) LC, 1% Foundation Level (FL) LC and 2% had a different qualification or did not provide information.

Engagement with MLS

- MLS services were used by 36% of the student population surveyed.
- There was clear evidence that MLS had a positive impact in influencing students not to drop out due to experiencing difficulties with mathematics. 22% of respondents who had availed of MLS had considered dropping out of their course due to mathematical difficulties and almost two thirds of these students stated that availing of MLS had a positive impact on their retention on their course. In addition to this 22%, a further 3% of MLS users who had not considered dropping out submitted additional comments to indicate that MLS had influenced their decision to stay in college.
- This positive impact on student retention was comprehensive in that it pertains in equal measure across the spectrum of Leaving Certificate mathematical achievement.
- Drop-in Centres were the most widely provided, availed of and positively endorsed MLS service with 83% of users considering them worthwhile or extremely worthwhile.
- Workshops and Support Tutorials were also positively endorsed and were considered worthwhile or extremely worthwhile by approximately 80% of MLS users.
- ICT enabled supports were the least positively endorsed, although it was still the case that 56% of students who had used these supports felt they were worthwhile or extremely worthwhile.
- MLS was not viewed by students only as a remedial support but rather, utilised by those students seeking to improve their understanding of mathematical concepts.
- Student comments on MLS services fell into 3 main categories: Satisfaction with services provided; Resourcing (staff, contact hours, space); and Quality of tutors/teaching.
- Seeking advice in their preparations for forthcoming assessments provided a key prompt to avail of MLS for 41% of MLS users.

[1] In the Republic of Ireland, the Leaving Certificate examination is the state school-leaving examination taken by 96% of the second level student cohort at the end of a 5 year programme. Mathematics is taken at Higher, Ordinary or Foundation Levels, with Higher Level being the highest rated in terms of level of subject matter covered and difficulty.

- The majority of students who used MLS reported that it had a positive effect on their mathematical confidence, performance and ability to cope with the mathematical demands of their course.
- The student responses highlighted the importance of the quality of tutors in students' experience of MLS.
- There was a strong association between mathematical achievement in Leaving Certificate and struggling with mathematics in HE to the extent of considering dropping out.

Non-engagement with MLS

- 64% of respondents did not engage with MLS.
- A prominent reason provided for non-engagement with MLS was that help was not required (49% of non-users of MLS). Overall this means that approximately one third of the students surveyed engaged with MLS, another one third did not engage as they did not feel the need to but the final one third of students did not engage but may have needed to.
- The second most common reason students gave for not using MLS services was that the available times did not suit them (29% of non-users of MLS and hence 56% of non-users who may have needed help).
- A significant proportion of responses indicated that enhanced advertising and promotion (in particular of location) of MLS services would also be of assistance in enabling students to engage with MLS.
- In response to what would encourage non-users to avail of MLS, two main themes emerged. The first indicated that students would go if they needed help, and the second encompassed comments about MLS structures. The stronger the mathematical background of the student the more likely the response fitted the first theme and the weaker the student the more likely it was in the second theme.

Prior educational attainment and MLS

- There was a significant association between Leaving Certificate mathematics levels and whether students availed of MLS, the higher the level, the less likely they were to avail of MLS. However, it must be noted that students using MLS had a broad range of mathematical backgrounds.
- 60% of students who reported taking OL LC mathematics prior to entry indicated that they had switched from HL to OL.
- For OL students who were initially doing HL and then switched, the longer they stayed in HL the better their OL LC grade.
- There was an association between switching from HL to OL and availing of MLS, the later they switched to OL, the less likely they were to seek help.

Focus on non-engaging students

- There was a significant relationship between LC mathematics results and reasons students gave for not availing of MLS. The better the prior mathematical attainment of the student the more likely they are to say that they did not need help.
- A significant proportion of OL students who did not avail of MLS attributed reasons associated with low self-efficacy for not engaging with extra support.

- There was a significant relationship between the reasons given by non-users for not availing of MLS and the type of institution (IoT or University) that they attended.
- For University students, there was a significant relationship between the reasons given by non-users for not availing of MLS and their LC level of mathematics and grade.
- For students who switched LC mathematics level, the later they switched the more likely they are to say that they did not seek help in the form of MLS as they felt they did not need it.

Gender and MLS

- A statistically higher proportion of females than males availed of MLS regardless of prior mathematical achievement levels or discipline of study.
- There was a significant association between gender and the categories that emerged from the reasons given for use of MLS. The incentive to do as well as possible in assignments and examinations emerged as the most significantly distinguishing feature (45% for female respondents as against 26% for male).
- Once they have engaged with MLS, male and female students did not report any difference in the academic impact of MLS or in their experience of MLS.
- For students who did not use MLS there was a statistical difference in the reasons given for not availing of MLS in 2 of 7 categories. A significantly higher proportion of females than males reported that they did not know where MLS was provided in their institution whereas more males than females said that they had never heard of the service.
- For non-users of MLS, males were more likely than females to indicate that they would avail of MLS if they needed it whilst females were more likely than males to suggest more suitable opening times were needed to encourage them to avail of MLS.

Mature Students and MLS

- A statistically significant higher proportion of Mature Students[2] (62%) than traditional students (32%) availed of MLS.
- The mathematical background of both users and non-users of MLS amongst Mature Students was very similar. In each subject discipline, the proportion of Mature Students using MLS was very similar to the proportion of all Mature Students.
- Mature Students reported different needs and motivations for seeking MLS. Mature students were more likely to use MLS simply because it was there for them and they wanted to access extra help. In contrast, the traditional students were more motivated by assessment demands.
- Qualitative feedback illustrated that for Mature Students MLS is a mathematical lifeline.
- Mature Students were more positive in their praise of MLS than their traditional counterparts and their experiences with MLS played a more significant role in their retention than in that of other students.
- Low self-efficacy in mathematics seemed to inspire Mature Students to avail of MLS rather than shy away from it.

[2] A Mature Student (also called an Adult Learner), 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.

Recommendations and future work

- MLS should be embedded as a permanent fixture in every HEI in the country and should be properly resourced in order to ensure the best mathematical experience for all students.
- Evidence of the positive contribution of MLS in terms of student transition and retention should be widely disseminated to HEI authorities to highlight the benefit from a financial perspective.
- Evidence of the positive contribution of MLS both in terms of student transition and retention, and improved student confidence in their mathematical ability and a more positive student attitude towards mathematics as a subject, should be communicated to incoming first year students in order to encourage engagement with MLS.
- Evidence that MLS services were used by one third of the first year students in this study with another one third possibly needing them should be communicated to incoming first year students to promote the accessing of MLS services as a key element of taking active responsibility for their own learning mathematical learning in HE.
- MLS providers should consider more extensive and innovative promotion of MLS to students using best international practice.
- Re-alignment of hours when MLS is provided should be considered to meet the needs of a significant cohort of students.
- There should be an increased collaboration between those teaching first year mathematics in HEIs and those providing MLS.
- First year mathematics modules should have an element of continuous assessment scheduled to occur very early in the module.
- Priority should be given to bespoke training and development of all MLS staff to ensure the optimal student experience.
- Digital literacy skills of students and practical issues of accessing online materials/service require further consideration in MLS to be of maximum benefit to students.
- Adequate MLS provision should be put in place as part of the learning infrastructure for the expanding population of Mature Students entering HEIs.
- The stark differences in motivation for availing of support should be highlighted in the training of MLS staff so as to enhance the learning experience of Mature Students.
- HE and the MLS community should be prepared for the high levels of Mature Student engagement. This trend will have resource implications when coupled with stated national policy objectives to increase the numbers of Mature Students in HE.
- Further research should be undertaken in the area of gender and engagement with MLS to explore the issue more deeply and ascertain further insights in order to provide the optimal MLS service to all users.
- The questionnaire used in this study should be used as a standard template in HEIs to facilitate easy comparison of data from each institution in future collaborative work.

- Any future study in this area should consider the impact of a higher proportion of students completing HL LC mathematics and the patterns of switching LC levels in mathematics, due to changes in the second level curriculum and LC points allocation for HL mathematics.

- A further large scale cross-institutional study of student evaluation of MLS be carried out in 2016 within a structure that enables the data collection and analysis of the survey to be completed expeditiously.

Future work

Currently the IMLSN is involved in a number of collaborative projects for the mutual benefit of practitioners of MLS on the island of Ireland and further afield. The projects we are currently working on include:

- Continued analysis and dissemination of data from the student evaluation.

- Addressing issues related to staff recruitment and training:

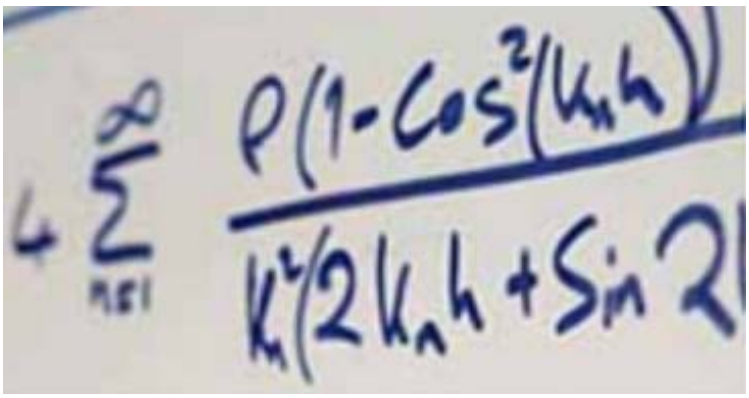
    - Dissemination of data with respect to the academic and financial benefits of MLS. This assists MLS providers in individual institutions in their ongoing efforts to secure suitable levels of staffing in the provision of MLS.

    - Developing and disseminating templates for tutor training sessions.

    - Designing a trial second level teacher internship programme.

- Investigating how best to improve the digital literacy skills of students using MLS and optimising online materials/services in MLS for student usage.

- Working more closely with The National Forum for the Enhancement of Teaching and Learning in Higher Education and the National Centre for Excellence in Mathematics and Science Teaching and Learning and continuing to collaborate with international MLS networks on various projects.



INTRODUCTION

In this document, we report on a student evaluation of Mathematics Learning Support (MLS) which was carried out in nine Higher Education Institutions (HEIs) in Ireland. This large scale evaluation, the first of its kind, was conducted by the Irish Mathematics Learning Support Network (IMLSN) in 2011 on first year students who were taking modules in service mathematics. The IMLSN was established in 2009 to promote and support individuals and HEIs involved in the provision of MLS in Ireland, similar in scope to the much larger and highly effective **sigma** (The Centre of Excellence in Mathematics and Statistics Support) network (http://www.sigma-network.ac.uk/) based in England and Wales. One of the initial aims of the IMLSN was to conduct a thorough evaluation of students' opinions on MLS with a view to establishing evidence for best practice in the provision of MLS on an institutional, national and international basis.

In Chapter 1, we provide a comprehensive literature review. We consider the reasons for the increasing numbers of students entering HEIs who take some level of mathematics or statistics as part of their degrees. We present research which shows that a significant number of these students demonstrate a lack of the basic mathematical skills that they require to succeed. This well documented problem, often labeled the 'Mathematics Problem', is commonplace in HEIs in Ireland, the UK and elsewhere. We focus on various responses from HEIs to this problem including the provision of MLS which is available in the majority of HEIs in Ireland and the UK. We also discuss international best practice in the evaluation of MLS, with systems of qualitative and or quantitative evaluations now commonplace in the wider MLS community. Additional literature reviews specific to Gender Differences in the use of MLS, and Mature Students are presented in sections 4.3 and 4.4 respectively.

In Chapter 2, further details on the establishment of the IMLSN and discussion of the reasons why we decided to conduct this survey are presented. Here, we also discuss the research instrument used in the evaluation and how the data was collated and analysed.

In Chapter 3, we present the survey results largely in line with the structure of the evaluation (see Appendix A). We initially provide an analysis of the results of Section A, the profile of the survey participants. We then focus on Section B, the responses of students who availed of MLS and close with Section C, the feedback of students who did not engage with MLS.

In Chapter 4, to gain further insight into the outcomes of Chapter 3, we present a more detailed analysis of the responses. We focus on four main areas: students' prior educational attainment; students who do not engage with MLS; gender difference in the use of MLS, and Mature Students and MLS. We consider how the results of our survey, in particular students' perception of MLS, tie in with existing research which suggests that appropriate student engagement with MLS can have a positive impact on student retention and progression. We present additional analysis on the problem of student engagement. This is one of the main challenges that face practitioners of MLS. We discuss the outcomes of the survey in terms of student engagement and non-engagement, their mathematical backgrounds, the type of HEI they attended, their gender and whether they were Mature Students or not. We also look at non-attendees, their reasons for non-engagement and their suggestions on how they could be encouraged to engage are all explored.

In Chapter 5 we discuss in detail the outcomes of the survey and their relevance to the provision of MLS on the island of Ireland and further afield. We believe this collaboration can act as a model for more large scale investigations into MLS and that the outcomes are extremely beneficial to the MLS and wider mathematics education community both nationally and internationally. We also present a brief overview of further work being carried out by the IMLSN in the area of MLS. Finally there is a discussion of what, if anything can be done to address the engagement levels of those students most in need of support who do not currently avail of it.

In order to facilitate timely dissemination of the results of this survey, a number of papers based on some elements of this report have already been already been published or submitted for publication, each focusing on a particular theme. We are extremely grateful to the editors of the journals involved for agreeing to allow us to include similar research in this report and would like to acknowledge that some of our results were presented for the first time in the following papers: Ní Fhloinn et al. (2014), Mac an Bhaird et al. (2013), Fitzmaurice et al. (to appear). As a result, copyright of the relevant tables and figures is in the ownership of the journals involved (see Appendix C for details).

Chapter 1. Literature review

1.1 The Mathematics Problem

More and more students entering Higher Education Institutions (HEIs) are taking courses in mathematics and statistics, in part because of the recent increase in recognition for and emphasis on the importance of STEM (Science, Technology, Engineering and Mathematics) subjects to society (Engineers Ireland, 2010; Expert Group on Future Skills Needs, 2008). However, a significant number of first year students do not appear to be adequately prepared for mathematics in HEIs and they often exhibit very weak mathematical backgrounds. For many years in the international academic community there has been widespread unease about the number of students who are entering HEIs without many of the basic mathematical skills that they require. This well documented problem, often labeled the 'Mathematics Problem', is common place in HEIs in Ireland, the UK and elsewhere (Lawson et al., 2012; Gill et al., 2010a; OECD, 2004).

The 'Mathematics Problem' and corresponding low achievement in mathematics have significant negative consequences. In 1999, the OECD viewed it as a contributing factor in low enrolment and retention rates in science and technology courses (OECD, 1999). An Irish Government body (Expert Group on Future Skills Needs, 2008) outlined the need for improving "our national mathematical achievement" and highlighted the importance of mathematics knowledge to the economy in Ireland. Similar reports across the world have highlighted the importance of mathematics to our future prosperity, for example in the UK (Vorderman et al., 2011) and Australia (McInnes & James, 1995).

This 'Mathematics Problem' was very well described in an Irish context by O'Donoghue in 2004, as outlined in Gill and O'Donoghue (2007). O'Donoghue described a number of overlapping themes including: the mathematical deficiencies of students upon entry; pre-requisite mathematical knowledge and skills; mathematical preparedness/under-preparedness; mathematics at the school/University interface; issues in service mathematics teaching; numeracy/mathematical literacy. Various aspects of the 'Mathematics Problem' in Ireland have also been investigated: for example Hourigan and O'Donoghue (2007) and Lynch et al. (2003) both considered the teaching and learning of mathematics at second level, and some of the details of the problems that are apparent at HE are also discussed. Outside of Ireland, considerable research is also available: for example Sutherland and Dewhurst (1999) discussed how the 'Mathematics Problem' impacted on a wide range of disciplines in a range of Universities across the UK. Rylands and Coady (2009) found that Universities and colleges worldwide have seen an increase in failure rates for first year mathematics courses because of the 'Mathematics Problem'. Lawson et al. (2012) contains a detailed overview of the history of the 'Mathematics Problem'.

1.2 Responses to the Mathematics Problem

Due to growing concern about the under-preparedness of incoming undergraduates to cope with the mathematical demands of their courses, many HEIs have implemented various forms of MLS, particularly aimed at first year students (Gill et al., 2010b). This widespread provision of MLS across HEIs in Ireland, the United Kingdom and Australia has been well documented in recent years with support services of various kinds now operating in the majority of HEIs (Perkin et al., 2012; Gill et al., 2008; MacGillivray, 2008). 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 HEI provided mathematics learning support in some form (Gill et al., 2008). In the UK the level of MLS provision in HEIs is above 85% of those surveyed (Perkin et al., 2012), and this is continuing to rise, in part due to the latest funding award to **sigma** from the UK government (see http://www.sigma-network.ac.uk/news/). It is clear that MLS is becoming an integral part of the support that any student should expect to receive within a HEI.

MLS has been defined as a facility offered to students, which is in addition to their traditional lectures and tutorials. MLS generally takes the form of Mathematics Learning Support Centres (MLSCs), whose main aims are "to address issues surrounding the transition to University mathematics and to support students' learning of mathematics and statistics across the wide variety of undergraduate courses that

require an understanding of mathematical concepts and techniques." (Matthews et al., 2012). MLS assists students in overcoming their mathematical difficulties, and the main target group (in line with our large scale survey) is first year students. This emphasis on provision of MLS to first year students resonates with Hourigan and O'Donoghue (2007) who state that mathematical deficiencies need to be addressed as early as possible in students' time in Higher Education (HE). The purpose of these supports is to offer non-judgmental, non-embarrassing and non-threatening one-to-one support (Ní Fhloinn, 2007; Lawson et al., 2003; Elliot & Johnson, 1994). MLSCs usually offer one-to-one help to students on a drop-in or appointment basis and are free of charge (Pell & Croft, 2008; Gill, 2006). Best practice guides are available for establishing MLSCs (Mac an Bhaird & Lawson, 2012). Additional supports also on offer include online resources, revision classes, extra tutorials, mathematical software and so on. Most MLSCs are committed to servicing the needs of traditional and non-traditional (i.e. International and Mature) students (Ní Fhloinn, 2007; Gill & O'Donoghue 2006). Carmody and Wood (2005) reported on the benefits of a drop-in support centre 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.

1.3 Evaluation of Mathematics Learning Support (MLS)

Continuous and thorough evaluation of MLS is of critical importance to the establishment of best practice, the maintenance of these services for the students who need them and ensuring that the service provided is meeting the needs of the students (Gill et al., 2010b). Evaluation of mathematics support is also important for ensuring that the service provided improves the overall mathematical level and knowledge of students, as well as justifying the financial outlay for HEIs who run such a service. As noted in Green and Croft "(e)vidence that a centre improves retention is a powerful weapon."(Green & Croft, 2012, p.13). However, evaluation of MLS is a complex task, as noted by Lawson et al: "It is very difficult to establish that the Mathematics [Learning] Support Centre has been the key reason behind the retention of any particular student." (Lawson et al., 2003, p.17). This is because the most effective support mechanisms should function within an overall model including lectures, tutorials and additional support sessions as needed, so it is challenging to isolate the effects of each support on its own. For example, a large scale study on retention conducted in the UK which asked students who dropped out of college for their reasons for doing so found that "(v)ery many of the responses… indicate that withdrawal was the result of a combination of circumstances, rather than attributable to a single cause." (Yorke & Longden, 2008, p. 25), again indicating the complexity of the issue. There are a considerable number of papers available on the type of suitable evaluation depending on the MLS provided. The 2012 **sigma** report (Matthews et al., 2012), gives a thorough review of the literature relating to the evaluation of MLS whilst MacGillivray and Croft (2011) contains a comprehensive overview and analysis of the issues at hand.

Numerous studies have been done to-date, mostly on a small scale, which attempt to quantify the impact of MLS in a quantitative manner, focusing upon examination performance within particular class groups or HEIs, and comparing performance with incoming mathematics level and subsequent usage of MLS. Much of the research focuses on evaluating the impact of MLS by using the success rate of the students who avail themselves of support as a metric (Burke et al., 2012; Mac an Bhaird et al., 2009; Pell & Croft, 2008; Symonds et al., 2007). Several of these papers report on the positive impact on the most at-risk students, and show improved student retention (Dowling & Nolan, 2006). The term 'at-risk' is used to refer to students who are at-risk of failing or dropping out of HE due to their weak mathematical backgrounds. Pell and Croft (2008) state that while support 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.

Other studies have focused on more qualitative information, such as staff and student feedback within individual Universities, generally through the form of anonymous surveys (Ní Fhloinn, 2009; Perkin et al., 2007). Student feedback has been recognized as crucial for measuring the effectiveness of MLS (Gill & O'Donoghue, 2007; Lawson et al., 2001). Ní Fhloinn (2008) looked at the role of student feedback in such

an evaluation in DCU, merging qualitative and quantitative data, and found that using a combination of both data gave a more complete picture of the MLSC there.

However, many of these studies, for example Grehan et al. (2011) and Mac an Bhaird et al. (2009), have also shown that a significant minority of students who are most in need of MLS do not avail of it and, indeed, do not engage with mathematics in general. The reasons for student non-engagement with MLS and mathematics are a complex area of research. As a consequence, many researchers have begun to consider the type of student using MLS (Mac an Bhaird & O'Shea, 2009; Croft & Grove, 2006). Pell and Croft (2008) found that first year Engineering students who received the top grades were more likely to attend the MLSC than those who failed or who just passed the module. Similar results have been reported in MacGillivray and Cuthbert (2007). Some authors have found that the fear of showing a lack of knowledge or ability negatively impacts on students' willingness to ask questions (MacGillivray, 2009; Ryan et al., 2001). In a study which investigated UCD students' reasons for dropping out (Redmond et al., 2011), respondents reported little, if any, engagement with any form of support early in their first year. Reasons given for not engaging included a lack of knowledge of who to approach, where to go, and this was particularly true for students in large classes. Grehan (2013) focused on the fears that students expressed and how these fears prevented them from engaging with mathematics during their first year at NUIM. Many of these factors were also identified in a study of students at Loughborough University (Symonds, 2008). Other factors include the availability, type and quality of the MLS in any individual institution as well as the discipline of study, the mathematical demands of the course and the student's prior mathematical achievements, see the 2012 **sigma** report (Mac an Bhaird & Lawson, 2012) for details on numerous reports in this area.

MLS has also been shown to have a positive impact in improving students' confidence in their own ability in mathematics, which is now recognised as a key feature in their overall performance. There is growing evidence of the importance of students' attitudes and beliefs about mathematics for their achievement in and successful applications of the subject. Typically, it is confidence in one's own mathematical ability (mathematical self-efficacy) that is correlated with achievement rather than liking or pleasure in the subject (Ernest, 2003). An investigation into the impact of first year Engineering students' confidence in their ability in mathematics upon their subsequent performance in examinations found a significant difference between the marks achieved by students with different confidence levels, and concluded that "having attended to the mathematics syllabi, lecturers could seek to boost student confidence in their ability in mathematics as a further means to improve student performance at University." (Parsons et al., 2009, p. 53). The same study found that engagement with mathematics support generally improved the marks of students with lower qualifications upon entry to the course.

In sections 4.3 and 4.4 there are additional short literature reviews which are specific to the MLS and Mature Students, and MLS and Gender sections of the survey analysis.

Chapter 2. Methodology

2.1 Background of the IMLSN and the survey

In Ireland in 2009, the need to formally establish a network to facilitate easier communication within the community of mathematics education and MLS practitioners was recognised. Furthermore, such a network, it was hoped, would provide opportunities for research collaboration and ensure the continuity of the already established and successful annual workshops. These workshops addressed issues which were relevant to all practitioners of MLS who were at various stages of progression. In 2009, the IMLSN was established as a focus point for those interested in mathematics and statistics support in HE in Ireland (Mac an Bhaird et al., 2011). The IMLSN (http://supportcentre.maths.nuim.ie/mathsnetwork) has a constitution and a steering committee whose members are drawn from a range of HEIs from around the island of Ireland and there is also a liaison between the committee and the NCE-MSTL.

In March 2009 the IMLSN committee prioritized the evaluation of MLS as one of its key objectives. In times of austerity, MLS could be seen as a target for cutbacks. So, while the majority of HEIs that provide MLS carry out their own evaluations, we decided to take this one step further and consider evaluating MLS on a large scale. A four person sub-committee of the IMLSN, Olivia Fitzmaurice, Ciarán Mac an Bhaird, Eabhnat Ní Fhloinn and Ciarán O'Sullivan, was established to manage the entire project.

The sub-committee conducted a thorough literature review (see Chapter 1) and in light of this, it was decided to develop a standard questionnaire for use in all HEIs who provide MLS. Such a large scale survey had not been considered before, and the rich data that could be accessed was very evident from the existing literature. This would allow us to ascertain student usage, experience and perceptions of MLS by conducting a large scale cross institutional survey of first year students. This project would also give valuable insights into best practice in analysing and reporting on such data.

2.2 Research instrument

To construct a valid and reliable research instrument and to establish best practice, a thorough review of the literature on both MLS evaluation and the use of questionnaires was conducted (Green & Croft, 2012; Research Methods in Education, 2001). In parallel, a one day IMLSN Workshop on Survey Creation and Analysis was organised in UL in June 2009 and was available for all members of the MLS community. It focused on how to create such a research instrument, how to phrase questions appropriately to measure what was intended and, furthermore, how to analyse both quantitative and qualitative data. The morning session was devoted to the design of surveys/questionnaires and was conducted by Dr. Jean Saunders from the Statistics Consultancy Unit in UL and in the afternoon, methods for the analysis of questionnaires were considered with sessions on the use of the statistical tools: Rasch analysis (delivered by Dr. Ann O'Shea (NUIM) and Dr. Sinéad Breen (St. Patrick's College, Drumcondra)), and NVivo analysis (Dr. John Keogh, IT Tallaght).

As a result of this initial work, it was decided to use an anonymous questionnaire for this study since the use of questionnaires to evaluate MLS is commonplace (Ní Fhloinn, 2008; Lawson et al., 2003; Croft, 2000). It was also decided, based on the literature review, to target only first year service mathematics students (i.e. students who were studying at least one mathematics module as part of their undergraduate programme, but were not specialising in mathematics) because they are generally the most relevant to MLS in terms of issues of retention and progression.

Based on existing best practice we decided that a paper-based (rather than online) questionnaire distributed in class would give the highest response rate and the richest data. These questionnaires were amalgamated and a communal pilot questionnaire was formed as a result. Samples of questionnaires already in use within HEIs to assess MLS were requested and collected from IMLSN members. This also took cognizance of both the literature review and outcomes of the workshop. The resulting pilot questionnaire comprised 16 questions in total, with a variety of multiple-choice, five-point Likert-scale,

and open-ended questions. The questionnaire had three main sections. The first section was to gather information regarding the respondents' background, and the student then was required to complete one of the remaining two sections depending on whether or not they had engaged with the MLS available. For users of MLS there was a section to indicate their levels of satisfaction with the services provided and to investigate their perception of the impact that MLS had on their mathematics education. For non-users of MLS there was a section which investigated the reasons why these students did not engage with the MLS available. The pilot questionnaire was issued to 100 students from five different HEIs (DCU, IT Tallaght, IT Tralee, NUIM and UL) at the end of the 2009-10 academic year.

The results of the pilot questionnaires were examined and expert statistical advice received to ensure the validity and reliability of the questions. This was a crucial part of the process as it allowed us to duly modify the survey as a result of findings from the pilot. The following changes were typical of the changes that were made:

Pilot Survey:

Leaving Certificate Mathematics Grade (if applicable):

A1 A2 B1 B2 B3 C1 C2 C3 D1 D2 D3 Other

Final Survey:

Leaving Certificate Mathematics Grade (if applicable):

Leaving Cert 1991 or before: A B C D E

1992 or after: A1 A2 B1 B2 B3 C1 C2 C3 D1 D2 D3 Other

This change was made as the Leaving Certificate Points/Grades system had changed in 1992. The rating scales were also altered:

Pilot Survey:

Not at all worthwhile 1 2 3 4 5 Extremely Worthwhile

Final Survey:

1 2 3 4 5 N/A

where 1=Not at all Worthwhile and 5=Extremely Worthwhile.

This change was made as students in the pilot survey were circling the words instead of the numbers.

An extra question was also added to determine if students were full-time or part-time. The Institutes of Technology (IoTs) have higher populations of part-time learners than some Universities.

Having adapted the questionnaire accordingly, Professor Ailish Hannigan (Statistical consultant to the NCE-MSTL) reviewed and approved the final questionnaire. The revised questionnaire contained 17 questions in total, with a variety of multiple-choice, five-point Likert-scale, and open-ended questions. The full survey questionnaire can be seen in Appendix A.

2.3 Data collection

In February 2011, the questionnaire was issued by IMLSN committee members to a representative involved in the provision of MLS within HEIs on the island of Ireland. They were invited to arrange for it to be issued during the second semester of the academic year 2010-11 to any first year students who were studying at least one service mathematics module. Evaluation sheets regarding MLS are usually distributed within MLSCs but this can lead to bias as they already rate the centre to some extent if they attend it (Lawson et al., 2003). In order to get a blend of users and non-users and to reduce bias we wanted the paper-based questionnaire issued in the appropriate lectures. The committee received 1633 completed questionnaires from nine HEIs all from the Republic of Ireland. The nine comprised of five Universities and four IoTs, out of a total of seven Universities and fourteen IoTs (Higher Education Authority, 2013). The Universities involved were DCU, NUIG, NUIM, UCD and UL. The Institutes of Technology involved were IT Blanchardstown, IT Carlow, IT Tallaght and IT Tralee.

2.4 Data analysis

In the summer of 2011 the IMLSN used funding from the NCE-MSTL and AISHE to employ 2 graduate students on a part-time basis to assist with inputting the enormous quantities of quantitative and qualitative data into SPSS, and with the production of an initial analysis of the quantitative data.

The large quantity of qualitative data obtained from the open questions was analysed using General Inductive Analysis (GIA) (Thomas, 2006) and Grounded Theory. GIA is an approach to Grounded Theory as laid out by Strauss and Corbin (1998). Instead of forming a theory and using the analysis of your research to find evidence supporting that theory, GIA and Grounded Theory allows for an open-ended approach. The theory emerges from the data itself. Initial coding of the data gives rise to labels, subsequent coding groups these labels into concepts, categories and themes. Members of the sub-committee working in pairs carried out the coding process independently and then compared for verification and to ensure reliability.

Initial analysis was conducted to explore the following research questions so as to gain insights into both the student experience of MLS and their perception of the impact of such support:

- What proportion of students availed of MLS?
- What was the profile of students availing of MLS?
- What reasons did students who availed of MLS give for doing so?
- How did students who availed of MLS rate the services provided?
- What was the profile of students not availing of MLS?
- What were the reasons given by students who had not availed of MLS for their lack of engagement with MLS?
- What would encourage students who did not avail of MLS to do so?
- Do students perceive an improvement in their mathematical confidence as a result of MLS?
- Do students feel that MLS impacts upon their examination performance?
- As a result of MLS, do students feel better able to cope with the overall mathematical demands of their course?
- Does MLS have an impact upon student retention?

Results of the analysis for these research questions are contained in Chapter 3. From the initial analysis of the data several categories emerged which we decided merited further analysis:

1. What is the influence of prior educational attainment in mathematics on the decision to avail of MLS?

2. Is there an interaction between the decision of the student not to avail of MLS and other factors such as prior educational attainment and type of institution attended?

3. Are there gender differences in the usage of MLS? In particular,
   a) Is there a significant difference between male and female students' level of engagement with MLS?
   b) Do male and female students report different reasons for using/not using MLS?
   c) Is there any evidence of a differing impact upon male and female students who use MLS?
   d) Are there different approaches that could be taken to encourage male and female non-users of MLS to engage with the service if needed?

4. Do Mature Students in mathematics use MLS differently? In particular,
   a) What are the motivational factors of Mature Students who seek MLS?
   b) Why do some Mature Students in mathematics not seek MLS?

The result of the analysis of these research questions is contained in Chapter 4.

Chapter 3. Research findings

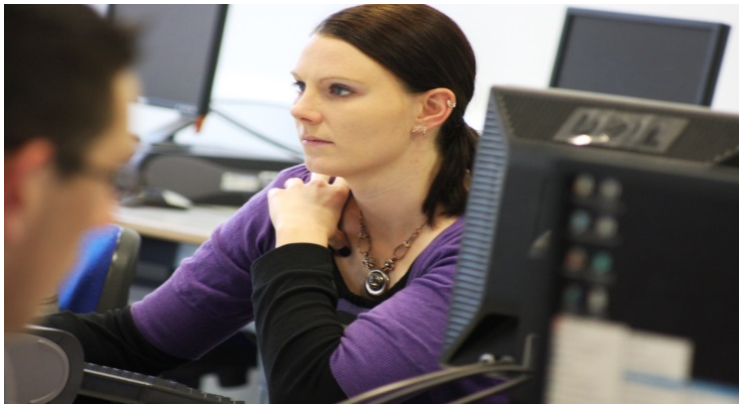
As stated previously, in order to facilitate timely dissemination of the results of this survey, a number of papers based on some elements of this report have already been already been published or submitted for publication, each focusing on a particular theme. We are extremely grateful to the editors of the journals involved for agreeing to allow us to include similar research in this report and would like to acknowledge that some of our results were presented for the first time in the following papers: Ní Fhloinn et al. (2014), Mac an Bhaird et al. (2013), Fitzmaurice et al. (to appear). As a result, copyright of the relevant tables and figures is in the ownership of the journals involved (see Appendix C for details).

3.1 Profile of survey participants

In Section A of the questionnaire, all students were asked a number of background questions and we present the results in this section of the report. Given the large scale and cross-institutional nature of the survey, there is a natural multi-dimensional complexity of respondent profile. It is clear that these dimensions will impact on the student experience to varying extents. Throughout the report, we are aware of this complexity of respondent profile in considering the results from the survey. Any implications that can be drawn, must be considered in this context. Nevertheless, the important unifying aspect is that all the respondents were first-year service mathematics students evaluating MLS services which they may or may not have used in their HEI. Their feedback, when analysed appropriately, gives insights that may be of benefit in the provision of such MLS services.

Key Findings

- 1633 first year service mathematics students from 9 HEIs participated, 1201 from 5 Universities and 432 from 4 Institutes of Technology (IoT).
- Students were from 6 disciplines of study: Science (583), Engineering (171), Computing (236), Business (484), Arts (67), and Education (90).
- 42% of respondents were female and 58% were male.
- 13.5% of respondents were classified as Mature Students.
- In terms of prior mathematical attainment 34% indicated they had completed Higher Level (HL) Leaving Certificate[3] (LC) mathematics, 63% Ordinary Level (OL) LC, 1% Foundation Level (FL) LC and 2% had a different qualification or did not provide information.



[3] In the Republic of Ireland, the Leaving Certificate examination is the state school-leaving examination taken by 96% of the second level student cohort at the end of a 5 year programme. Mathematics is taken at Higher, Ordinary or Foundation Levels, with Higher Level being the highest rated in terms of level of subject matter covered and difficulty.

3.1.1 Institutions

Of the 1633 responses, 1201 were from University students and 432 from Institute of Technology (IoT) students. A detailed breakdown is included in Table 1.

Table 1: Breakdown of student respondents per Higher Education Institute

University	No. of Respondents	Institute of Technology	No. of Respondents
UL	263	Tallaght	256
NUIM	345	Tralee	59
NUIG	90	Carlow	83
UCD	295	Blanchardstown	34
DCU	208		
Total	**1201**	**Total**	**432**

In considering the student responses to the survey it is important to highlight the different and complementary roles and missions Universities and IoTs have within the HE system in Ireland. At undergraduate level Universities focus on Level 8 (Honours Degree programmes), e.g. in 2011-2012, 97% of full-time undergraduate students in Universities were on level 8 programmes. IoTs emphasise career-focused HE offering Level 8 programmes but also programmes at Level 7 (Ordinary Degrees) and Level 6 (Higher Certificates), e.g. in 2011-2012, 53% of full-time undergraduate students in IoTs were on Level 8 programmes, 38% were on Level 7 programmes, and 9% were on Level 6 programmes. IoTs also have a larger proportion of Mature Students and students from disadvantaged areas and are stronger than the Universities in part-time and flexible provision. Universities are more active in research at postgraduate level, have a higher proportion of research activity and a much higher proportion of national and international research funding whilst IoTs are involved in less research activity in a smaller number of focused areas concentrating on industry-focused research and innovation (HEA report, 2013). In the IoTs that participated in the survey, the ratio of Level 8:7:6 students was 49:38:11% which is very similar to the 53:37:9% proportion of Level 8:7:6 students in IoTs nationally in the 2011-12 academic year.

3.1.2 Area of study

The students surveyed were asked to indicate their degree programme. As students were from a wide number of different institutions, it is natural that they were studying service mathematics across a range of discipline areas. Of the 1633 students, 1631 indicated their discipline of study and these were categorised as: Science, Engineering, Computing, Business, Arts, and Education, as shown in Table 2.

Table 2: Breakdown of survey respondents by discipline area and institution

HEI	Science	Computing	Engineering	Business	Arts	Education	Total
UL	56		30	146	5	25	262
NUIM	194	20		43	62	26	345
NUIG	90						90
UCD	73		102	120			295
DCU	101	68				39	208
IT Tallaght	69		45	141			255
IT Tralee			59				59
IT Carlow		83					83
IT Blanchardstown				34			34
Total	**583**	**171**	**236**	**484**	**67**	**90**	**1631**

3.1.3 Mode of study

Students were asked to indicate whether they were full-time or part-time students. 1604 of the students in the survey were full-time students and 29 were part-time students. All the part-time students attended IT Tallaght. Of these 29 part-time students, 20 were Mature Students. None of these 29 students availed of MLS. This is in part was due to the scheduling times of the MLS hours in that year. As a result of the feedback from these part-time students in this survey, MLS sessions were timetabled at times to suit them in subsequent years. This highlights the importance of suitable MLS evaluation.

3.1.4 Gender profile

Students were asked to indicate whether they were male or female. Of the 1633 respondents, four did not indicate their gender. The results for the other 1629 students are given in Table 3, where it can be seen that there were more males than females in the survey.

Table 3: Breakdown of survey respondents by gender

Gender	Total	%
Female	690	42.36
Male	939	57.64
Total	**1629**	**100**

For the 1629 students who indicated gender and area of study, the proportions of male and female in each of the disciplines are shown in Table 4.

Table 4: Breakdown of survey respondents by discipline area and gender

	Science	Engineering	Business	Arts	Education	Computing	Total
Male	50.09%	86.81%	49.9%	41.79%	35.96%	83.04%	57.77%
Female	49.91%	13.19%	50.1%	58.21%	64.04%	16.96%	42.32%
Total	**583**	**236**	**483**	**67**	**89**	**171**	**1629**

There is a significant association between gender and discipline ($p<0.001$). As expected, this is particularly pronounced in our survey in disciplines such as Engineering and Computing (see Table 4), which are traditionally male-dominated. The Education students in question were all studying to be secondary school teachers, rather than primary, and so we do not see as severe a bias towards female respondents in this cohort as might have been observed had pre-service primary teachers been included in the sample. A recent government report in Ireland showed 83% of primary teachers are female, compared with 60% of secondary teachers, figures which are in line with international averages (O'Connor, 2007, p. 10). Gender differences in those availing of MLS are discussed in Section 4.3.

3.1.5 Mathematical attainment prior to entry

The 1633 respondents were asked to indicate the level of mathematics they had studied prior to entry to their HEI. The Leaving Certificate (LC) is the terminal examination taken by pupils at the end of secondary school in Ireland. While mathematics is not strictly a compulsory subject for students, it is taken by the majority of students and is usually taken by more students than any other subject, e.g. in 2010, 54481 students took the LC and 52290 (95.98%) took mathematics (http://www.examinations.ie). Mathematics can be taken at three levels: Higher (HL), Ordinary (OL) and Foundation (FL). Generally, a minimum of OL mathematics would be needed for most service mathematics courses in HEIs and this is reflected among respondents with only 18 of the 1563 respondents who provided their LC results having studied mathematics at FL. If they had not taken the LC, then they could select the Other option. 1601 students selected one of these four options and a breakdown of responses is given in Table 5.

Table 5: Leaving Certificate mathematics level of respondents who provided answers

Higher Level LC	Ordinary Level LC	Foundation Level LC	Other	Total
33.79% (541)	62.71% (1004)	1.12% (18)	2.37% (38)	100% (1601)

For 1599 of the 1601 students it was possible to examine the relationship between gender and LC level:

Table 6: Leaving Certificate results of surveyed students by gender

		Higher Level LC	Ordinary Level LC	Foundation Level LC	Other	Totals
Male	**No:**	313	572	13	21	919
	%:	34.06%	62.24%	1.41%	2.29%	
Female	**No:**	227	432	5	16	680
	%:	33.38%	63.53%	0.74%	2.35%	

In terms of prior mathematical achievement, the vast majority (almost 96%) of respondents provided a LC level and grade for mathematics. In this survey, gender and LC mathematics level are independent ($p=0.415$), with very similar proportions of males and females studying mathematics at each level; however, gender and overall LC mathematics grade at each level are significantly linked (chi-square=40.643, 8df, $p<0.001$), with 6% of male respondents receiving an A-grade in HL (HA) compared to 3% of female respondents. While at OL, this trend reverses with 14% of males receiving an A-grade (OA) compared to 22% of females. This is generally reflective of (if more pronounced than) the national trend that year (see statistics from www.examinations.ie), where (considering only students who passed the LC examination, as these are the only ones who would be included in our survey) 3.5% of males and 2% of females obtained a HA, while 8% of males and 12% of females obtained an OA.

3.1.6 Mature Student profile

A Mature Student (also called an Adult Learner), 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 to a HEI for Mature Students who have not got the minimum requirement for entry to their chosen course of study is typically gained via interview and is based on a number of factors including life experience and motivation, in addition to prior qualifications. In this report non-Mature Students will be ascribed the descriptor of traditional learners as they are learners who are under 23 years old and who are therefore engaging in their HE studies soon after completing their second level education.

Of the 1633 respondents, 221 (13.5%) indicated that they were Mature Students. 73% of the 221 Mature Students were male and 91% of the Mature Student cohort were full-time students. If we consider their mathematical attainment prior to entry to their HEI, 202 of the 221 Mature Students picked one of the four options given, as outlined in Table 7, with the majority studying OL.

Table 7: Leaving Certificate levels of Mature Students

HL LC	OL LC	Foundation Level LC	Other	Total
9.90% (20)	73.76% (149)	4.46% (9)	11.88% (24)	100% (202)

We then considered the disciplines in which Mature Students were taking service mathematics when compared to the breakdown of disciplines for all respondents. A breakdown is contained in Table 8.

Table 8: Degree Programmes of Mature Students and of overall survey respondents.

	No. of Mature Students	%	No. of Respondents	%
Science	80	36.2	583	35.7
Engineering	50	22.6	236	14.45
Business	55	24.9	484	29.64
Arts	7	3.2	67	4.10
Education	6	2.7	90	5.51
Computing	23	10.4	171	10.47
Total	**221**	**100.0**	**1631**	**100.0**

On comparison with the overall distribution it can be seen that, for most discipline areas, the proportion of Mature Students is in line with the overall proportions of survey respondents.

3.2 Insights into engagement with MLS

Students were asked whether they had used MLS (e.g Drop-In, Support Workshops, ICT) or not. This section of the report focuses on students who indicated that they had availed of MLS and then went on to complete Section B of the questionnaire. These respondents answered a series of 7 questions (Questions 9 – 15) which sought to gather information as to why they had first engaged with MLS; how they rated the MLS services provided in their institution; if they had ever considered dropping out because of mathematical difficulties, and if they had, did MLS influence their decision to stay; how they rated the influence of MLS on their mathematical confidence, performance in examinations/tests and their ability to cope with the mathematical demands of their course.

Key Findings

- MLS services were used by 36% of the student population surveyed.
- There was clear evidence that MLS had a positive impact in influencing students not to drop out due to experiencing difficulties with mathematics. 22% of respondents who had availed of MLS had considered dropping out of their course due to mathematical difficulties and almost two thirds of these students stated that availing of MLS had a positive impact on their retention on their course. In addition to this 22%, a further 3% of MLS users who had not considered dropping out submitted additional comments to indicate that MLS had influenced their decision to stay in college.
- This positive impact on student retention was comprehensive in that it pertains in equal measure across the spectrum of Leaving Certificate mathematical achievement.
- Drop-in Centres were the most widely provided, availed of and positively endorsed MLS service with 83% of users considering them worthwhile or extremely worthwhile.
- Workshops and Support Tutorials were also positively endorsed and were considered worthwhile or extremely worthwhile by approximately 80% of MLS users.
- ICT enabled supports were the least positively endorsed, although it was still the case that 56% of students who had used these supports felt they were worthwhile or extremely worthwhile.
- MLS was not viewed by students only as a remedial support but rather, utilised by those students seeking to improve their understanding of mathematical concepts
- Student comments on MLS services fell into 3 main categories: Satisfaction with services provided; Resourcing (staff, contact hours, space); and Quality of tutors/teaching.
- Seeking advice in their preparations for forthcoming assessments provided a key prompt to avail of MLS for 41% of MLS users.
- The majority of students who used MLS reported that it had a positive effect on their mathematical confidence, performance and ability to cope with the mathematical demands of their course.
- The student responses highlighted the importance of the quality of tutors in students' experience of MLS.
- There was a strong association between mathematical achievement in Leaving Certificate and struggling with mathematics in HE to the extent of considering dropping out.

3.2.1 Level of engagement with MLS

Students were asked whether they had used MLS (e.g. Drop-In, Support Workshops, ICT) or not. There were 1628 respondents and for the rest of Section 3.2 we consider only their answers, as outlined in Table 9.

Table 9: Number of respondents availing or not availing of MLS

	Used MLS	Did not use MLS	Total
Student numbers	587	1041	1628
%	36.06	63.94	100

587 (36.1%) of the 1628 students who responded indicated that they had availed of MLS. The engagement levels varied across the different HEIs, and a breakdown by HEI is given in Table 10. It should be noted that the number of first year service mathematics students in each HEI varies considerably, and not all HEIs target all first year service mathematics students in their provision of MLS. However, based on the number of first year students registered in relevant discipline areas for that year (Higher Education Authority, 2013), a minimum overall response rate of 25% for Universities and 28% for IoTs can be calculated for the survey. We do not claim that the results of this survey are representative, but they give an invaluable first insight at the state of MLS on a large scale.

Table 10: Number of respondents using MLS in each HEI

HEI	UL	NUIM	NUIG	UCD	DCU	Tallaght	Tralee	Carlow	Blanchardstown
No. of respondents availing of MLS	89	240	32	38	84	18	21	35	30

3.2.2 Reasons given by students for their decision to first avail of MLS

In Question 9, students were asked an open–ended question in which they could supply comments as to why they first decided to use the MLS. 556 of the 587 attendees responded, and students could give more than one response. There were 577 comments in total, which were coded, and a breakdown of categories is included in Table 11. Note that 21 respondents gave comments which could be categorised in more than one category.

Table 11: Frequency of reasons given for availing of MLS

Categories of comments	**% of 577 comments**	**Sample comments**
Assignments/Examinations: Looking for help with specific aspect of coursework assessment during the semester (upcoming test, assignment) or attending for revision or prep for end of term examinations.	41.25%	"*As I was finding my homework hard*"; "*Because I couldn't do my maths assignments on my own*"; "*Because I thought it will be a great idea to use drop-in clinic if I want to get good grades*"; "*I really needed help with maths before the January exams*"; "*When I struggled with homework my friends told me how helpful it was*".
Extra help	20.62%	"*Needed help with maths*"; "*Because I needed help*"; "*I had to catch up on missed lectures*"; "*Had problems with 3D geometry*".
Improve Understanding: Positive comments about attending to try to improve or gain better understanding	15.94%	"*I did not understand a particular subject topic in maths*"; "*I decided to use the MSC for help in explaining maths concepts that I did not fully understand during the lecture*"; "*To help me understand the topics better*".
Mathematics Difficult	9.71%	"*Because I find maths very difficult*"; "*Encouraged by lecturers. Sought help with homework. Maths is very intimidating at the start and needed help*"; "*College maths became very difficult*".
Background/Ability: Comments on being away from maths prior to entry (Mature Students) or comments suggesting poor confidence in maths ability.	7.45%	"*Hadn't done maths in ages so I needed extra help*"; "*As I have been out of the education system for many years I felt I needed the extra support*"; "*Lack of basic maths*"; "*I am bad at maths*".
Struggling	5.03%	"*Struggling with maths*"; "*Completely lost in my maths course*".

3.2.3 Student evaluation of particular MLS services

In Question 10, students were asked to rate a list of MLS services which were provided in their HEI on a scale of 1 to 5 where 1=Not at all Worthwhile and 5=Extremely Worthwhile. They also had an option to mark Not Applicable, because different HEIs offer different services. The number of parts in this question depended on the number of services available in the individual HEI, for example, in NUIM students were asked about the Drop-In Centre, Online Supports and Topical Revision Workshops, whereas in IT Tallaght they were asked about the Drop-In Centre, Topical Revision Workshops and Support Tutorials, see Table 12 for further details.

The range of services included Drop-In Centre, ICT enabled Support (e.g. online support/website, email questions service, CALMAT software), Topical or Examination Revision Workshops and Support Tutorials. Support Tutorials are treated separately as they are not run on a weekly basis, students decide when they run, and what materials will be covered. This list was modified locally in each HEI to reflect the range of

services that they offered; a breakdown is shown in Table 12 along with details of the number of ratings and comments submitted by students with respect to each.

Table 12: MLS services and HEIs in which they were available

No. of respondents providing rating of the service.	No. of comments about the service.	Support available	Number of the 9 HEIs offering each service	UL	NUIM	NUIG	UCD	DCU	IT Tallaght	IT Tralee	IT Carlow	IT Blanchardstown
519	244	Drop-In Centre	9	Y	Y	Y	Y	Y	Y	Y	Y	Y
268	112	ICT enabled Support	8	Y	Y	Y	Y	Y	N	Y	Y	Y
232	95	Topical or Examination Revision Workshops	6	Y	Y	Y	Y	Y	Y	N	N	N
101	31	Support Tutorials	3	Y	N	N	N	N	Y	N	Y	N

Students were also given the opportunity to make additional comments/suggestions. Coding the responses led to the emergence of three main categories: Resourcing (staff, contact hours, space); Satisfaction levels with services provided; Quality of tutors/teaching. A small number of responses could not be placed in any of these categories. These are labelled as Other and sample quotes provided where appropriate. These ratings and comments are discussed in the following subsections.

3.2.3.1 Drop-In Centre

519 of the 587 attendees rated their Drop-in Centres and a breakdown of responses is given in Figure 1. Over 82.5% of these 519 students felt MLS Drop-In was worthwhile and 6.74% suggested it was not worthwhile. There were 244 additional comments and a breakdown of these responses including sample comments is given in Table 13.

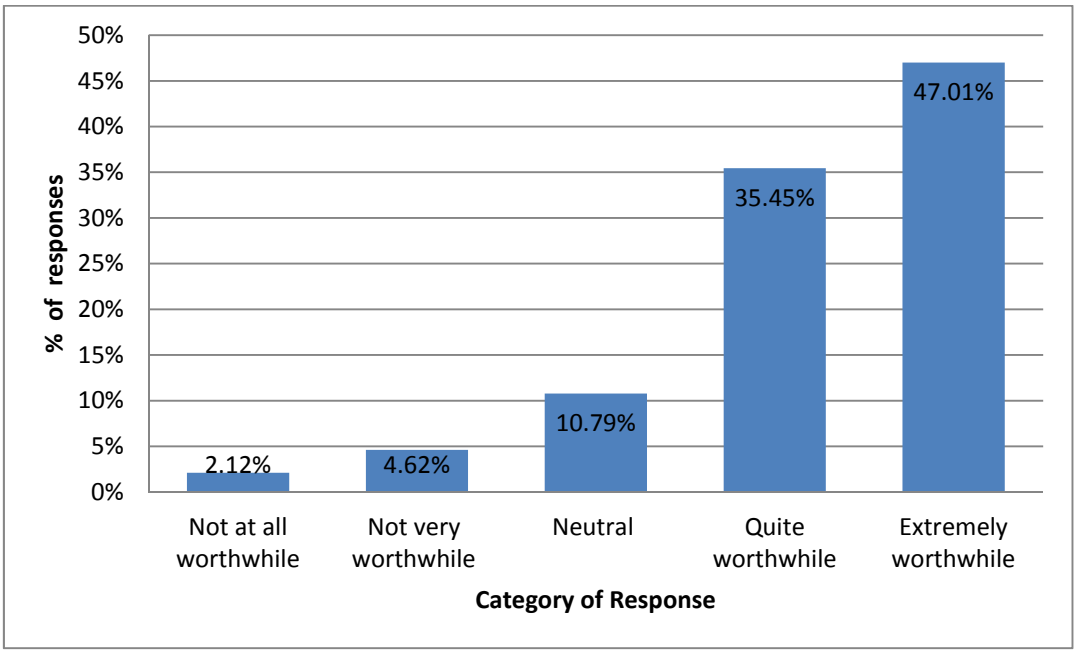


Figure 1: Student responses to rating Drop-in Centres

Table 13: Student comments/suggestions regarding Drop-In Centres

Category of comments	% of 244 comments	Sample comments
Satisfaction level with services provided	42.21%	"*Very helpful/Excellent service*"; "*Helpful, very friendly, very approachable tutors*"; "*Website/extra notes very helpful*"; "*Excellent service; very helpful; very well run*"; "*I left knowing all I needed to know for answering questions like the one I was stuck on*"; "*It is a good place to go and do maths assignments. It supplements lectures and tutorials and provides the right environment for solving problems*"; "*Only for the centre I probably would have dropped out*"; "*Without the MLSC I would fail maths! I learn the most from talking to tutors and other students there*".
Resourcing (staff, contact hours, space)	36.07%	"*Better/longer opening hours*"; "*More tutors needed";* "*Not worthwhile when busy but extremely worthwhile when quiet*"; "*Bigger room needed*"; "*It's excellent. Wish there were more hours open because some people's timetables are so jam packed you can rarely get there*"; "*Not enough room or people around to help. Extend opening hours*"; "*Occasionally, a bit crowded; may need extra tutor for this (nearer exams)*".
Quality of tutors/teaching	18.03%	"*I find the tutors are very helpful and they have helped my confidence in my own mathematic ability to grow. Especially **, he is always willing to help and spend ages with me until I understand it 100%*"; "*Sometimes the support (tutors) can be judgmental and rude but more often others are extremely helpful!*"; "*Tutors were excellent, was just waiting for help for a while*"; "*The tutors spent more time trying to figure out the questions and then didn't know how to explain it*".
Other	3.69%	"*Didn't use it even though I should have and I feel really guilty for not doing that*".

3.2.3.2 ICT enabled Support

In 8 of the 9 HEIs attendees were asked to rate ICT enabled Supports (e.g. MLSC websites, online supports, software packages etc.). A breakdown of the 268 responses is available in Figure 2.

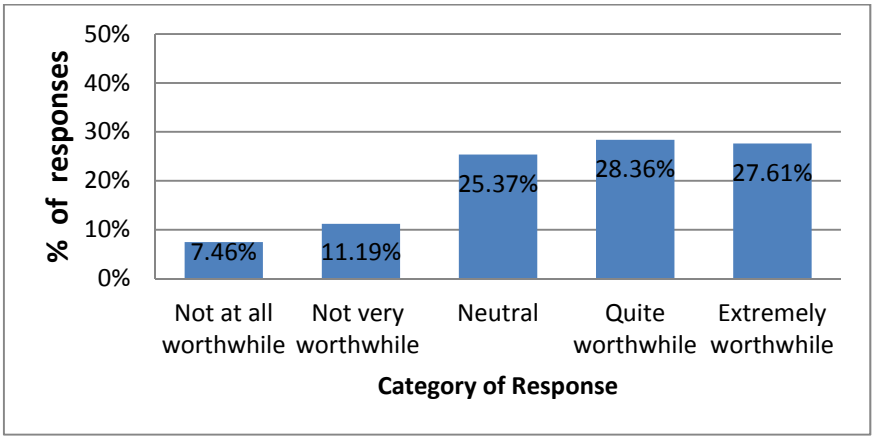


Figure 2: How students rated the ICT enabled Supports

Almost 56% of these 268 students felt that ICT enabled Supports were quite or extremely worthwhile and just less than 19% felt that they were not worthwhile. 112 students made additional comments/suggestions. (Note that these 112 responses include 14 from students who had not rated the ICT enabled Supports but wanted to comment - for example 8 responses indicated that they did not know about the ICT enabled Support). Coding of the 112 responses gave 4 main categories: Satisfaction level with services provided; Quality of materials/layout/ease of access; Did not know it was there; Prefer human help with mathematics. A breakdown of these responses including sample comments is given in Table 14.

Table 14: Student comments/suggestions relating to ICT enabled Supports

Category of comments	**% of 112 comments**	**Sample comments**
Satisfaction level with services provided	41.07%	"*Really helpful for revision*"; "*Helps learn the basics*"; "*It is a good point for reference or a quick way of looking back on material*"; "*Very helpful, especially towards exams*".
Quality of materials/layout /ease of access	27.68%	"*Not everything works like the videos*"; "*Difficult to download*"; "*Can't run on my computer*"; "*Hard to access some material*"; "*Maybe have questions there in folder for practice*".
Prefer human help with maths	12.50%	"*Still need help being explained in person*"; "*I don't like that you have no-one to help with these if you get stuck*".
Did not know it was there	8.93%	"*Didn't know about it*"; "*Never knew it was available*".
Other	8.93%	"*I find it hard to make time to engage in the online course*"; "*No extra time really to do the online courses*"; "*Never used that often*".

3.2.3.3 Workshops

In 6 of the 9 HEIs attendees were asked to rate the Topical or Examination Revision Workshops. These workshops were grouped together for two reasons. Firstly, similar percentages of students in the HEIs availed of the workshops. Secondly, they were similar in the sense that they were scheduled sessions, as distinct from Support Tutorials which are reported on in Section 3.2.2.4. Support Tutorials are student led sessions which occur as the need arise. A breakdown of the 232 responses is available in Figure 3.

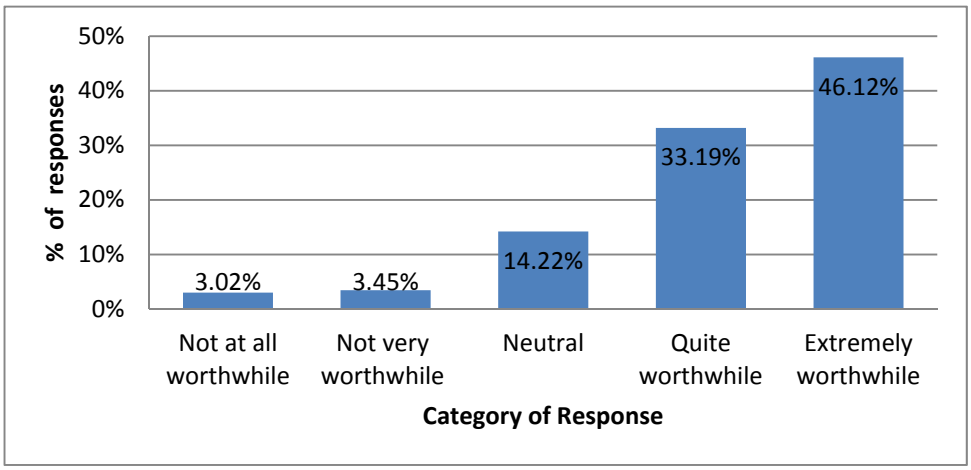


Figure 3: How students rated the Topical or Examination Revision Workshops

Over 79% of the respondents found the workshops quite or extremely worthwhile whereas just less than 6.5% found the workshops not worthwhile. 95 students made additional comments/suggestions. Coding of the responses gave 4 main categories: Satisfaction level with workshops; Issues with timing of workshops; Did not use it; Did not know about them. A breakdown of these responses including sample comments is given in Table 15.

Table 15: Student comments/suggestions regarding Topical or Examination Revision Workshops

Category of comments	**% of 95 comments**	**Sample comments**
Satisfaction level with workshop	66.32%	*"Mature student workshops great"*; *"Extra help is always great"*; *"Wouldn't have passed without them"*; *"Made maths simple"*; *"Very helpful"*; *"Excellent for revision"*; *"Also fantastic, a great help – brings material back to basics"*; *"Great to reinforce concepts that may have been overlooked"*.
Issues with timing of workshops	16.84%	*"Times didn't suit"*; *"I have only gone to one because it's on at a bad time. But it was great the time I went"*; *"Could never attend as it clashed with my physics labs"*.
Did not use it	9.47%	*"Didn't go"*.
Did not know about them	5.26%	*"Wasn't aware of it"*.

3.2.3.4 Support Tutorials

In 3 of the 9 HEIs (UL, IT Carlow and IT Tallaght) attendees were asked to rate Support Tutorials. A breakdown of the 101 responses is available in Figure 4.

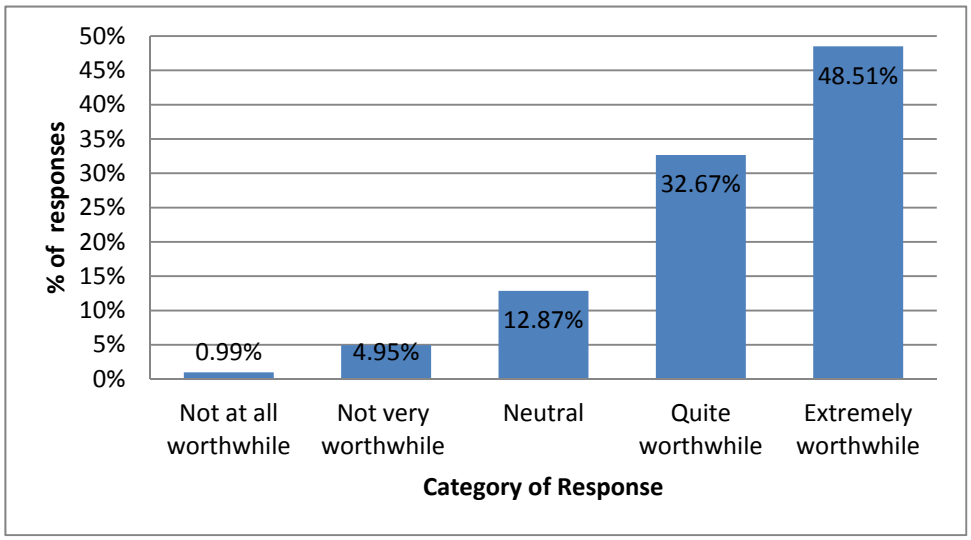


Figure 4: How students rated Support Tutorials

Over 81% of respondents found the Support Tutorials worthwhile whereas less than 6% found them not worthwhile. 31 students made additional comments/suggestions. Coding of the responses gave 2 main

categories: Satisfaction with Support Tutorials; Issues with timing of Support Tutorials. A breakdown of these responses including sample comments is given in Table 16.

Table 16: Student comments/suggestions regarding Support Tutorials

Category of comments	% of 31 comments	Sample comments
Satisfaction level with Support Tutorial	70.97%	"*Very helpful*"; "*Good tutors*"; "*Excellent. Really good at narrowing down a topic and making it easier to understand*"; "*The support tutorial is of extreme benefit and I would not have passed maths without it*"; "*Very good – teacher goes through content well*".
Issues with timing of Support Tutorial	16.13%	"*On too late in the evening so a lot of people can't attend*"; "*Increase number of days because the times clash with lecture times*".
Other	12.90%	"*Would prefer one-to-one grind*".

3.2.4 Student perception of MLS impact

In 5 questions (11-15) students were asked to rank their perceptions of the impact of MLS and they were also given the opportunity to comment on their answers.

3.2.4.1 Student perception of MLS impact on mathematical confidence

Students were asked to rank how they perceived that MLS had helped their confidence in mathematics, with a five-point scale from 1 = Not at all helpful to 5 = Extremely helpful. 539 (91.8%) of 587 attendees responded and the breakdown is shown in Figure 5.

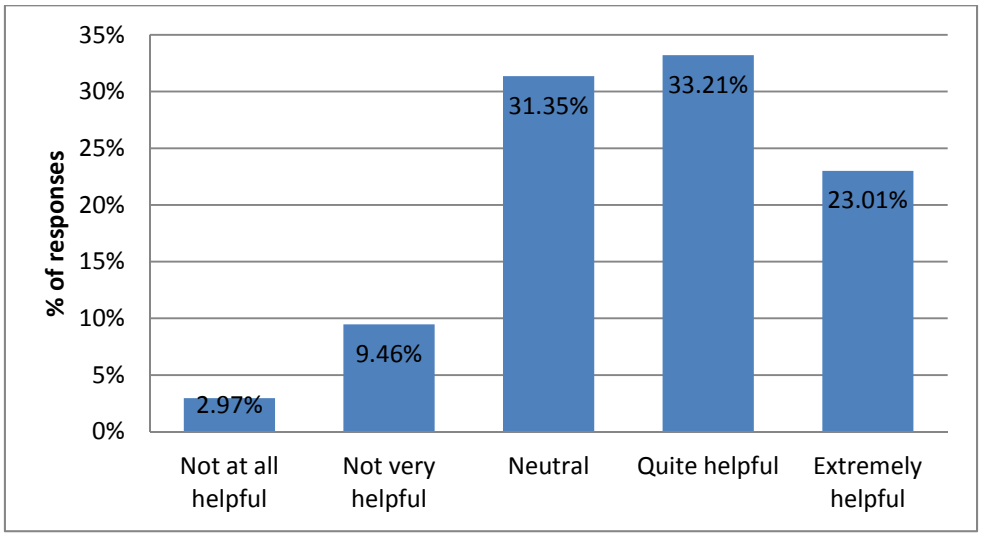


Figure 5: Student responses on how they perceived that MLS has helped their confidence in mathematics

Over 56% of the students felt the MLS was helpful to their confidence in mathematics, just over 12% felt it was not helpful. Students were also given the opportunity to comment and 106 did so. When the responses were coded, the majority fell into the 6 categories outlined in Table 17.

Table 17: Categories of student comments on how MLS has helped their confidence in mathematics

Category of comments	% of 106 comments	Sample comments
Very helpful/good to know it's there	32.08%	*"I know that if I don't understand something in class that I can always go there"*; *"Very helpful – just have a slow understanding of maths"*.
Made maths/examinations/assignments doable	19.81%	*"Made me see that it is not impossible to grasp a particular mathematical task but that it takes practice and time"*; *"Instead of just giving you the answer the MLSC helps you and makes you get the answer yourself - when you see this is possible it increases confidence"*; *"I feel confident with the material as far as how and when to apply it in exams and homework"*.
Understanding improved	15.09%	*"They answered all my questions very clearly and my understanding of that topic of maths increased"*; *"Tutors help me understand concepts that I can then apply to other maths problems"*; *"It helped me to understand questions and not to be afraid of attempting them"*.
Weak at maths/not confident	12.26%	*"I'm just not the best at maths"*; *"Still would never say I'm confident whilst doing maths";* *"no help"*; *"I'm still not very confident doing it on my own but it has helped"*.
Didn't go enough	11.32%	*"Only availed of the service twice this year so it hasn't really influenced me greatly"*; *"Have only gone twice and only helped with specific question – not maths in general"*.
Confidence not an issue	5.66%	*"I was already confident"*; *"I was always confident in maths but now it's easier to look and ask for help"*.

3.2.4.2 Student perception of MLS impact on mathematical performance

Students were asked to rate how they perceived that MLS had impacted upon their mathematics performance in tests or examinations to date, with 1 = No impact at all to 5 = Has had a large impact. 526 (89.6%) of the 587 attendees responded to this question, and the results are shown in Figure 6.

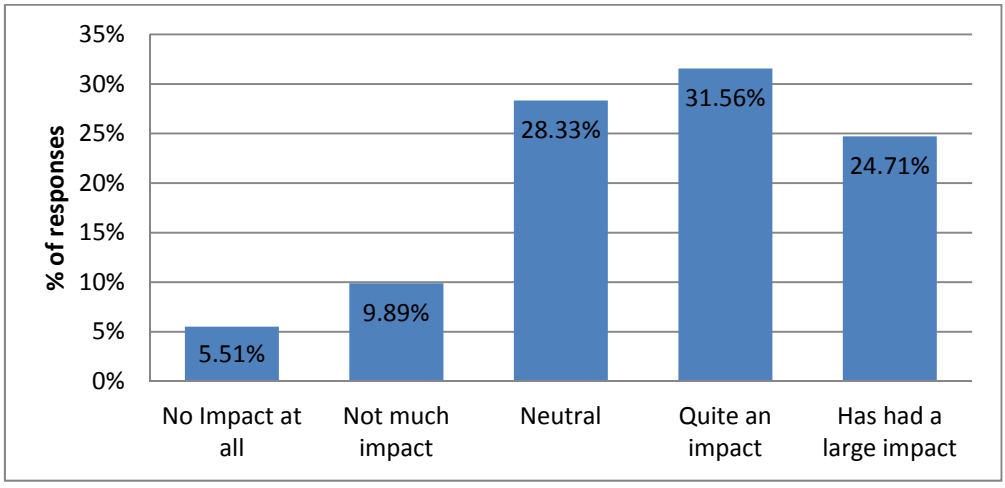


Figure 6: Student perception on how MLS had impacted on their mathematics performance so far

Over 56% of respondents felt that MLS had an impact on their mathematics performance, 15.4% felt it had no impact. 103 respondents made additional comments. The most common categories to emerge from the coding of these comments are in Table 18.

Table 18: Categories of comments on how MLS had impacted on students' mathematics performance

Category of comments	**% of 103 comments**	**Sample comments**
Grades improved	28.16%	"*Went up 20% - Whoo!!*"; "*Helped me get better grades by helping me with things I was having trouble with*"; "*I would have failed if the extra help had not been there*".
Very helpful	27.18%	"*It has helped no end, the only problem is I'd like to be able to make more use of it*"; "*Great for the questions I was stuck in*"; "*Helped me with one exam but I still failed*".
Useful for assignments	17.48%	"*Helped a lot with assignments that I may not have been able to do by myself*"; "*Has helped me get through my assignments throughout the year which adds to continuous assessment*"; "*It has helped greatly with assignments as I can get tutors/students to check over them and pick out any mistakes*".
Understanding improved	9.71%	"*They have given me more confidence which came through in the exam*"; "*It has helped me to understand methods quicker than I otherwise would* ".
Didn't go enough	6.80%	"*I didn't use it enough*".
Results unknown	5.83%	"*Don't know – still have no results!*"

3.2.4.3 Student perception of the impact of MLS on helping them cope with the mathematical demands of their course

Students were asked how they felt that MLS had helped them to cope with the mathematical demands of their course, with a five-point scale from 1=No help at all to 5=Has been a huge help. 530 (89.6%) of the 587 attendees responded and the results are given in Figure 7.

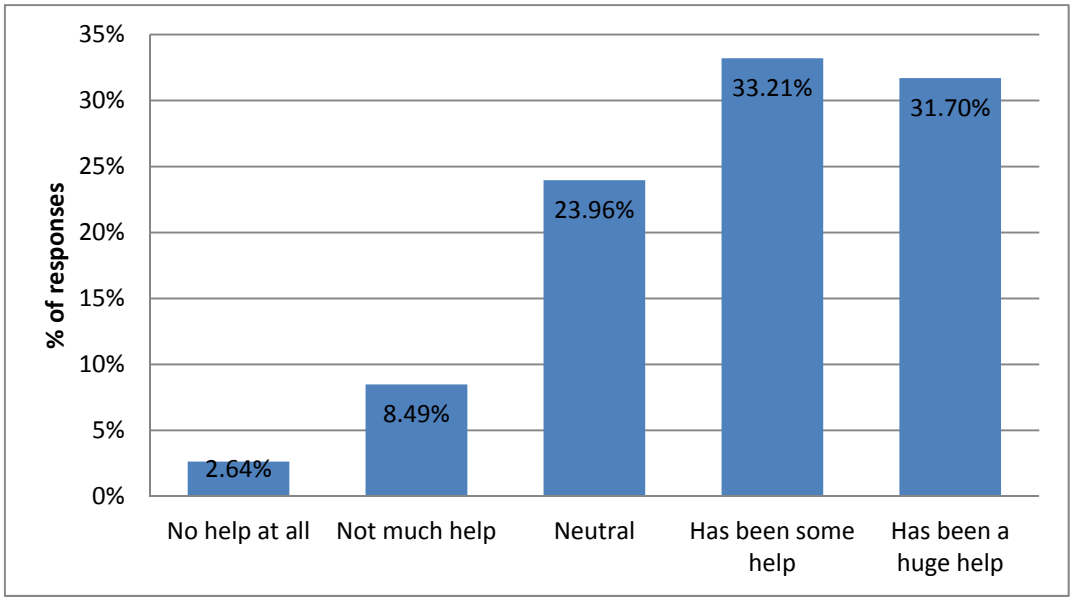


Figure 7: Student perceptions of how MLS has helped them cope with the mathematical demands of their course

Nearly 65% of respondents felt that MLS had helped them to cope with the mathematical demands of their course, while just over 11% felt that it had not. There were 55 additional comments. The most common category of comment which emerged from the coding was how helpful they found MLS, with 30 students directly mentioning this. Some focused particularly on assignments or specific topics with which they had received help: "*Huge help in completing assignments and my understanding of maths*"; "*It taught me how to draw graphs which come up in all questions*". Others mentioned its helpfulness in an overall sense: "*The maths in science appears to be quite difficult, so the centre helps me a lot*". Several students mentioned their fear that without MLS, they would fail their module: "*I probably would be failing really badly without it*". A small number alluded to the fact that, although they had received help from MLS, they still found mathematics challenging: "*It helped a lot, but maths is still so difficult*".

3.2.4.4 Student perception of MLS impact (trend analysis)

On average over 75% of the people who responded with a positive answer in one of the 3 questions (Questions 13, 14, or 15) discussed in the previous sections (the impact of MLS on mathematical confidence, performance and helping them cope with the mathematical demands of their course) also responded with a positive answer in the other two. It is also worth noting that approximately 60% of the people who responded with a negative answer in one of the 3 questions also responded with a negative answer in the other two questions.

3.2.5 Student perception of the influence of concerns about mathematics on considerations of dropping out

In Question 11, students who availed of MLS were asked if they had considered dropping out of their course/college because of mathematical difficulties and they were also given the opportunity to provide further comment on their reply. 567 (96.59%) of the 587 users of MLS responded and 125 (22.05%) of these said that they had considered dropping out because of difficulties with mathematics.

In terms of the type of institution attended, 468 of respondents were attending University, and 99 attending an Institute of Technology (IoT). 103 (22%) of University and 22 (22.2%) of IoT students indicated that they had considered dropping out because of mathematical difficulties. In gender terms, of the 125 students who considered dropping out, 51.2% were male and 48.8% were female, while 20% were Mature Students. The Leaving Certificate mathematics level could be identified for 122 of the 125 students who considered dropping out. 9% of the 122 students (11) did Higher Level LC while 83.6% (102) did Ordinary Level LC, and 7.4% (9) had done Foundation Level or selected the Other category. There is an association ($p<0.001$) between LC level and considering dropping out.

135 additional comments were made and the 6 most common categories are identified in Table 19. A description of each category and sample comments follow the table. This layout is slightly different to that of previous sections in order to more easily compare and contrast the reasons given by students for the potential influence of MLS on their decision to drop out of their HEI.

Table 19: Categories of comments made by students in relation to dropping out of their course/college because of mathematical difficulties

Category	Comments (Considered dropping out)	Comments (Did not consider dropping out)	Total Comments
Difficulty of mathematics	23	18	41
Overcame difficulties due to MLS	6	19	25
Fear of failure/ Worried	11	10	21
Falling behind	8	2	10
Problems with lectures/lecturers	6	0	6
Gap between 2nd and 3rd level	5	1	6

Difficulty of mathematics (41 students): This was the most common category of comment, both for those who considered dropping out and those who did not. 56% of comments under this category were made by students who considered dropping out due to mathematical difficulties: "*I am finding maths exceedingly difficult in comparison to my other subjects*"; "*It is very time consuming – I didn't realise how difficult it was going to be*". All but two of the students who commented thus had taken OL mathematics. However, even for students who did not consider dropping out, the difficulty of their mathematics module was frequently mentioned: "*Didn't consider dropping out but I do find 3rd level maths very hard!*"; "*But still didn't realise it would be so difficult*".

Overcame difficulties due to MLS (25 students): This category was far more prevalent among students who had not considered dropping out with such students making 76% of the comments under this category. These students tended to admit to mathematical difficulties. However, they felt that they had received sufficient MLS so that they felt they could cope: "*Because I got good help I didn't need to worry about dropping out*". Others felt they had ongoing mathematical difficulties, but these were being adequately managed through MLS: "*I had difficulties with maths and still do but the MLSC helped me a lot and made me think to do maths next year*". Others mentioned that, without MLS, they would have been more likely to consider dropping out: "*I hadn't considered it but I know if the MLSC wasn't there I probably would have considered it*". Students who considered dropping out were quite explicit in their credit for the impact that MLS has had on them: "*I thought I would really struggle but the extra support is just excellent!!*"; "*The MLSC helped me get over this*".

Fear of failure/Worried (21 students): A category which was almost equally prevalent among the two groups was a fear of failing their mathematics examinations, or general expressions of anxiety and nervousness regarding mathematics: "*I've considered dropping out because I'm worried about failing my maths exam in May*"; "*I'm finding the maths aspect of the course very difficult and fear that I may fail in the summer exams*"; "*Was always scared of maths*". Some credited MLS with removing these worries: "*But did worry about failing maths before using these facilities*". While others felt failure was an ongoing concern: "*However, I do fear failing this module in the summer and the repeats also*".

Falling behind (10 students): Under this category, 80% of the comments came from students who had considered dropping out due to mathematical difficulties: "*Sometimes I feel I am falling behind*". Others identified specific reasons such as: "*When you miss a class it's difficult to catch up*"; "*Unless you walk straight out of school into college it can be extremely frustrating to catch up*". Another student, who had considered dropping out, had also considered "*repeating the year because I couldn't catch up*".

There were surprisingly few comments (only 4.4%) making any direct reference to problems with lectures or lecturers, however these 6 comments did all come from students who were considering dropping out. There were also 6 comments which drew attention to the gap between the OL Leaving Certificate material and that which they covered in HE.

3.2.6 Student perception of MLS impact on retention

Question 12 explored if MLS has had an impact upon retention. Respondents who answered yes to Question 11, in other words they said that they had considered dropping out of their course/college because of mathematical difficulties, were asked in Question 12 to indicate if they felt that MLS had or had not influenced their decision not to drop out. They were also given the opportunity to comment.

110 of the eligible 125 responded, and 69 students (62.7%) felt that MLS had influenced their decision to not drop out, 41 (37.3%) felt that it had not. Of these 110 students, 91 were from University and 19 from IoTs. 58 (63.7%) of University and 11 (57.9%) of IoT students indicated that MLS had influenced their decision not to drop out. Of the 69 students, 37 (53.6%) were female and 32 (46.4%) were male, while 17 (24.6%) were Mature Students. LC mathematics levels were available for 67 of these 69 students. 85% of the 67 students had done Ordinary Level, 7.5% of the 67 students had done Higher Level mathematics

while 7.5% of the 69 students had done Foundation Level or Other. There was no significant association (p=0.452) between LC Level and the influence of MLS on not dropping out.

40 additional comments were made to this question. 25 of the comments came from students who had indicated from their answer to Question 11 that they had considered dropping out and 21 of these 25 comments were very positive about the influence of MLS on their decision. Interestingly, 15 students who had not considered dropping out, also used the opportunity to express the positive opinions that MLS had influenced their decision to stay in their HEI even though they had not indicated that they considered dropping out in their answer to Question 11. The most common categories to emerge from the coding of these comments are in Table 20.

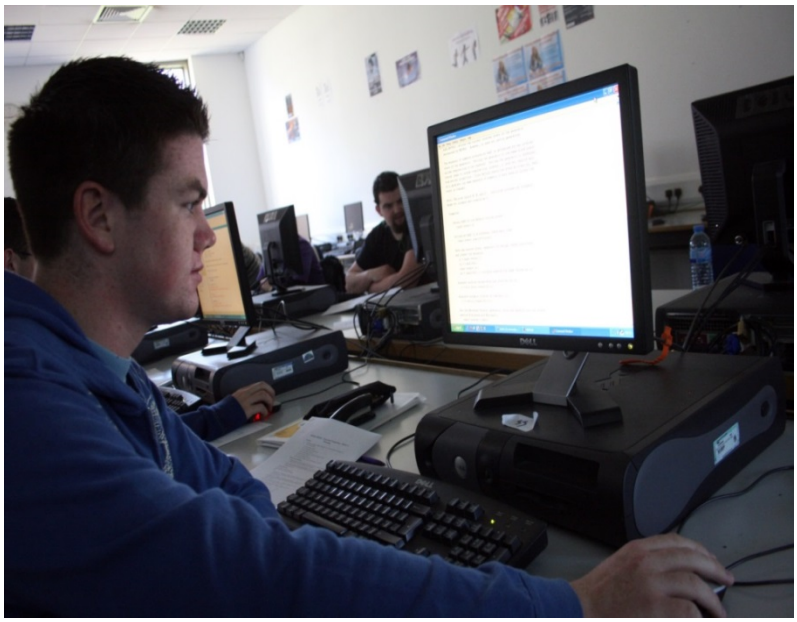


Table 20: Categories of comments made by students in relation to the influence of MLS on their decision to stay in college

Category of comments	**% of 40 comments**	**Sample comments**
Importance of support received	42.50%	"It seems more doable when explained one-to-one"; "Without the extra help I would have dropped out"; "With the support it cleared up some problems to help me continue"; "They helped me with the stuff causing me a lot of difficulty".
Encouragement received in MLS	17.50%	"Encouraged me to trust that my worries were normal and that practice would improve me"; "Lecturer very supportive and gives good encouragement and has more faith in me then myself".
Positive impact MLS had on student confidence	17.50%	"Gave me more confidence because I knew I had help"; "Maths isn't scary anymore"; "Greatly. It has given me the confidence to turn maths as my worst subject into one of my best".
Increase understanding of mathematics as a result of MLS	15.00%	"Greatly! It's the reason I'm still here. It has helped me to understand"; "It has helped me understand some of the maths".
Miscellaneous	7.50%	"I might still drop out".

For students who indicated that they had considered dropping out due to difficulty with mathematics and who also indicated that MLS *had* influenced their decision to not drop out, their perception of the impact of MLS on mathematical confidence, performance and helping them cope with the mathematical demands of their courses was positive as illustrated in Figure 8.

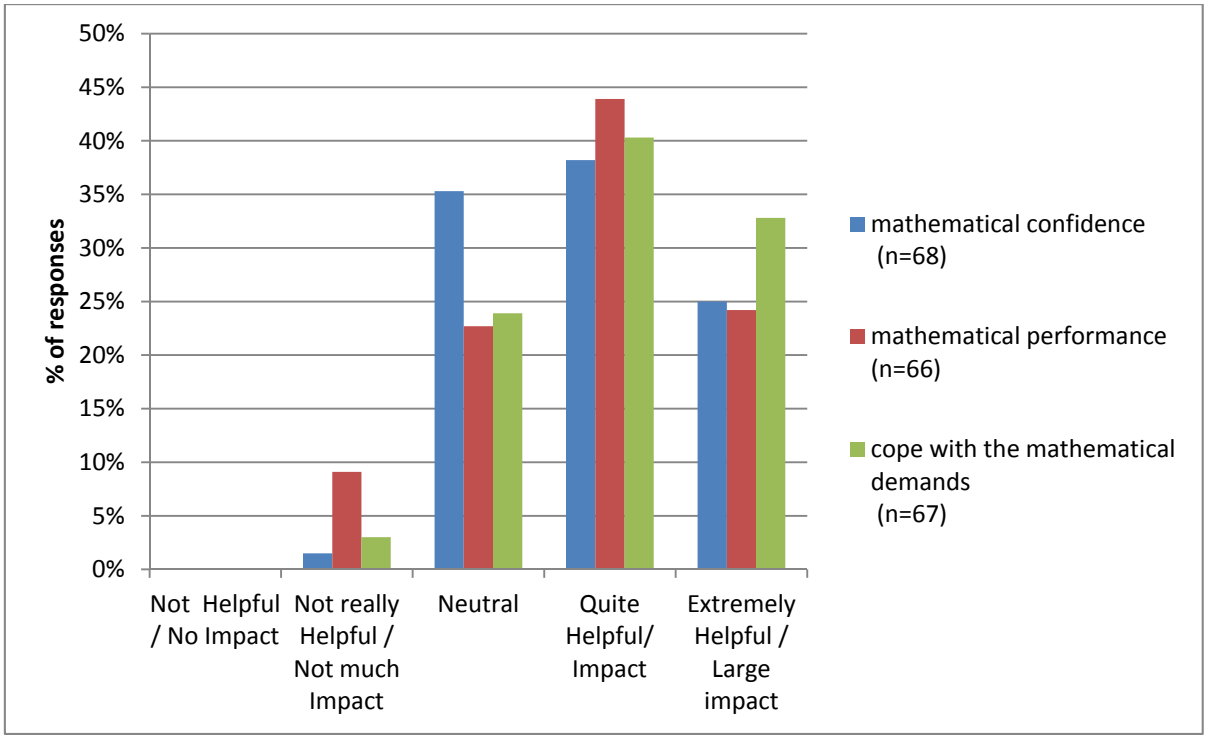


Figure 8: Perceptions of the impact on three aspects of their mathematical experience of students who had indicated that MLS had influenced their decision not to drop out

For students who indicated that they had considered dropping out due to difficulty with mathematics and indicated that MLS *had not* influenced their decision to not drop out, their perception of the impact of MLS on mathematical confidence, performance and helping them cope with the mathematical demands of their courses is less positive as illustrated in Figure 9.

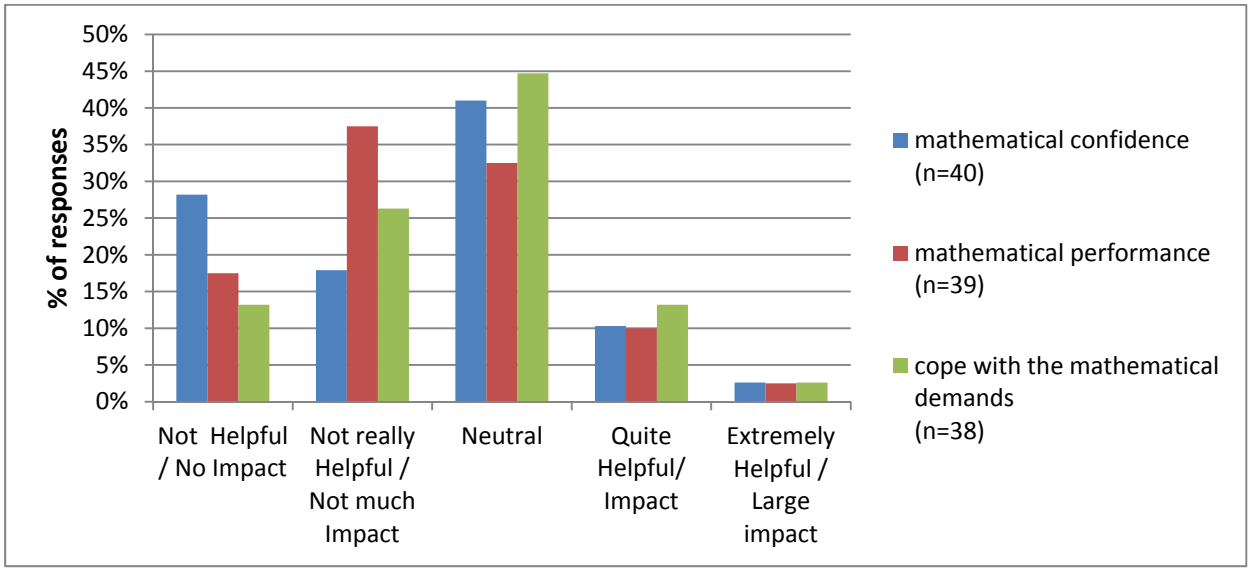


Figure 9: Perceptions of the impact on three aspects of their mathematical experience of students who had indicated that MLS had not influenced their decision on dropping out

The skewing on the Figures 8 and 9 illustrate that students who felt that MLS had an impact on their decision not to drop out were mainly positive in their responses to the questions about mathematical confidence, performance and helping them cope with the mathematical demands of their courses and the people who felt the MLS had no impact on their decision to drop out were not.

3.3 Insights into non-engagement with MLS

This section of the report focuses on students who had not engaged with MLS, (respondents to Section C) and analyses their responses to two questions, the first of which sought to elicit the reasons given for their non-engagement (Question 16) and the second of which sought suggestions from non-users of MLS as to what might encourage them to attend (Question 17). The breakdown of the responses to Question 16 is analysed using the students' mathematical background (Section A, Questions 4-6) and they are also analysed based on what type of HEI they attended. The analysis of the student responses as to what would encourage them to use the supports provided (Question 17) is presented with the link between these responses and the students' mathematical backgrounds being considered.

Key Findings

- 64% of respondents did not engage with MLS.
- A prominent reason provided for non-engagement with MLS was that help was not required (49% of non-users of MLS). Overall this means that approximately one third of the students surveyed engaged with MLS, another one third did not engage as they did not feel the need to but the final one third of students did not engage but may have needed to.
- The second most common reason students gave for not using MLS services was that the available times did not suit them (29% of non-users of MLS and hence 56% of non-users who may have needed help).
- A significant proportion of responses indicated that enhanced advertising and promotion (in particular of location) of MLS services would also be of assistance in enabling students to engage with MLS.
- In response to what would encourage non-users to avail of MLS, two main themes emerged. The first indicated that students would go if they needed help, and the second encompassed comments about MLS structures. The stronger the mathematical background of the student the more likely the response fitted the first theme and the weaker the student the more likely it was in the second theme.

3.3.1 Student reasons for not availing of MLS

1041 students indicated that they did not avail of MLS. These students were given a list of 7 options regarding why they had not availed of MLS. These options were based on an analysis of the most common responses given by students on individual MLS evaluations in various HEIs. The students were asked to tick any options that applied to them. The 7 options given were:

- I do not need help with Maths
- I never heard of the MLSC
- 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)

Students could select more than one option and there were 1472 responses in total. Table 21 shows the number of responses ticked. As can be seen, 1024 students selected at least one of the options with a majority (66.19%) of them selecting only one option but a significant minority (23.02%) ticking two options and 6.05% selecting 3 options in response to the question.

Table 21: Frequency of responses ticked in Question 16

Number of Responses ticked	Number of Students	% of 1041 non attendees
0	17	1.63%
1	689	66.19%
2	249	23.92%
3	63	6.05%
4	18	1.73%
5	3	0.29%
6	2	0.19%

A breakdown of the responses and percentage of students who gave each response is given in Table 22 (note that there were 1472 responses to Question 16 from 1024 attendees).

Table 22: Responses to Question 16 from non-attendees

Q16 response options	Do not need help	Times do not suit	Did not know where it was	Hate Maths	Embarrassed or afraid to go	Never heard of the MLSC	Other Reason
No. of responses	501	295	186	151	119	87	133
As a % of respondents	48.83%	28.81%	18.16%	14.75%	11.62%	8.5%	12.99%

501 (48.13% of) respondents said that they did not avail of MLS because they felt they did not need help with mathematics.

The 7th option 'Other Reason' was selected by 133 (25.38%) non-users. Students who selected 'Other Reason' were asked to specify what these were and 123 of the 133 students did so. 60 of these responses fell under (at least one) of the other 6 fixed options given in Question 16 and some students gave more than one reason. 51 of the 60 said that they did not need help and gave a variety of positive reasons including that:

- they might need help in the future:
  - "*Did not need help with maths for Christmas exam but in second semester I have found the calculus hard and may use it before the summer exam*";
- the existing traditional class structures were sufficient:
  - "*Had many tutorials to deal with any problems encountered and this helped so didn't need the MLSC*";
- their method of dealing with problem material was working fine for them:
  - "*I can often figure out problem if I go over the notes or ask a friend to give me a hand*".

There were four negative responses. Two of these highlight the complexity of this issue: "*At the moment I do not need help with maths but also I would be quite embarrassed too*"; "*Did not feel that I needed to go but if I did, would not really be sure of how to go about using the MLSC*".

The remaining 63 of the 123 'Other Reason' comments did not fall into any of the other 6 fixed options given in Question 16. The majority of these comments fell into the following three main categories:

- 33 (26.8%) referred to laziness or lack of motivation to attend or engage with mathematics:
  - "*Wanted to go but haven't been motivated*";
  - "*To be honest lectures are so boring and slow that doing anymore would kill me altogether*";
- 12 (9.8%) referred to the structure of the MLSC:
  - they were unsure how it worked "*I didn't know what to start with first if I went to the MLSC*";
  - they had heard negative comments "*I heard that people weren't very helpful and it wasn't run very well*";
  - they had attempted to go but it was too busy "*When I went in there were too many people. I could not get a seat, I did not bother afterwards*";
- 9 (7.3%) referred to being too busy or having a lack of time:
  - "*I have a busy schedule and find it hard to make time to go*".

Students who ticked one of the first 6 fixed options were also given the opportunity to provide an additional comment. The majority (141) of these 185 comments were consistent with the options they had selected: 96 saying that they did not need help: "*If I was really struggling with the maths I would go to the MLSC but so far I haven't had any trouble*", "*If I do need help later on in my degree I will use the service as I have heard good reports and it had been suggested in my classes by various lecturers*"; 33 saying the opening hours did not suit. Of the remaining 44 comments: 21 referred to MLSC structures such as: "*Better advertisement about MLS would make me more aware of MLS*", "*I didn't understand how MLSC worked as in if they did it with individuals or in groups*", "*Wouldn't be sure that the learner centre teach differently or explain things worse that what is taught within the lecture*"; and 3 referred to motivation: "*I always had intentions to go, however I never got around to it*". The remaining 20 comments could not be placed in one specific category but again they show the many factors that can be at play: "*To be honest, I don't actually hate maths; it's more that I am not bothered with most stuff outside statistics. Plus I hate telling people I need help. Also, my tutor doesn't really help and I worry support centre will be the same*"; "*I feel that maths is a subject that you either get or don't get. And the MLSC would be of no use to me*".

To gain a clearer insight into the reasons selected for not availing of MLS, we first exclude the 500 students who indicated that they had not availed of MLS because they felt they that did not need help with mathematics. The 971 responses of the remaining 524 respondents are outlined in Table 23.

Table 23: Reasons for not availing of MLS for students other than those who had indicated they felt did they not need help with mathematics

Reasons for not availing of MLS	Number of	As a % of the 524 students who had
The times do not suit me	295	56.30%
I did not know where it was	186	35.50%
I hate Maths	151	28.82%
Other	133	25.38%
I was afraid or embarrassed to go	119	22.71%
I never heard of the MLSC	87	16.60%

It is interesting to note that 56.3% (295) of the students in this group indicated the times not being suitable as a reason which underlines the importance of resourcing the MLS services adequately in terms of hours and the need to ensure the hours are aligned with times the students can avail of these. The issue of the promotion of the existence of MLS services and their location is highlighted by the 186 (35.5%) students indicating they did not know where it was while 87 (16.6%) indicated they had never heard of the MLSC. The fact that 119 (22.71%) students who indicated that they were afraid or embarrassed to go illustrates the importance of promoting the MLS services in as supportive a way as possible. The 28.82% response rate indicating hatred of mathematics is also of a concern as the first year students surveyed were all studying courses for which mathematics was a compulsory service subject.

Initial analysis of these results seems to suggest that most students are not using MLS because they believe they do not need the help, although a number of more complex issues have also come to the fore. To gain further insight, the responses were analysed further using the students' mathematical backgrounds and the type of HEI they were attending, see Section 4.2.

3.3.2 Student insights into what would encourage them to avail of MLS

In Question 17, non-users of MLS were asked to comment on what would encourage them to avail of MLS and there were 667 responses. Analysis of the responses placed the majority of comments into 7 categories, 5 of which formed two main themes:

Theme 1) Would attend if they needed help: "*If I was struggling I would go*", "*If the maths gets harder I will go*", "*If I needed help with maths*".

Theme 2) Comments on MLS structures: "*Better/More opening hours*"; "*Longer opening hours*"; "*Flexible times*"; "*Better location*"; "*More advertisement*"; "*Greater awareness of resources available*"; "*Encouragement from lecturers*"; "*If I knew how it worked/what topics they cover*"; "*Information on how they can help me*". A breakdown is given in Table 24.

Table 24: Frequency of students comments about what would encourage them to avail of MLS

Theme	Category	Count	%
1	Go if needed	197	29.10%
1	Results/Examinations	77	11.37%
2	Better times	116	17.13%
2	More Information	91	13.44%
2	Resources/Location	101	14.92%
	Advised to go	43	6.35%
	Student Feedback	36	5.32%
	Miscellaneous	16	2.36%

To gain a clearer insight into the responses given in Question 17, we conducted further analysis based on the Leaving Certificate (LC) result of the respondent, 665 of the 667 responses were made by students whose LC result was known. We looked at HL, OL A and finally OL B1 or lower (OL<=B1)[4]. The third category would generally be considered to be at-risk of failing using a criterion used at some Universities in Ireland (Grehan, 2013).

3.3.2.1 Detailed analysis of suggestions made by students whose LC grades are known as to what would encourage them to avail of MLS

There were 269 responses to Question 17 from HL students, 90 from OL A and 306 from OL<=B1. When a chi-square test was conducted the results were statistically significant ($p<0.001$) showing that the stronger the mathematical background of the student, the more likely that their response was in Theme 1 (they would go if they needed help); the weaker the student, the more likely their response would be in Theme 2 (comments on MLS structures).

Analysis using LC Level of Theme 1: They would attend if they need help

Examining the 269 responses from HL students, 126 (46.8%) said they would go if they needed help: "*If I begin to struggle with my course I'll probably look for help then*"; "*I would be encouraged to go if I needed to because of my grades. If I was a doing poorly in maths, I would go to increase my grades*". Of 90 responses from OL A students, 32 (35.6%) gave this response: "*If I needed the MLSC's services that is encouragement enough for me*"; "*If I needed help I would go however I don't need help so I don't*". The final 306 responses from the remaining OL<=B1 students, show that 97 (31.7%) gave this response: "*If I was struggling with the maths in my course I would attend MLSC*"; "*If I was falling behind in maths coming up to a test and final exam*"; "*If I was failing desperately and could not understand the notes*". All comments given were consistent with comments in Question 16.

Analysis using LC Level of Theme 2: Comments on MLS Structures

Comments on MLS structures were considered to have the most potential for providing insight on the level of engagement with MLS, so this theme was further analysed to break them down into the 3 categories outlined in Table 24. The same three main subcategories emerged for each group.

Examining the 269 responses from HL students there were 113 (42%) comments regarding MLS structures. The 3 main categories that emerged were:

- 28 (10.4 %) referring to the need for further information:
  - "*More information about times etc – clearly visible (poster etc.)*";
  - "*Didn't know when to go or how to ask for help on specific areas*";
- 25 (9.3%) referred to the opening hours:
  - "*More hours in place so I could go when it suited my timetable*";
  - "*More flexible times*';
- 26 (9.7%) referred to specific services:
  - "*If there were small groups and if the tutor could talk to you individually if you needed them to*";
  - "*More user relatable maths, i.e. applicable examples relating to material things makes it more appealing and relatable*".

Examining the 90 responses from OL A students, there were 50 (55.5%) comments regarding MLS structures. Further breakdown revealed that:

- 24 (26.7 %) referring to the need for further information:
  - "*More information available because I don't actually know what they do*";
  - "*I would have liked to know more about it and its hours and who can go*";

[4] The Leaving Certificate grading system for Higher and Ordinary Level subjects is broken down as follows: Higher A 1 (HA1), HA2, HB1, HB2, HB3, ….., HD2, E, F, No Grade (NG), Ordinary A1 (OA1), etc.

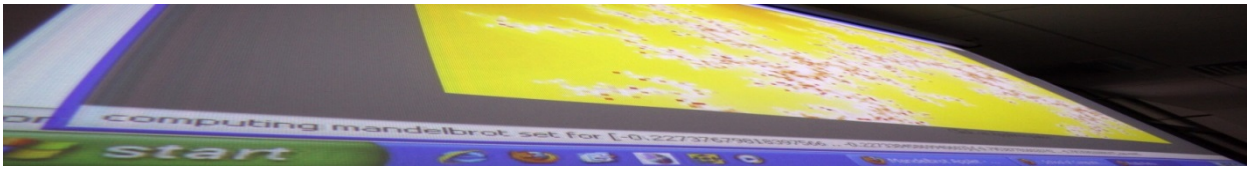
- 10 (11.1%) referred to opening hours:
  - "*More hours for it to open; more workshops instead of just once a week as I would definitely go*";
- 8 (8.9 %) referred to specific services:
  - "*If they have certain timetables for different groups so you're not arriving in with final year students who need it more than myself*".

Examining the 306 responses from the remaining OL<=B1 students, revealed 189 (61.8%) comments regarding MLS structures. Again the same three main subcategories emerged from the further analysis:

- 55 (18%) referred to additional information:
  - "*Better information before year starts*";
  - "*If we were told about them more and knew when they were on*";
  - "*If I was informed by my teacher as to when it was on and where it is*";
- 46 (15%) referred to opening hours:
  - "*The support tutorials could be on earlier. The MLSC should be opened all the time so I might avail of its services*";
  - "*Extra hours that don't clash with class; late opening, 6-9, twice a week*";
- 39 (12.7%) referred to specific services:
  - "*If they did a time for a certain year, for instance, Semester two maths for marketing management at 3pm today*";
  - "*Maybe online tutorials that are wrote in depth, or videos. A question thing for students that tutors can answer in their own time*";
  - "*Part of a tutorial instead of being optional – make it so that it's compulsory*".

The majority of the remaining comments fell into two categories: Human Interactions (Feedback, Tutors, Friends/Groups, Lecturer); Miscellaneous (Rewards, Motivation). These can be broken down as follows:

- Feedback 18 (7 HL, 1 OLA, 10 OL<=B1): comments about receiving feedback from staff or students about the need to go to or the benefit of MLS:
  - "*Maybe, if the lecturer felt I needed to go*";
  - "*People telling me how much it helped improve their average in maths*";
  - *Positive feedback from friends who have used the MLSC would encourage me to go if needed*;
- Friends\Groups 12 (2 HL, 0 OLA, 10 OL<=B1): comments about going to the MLSC if their friends or a group were going:
  - "*If my friends had problems also with maths and we went as a group for help*";
- Tutors 11 (8 HL, 0 OLA, 3 OL<=B1): comments on tutor behaviour:
  - "*Friendly tutors who are helpful and patient*";
- Coursework\Lecturer 10 (5 HL, 2 OLA, 3 OL<=B1): comments about coursework or lecturer:
  - "*I would not understand some part of maths/the lecturer would be terrible*";
- Rewards 9 (2 HL, 1 OLA, 6 OL<=B1): comments on being rewarded with marks\grades for attending:
  - "*If you got a percentage of final grade for going*";
- Motivation 7 (2 HL, 3 OLA, 2 OL<=B1): comments on being motivated to attend:
  - "*It comes down to my attitude towards maths; I always feel defeated by it so don't feel enthusiastic about doing it*".



3.4 Categories emerging from the open "Any other comment/suggestion" section at the end of the survey

All 1633 respondents were given the opportunity to make additional comments/suggestions about MLS at the end of the questionnaire and 147 choose to do so (86 who had used MLS and 61 who had not).

Key Findings

- 9% of respondents provided additional comments.
- The most frequent category of comments were complimentary ones about the staff/service of MLS.
- The need for more resources (both time and space) also occurred with a high frequency.

Responses were coded and categories which emerged for both users and non-users of MLS are outlined in Table 25 and Table 26 (not all comments could be placed in one category). In both cases the most frequent category of response was complimentary comments about MLS staff/services. The need for more hours or flexible hours also occurs with high frequency for both groups. For users of MLS, issues about the size of the room also featured prominently but suggestions about promotion of the centre were less frequent, while the opposite was true for non-users with comments on promotion more frequent than comments on the size of the facility.

Table 25: Categories of responses of users of MLS to the additional comments and suggestions question

Categories of comments	**% of 86 comments**	**Sample comments**
Compliments about the service and staff	39.53%	"*A very useful, helpful service*"; "*Everyone is always so willing to help and things are explained very well*"; "*It was a very valuable experience, without it I would have certainly failed*"; "*Without MLS more students would drop out (especially matures)*".
Need for more resources (bigger room or more tutors)	27.91%	"*Larger room and more tutors. Sometimes the wait for assistance is 30-45 mins*"; "*More space!! Preferably in a more prominent location for such an important function; more staff for critical times (close to exams!)*".
More hours or more flexible hours	19.77%	"*Maybe have some MLSC slots in the morning weekdays because I know a lot of students have free time in the morning as opposed to the evening*"; "*The MLSC opened earlier and for longer hours*".
Comments about online resources	3.49%	"*Only used online courses for certain topics and it was helpful. Didn't use it often enough to find an overall impact on grades*".
Negative comments about service	2.33%	"*Possibly some training in social skills for one or two of the tutors. Otherwise it's a fabulous service. Thanks!!*"
Better promotion	2.33%	"*Maybe to have an open day on how this centre works…*"
Comments about education in general	2.33%	"*I think this should be available in every college or University as maths is a huge problem with all courses*".

Table 26: Categories of responses of non-users of MLS to the additional comments and suggestions question

Categories of comments	**% of 61 comments**	**Sample comments**
Compliments about the service and staff	27.87%	"*I think it is a great service even though I have not availed of it. I do know of students that have and give it nothing but praise*"; "*I think it is a great service for those who do avail of it. If I was more concerned about my grade in Maths I would most likely use it*"; "*Great idea, it's pretty helpful for some of my friends*".
More hours or more flexible hours	26.23%	"*Earlier times*"; "*If the times were more suitable because I don't want to miss out on other classes*"; "*Variation in time slots*".
Need/ideas for better promotion	21.31%	"*I had heard of the drop-in for the MLSC but not really any other part. Maybe they could be better advertised?*"; "*More information about MLSC posted around campus like opening times, how to make an appointment*"; "*That the students be shown or even brought into the MLSC so that they become more familiar with [it] and it will be less frightening to go*".
Need for bigger room or more tutors	8.20%	"*Room is very small*".
Online Resources	6.56%	"*Interactive tutorial board online*".
Comments about education in general	4.92%	"*I believe there should be two levels of maths as everyone is not at the same level*".
Wish had gone or stated intention to go	4.92%	"*I might go today*"; "*I wish I went to the MLSC because I heard it's awesome*".

Chapter 4. Special Focus Analysis

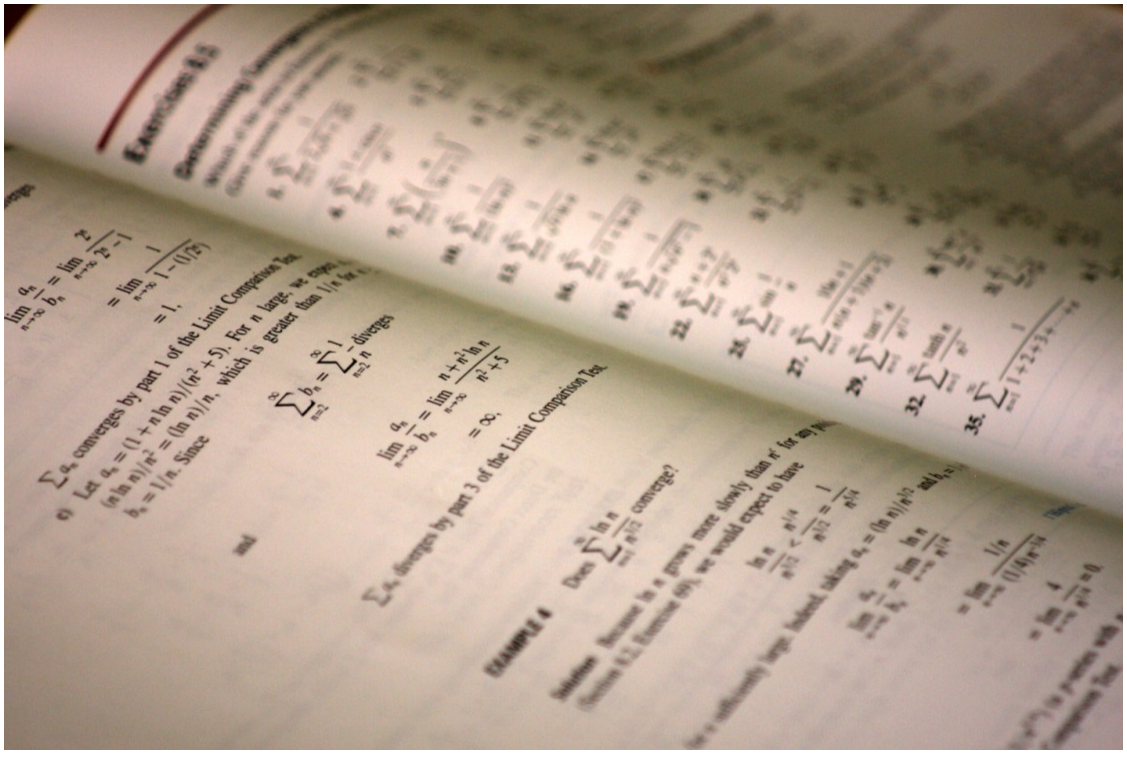
After the initial analysis of the questionnaire data was completed, four key areas emerged which required more detailed and focused analysis: prior educational attainment; non-engaging students; gender difference in the use of MLS; and Mature Student engagement with MLS. These are discussed in detail in this chapter. As noted earlier in the report, some of the research outcomes from this survey are also available in Ní Fhloinn et al. (2014) ; Mac an Bhaird et al. (2013); Fitzmaurice et al. (to appear) (see Appendix C for details).

4.1 Focus on prior educational attainment

In this section, in order to gain further insight on the respondents, we present a breakdown of their mathematical background (where this was known). We consider both the level and grade of their Leaving Certificate (LC) mathematics results, we look at when they had switched LC level (if they had done so), and compare this data with their engagement levels with MLS.

Key Findings

- There was a significant association between Leaving Certificate mathematics levels and whether students availed of MLS, the higher the level, the less likely they were to avail of MLS. However, it must be noted that students using MLS had a broad range of mathematical backgrounds.
- 60% of students who reported taking OL LC mathematics prior to entry indicated that they had switched from HL to OL.
- For OL students who were initially doing HL and then switched, the longer they stayed in HL the better their OL LC grade.
- There was an association between switching from HL to OL and availing of MLS, the later they switched to OL, the less likely they were to seek help.



4.1.1 Leaving Certificate results

Respondents were asked to indicate their highest mathematical achievement prior to entry to their HEI, 1601 did so. 1563 of these respondents indicated that they had taken the LC in mathematics at either HL (541), OL (1004) or Foundation Level (FL) (18). 1535 of these 1563 students also indicated their LC mathematics grade and the breakdown is contained in Table 27.

Table 27: Leaving Certificate mathematics grades of respondents

Grades:	A	B	C	D	Other
Higher Level (HL) Students (n=532)	13.35%	33.08%	38.35%	14.47%	0.75%
Ordinary Level (OL) Students (n=990)	26.46%	44.95%	20.61%	6.87%	1.11%
Foundation Level (FL) Students (n=13)	23.08%	23.08%	7.69%	15.38%	30.77%

The other 38 students indicated a range of mathematical backgrounds, e.g. Fetac, GCSE, A-Levels etc.

4.1.2 Relationship between level of prior mathematical achievement and availing of MLS

1599 of the 1601 respondents who had indicated their previous level of mathematical achievement also indicated whether or not they had used MLS. A breakdown of this relationship is given in Table 28.

Table 28: Comparison of LC results of students availing and not availing of MLS

	HL LC	OL LC	FL LC	Other
Students availing of MLS (n=574)	25.26% (145)	69.69% (400)	1.74% (10)	3.31% (19)
Students NOT availing of MLS (n=1025)	38.63% (396)	58.73% (602)	0.78% (8)	1.85% (19)

Using the chi-square test, there was a significant association between students who used MLS and their LC mathematics level ($p<0.001$). The majority of students who availed of MLS had OL or a lower standard of mathematics.

Of the 587 respondents who indicated that they had availed of MLS, 545 had indicated both their LC mathematics level and grade (142 students of 145 at HL, 396 students of 402 at OL and 7 of 10 students at FL). A breakdown of these 545 results is given in Table 29.

Table 29: Leaving Certificate mathematics grade of respondents who had used MLS

Grades:	A	B	C	D	Other
Higher Level (HL) Students (n=142)	4.93%	33.8%	40.85%	20.42%	0%
Ordinary Level (OL) Students (n=396)	28.28%	44.7%	19.19%	7.07%	0.08%
Foundation Level (FL) Students (n=7)	14.29%	28.57%	0%	14.29%	42.86%

Neither students who avail of MLS nor indeed practitioners of MLS see it as only remedial support for students with very weak mathematical backgrounds. It is clear from Table 29 that students with a broad range of mathematical backgrounds are using MLS. This is broadly in agreement with findings from other surveys. One of the principal aims of providing MLS is to allow all students the opportunity to become active independent learners of mathematics.

1006 of the non-users of MLS indicated their LC level in mathematics. Of those, 979 gave their LC grade (390 of 396 students at HL, 583 of 602 at OL and 6 of 8 at FL) and a breakdown is given in Table 30.

Table 30: Leaving Certificate mathematics grade of respondents who had not used MLS

Grades:	A	B	C	D	Other
Higher Level (HL) Students (n=390)	16.41%	32.82%	37.44%	12.31%	1.03%
Ordinary Level (OL) Students (n=583)	25.73%	44.43	21.78%	6.86%	1.2%
Foundation Level (FL) Students (n=6)	33.33%	16.67%	16.67%	16.67%	16.67%

Almost 40% of students who did not avail of MLS had completed HL LC mathematics. In addition, a further 15.3% of non-users had achieved an OL A. This is consistent with the analysis in Section 3.3.1 and suggests that the majority of non-users did not attend because they did not need to. To gain additional insight, it was decided to investigate in more detail the information provided by OL students and examine if and when they had changed from HL.

4.1.3 Timing of switching from Higher to Ordinary Level mathematics

In Question 6, students were asked that if they had started off doing LC HL mathematics, but changed to OL to indicate at what point they switched levels. 606 of the 1004 students who reported taking OL switched from HL before the LC. A breakdown of when they said they switched is contained in Table 31. They were given 5 fixed options, based on the most common times that students normally switch. Note that the Mock examinations are sample examinations that are typically run in February for final year students.

Table 31: Timing of switching of LC levels of respondents

Timing of Switch between levels	% of students (n=606)
Switched before Christmas of 5th year	32.51%
Switched between Christmas of 5th year and the end of 5th year	24.09%
Switched before Christmas of 6th year	23.93%
Switched after Christmas of 6th year and before Mock examinations of 6th year	0.17%
Switched after Mock examinations of 6th year	19.31%

LC achievement of Students who switched from Higher to Ordinary Level mathematics

The OL results of 603 of the 606 students who indicated that they had switched LC levels were available and a breakdown is contained in Table 32. It is interesting to note that the LC achievement of these students is generally good with 34.99% getting an OL A. Also 138 (48%) of the B's were B1's .

Table 32: LC grades of students switching LC levels

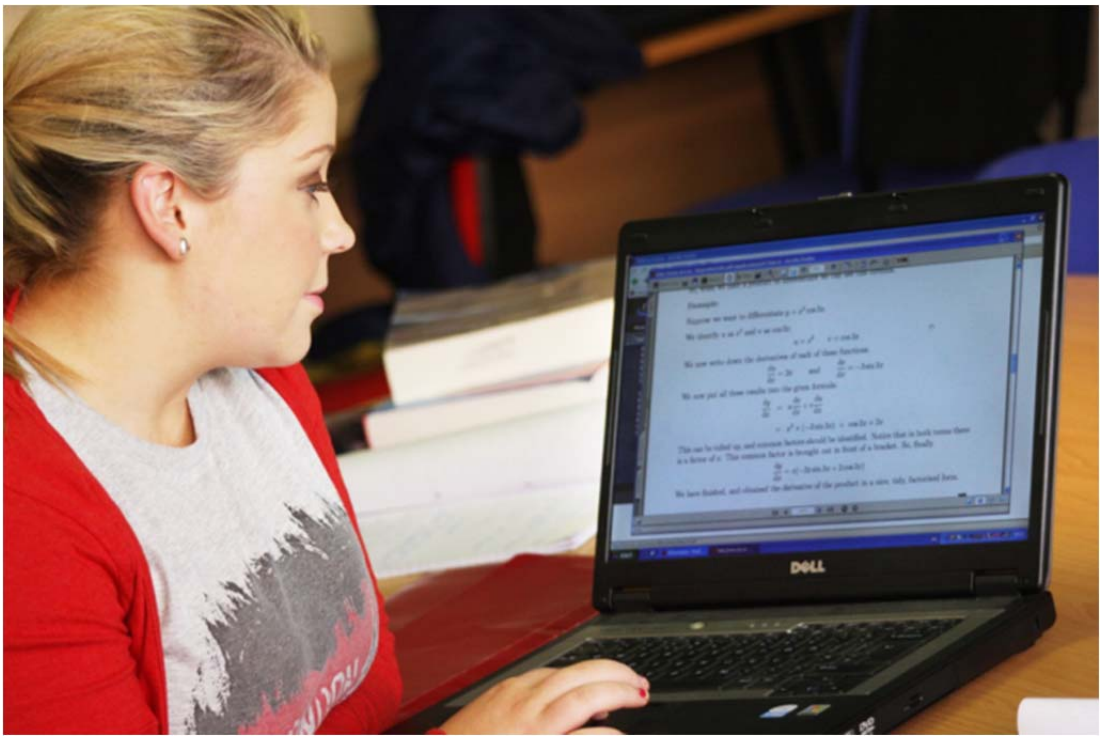
OL Grades:	A	B	C	D	Other
% of Students (n=603)	34.99%	47.6%	14.1%	2.82%	0.5%

We then considered the OL LC grades obtained by the students who had switched, broken down by when they switched levels from HL to OL, see Table 33.

Table 33: Relationship between grade obtained and the time at level switch was made

Grades:	A	B	C	D	Other
Switched Before Christmas of 5th year (n=197)	26.02%	47.45%	22.45%	3.57%	0.51%
Switched between Christmas of 5th year and the end of 5th year (n=146)	28.28%	50.34%	15.17%	6.2%	0%
Switched Before Christmas of 6th year (n=145)	43.75%	47.22%	8.33%	0%	0.69%
Switched after Christmas of 6th year and before Mock examinations of 6th year (n=1)	100%				
Switched After Mock examinations of 6th year (n=117)	47.01%	43.59%	5.98%	0.85%	0.85%

Note that there is very little time difference between when the Christmas examinations and the Mock examinations take place in most schools so it would be expected that very few students would decide between the Christmas and Mock examinations to switch. There is a significant relationship ($p<0.001$) between the time of switching to OL and the LC grade achieved. In general, the longer you stay in HL, the better your OL grade if you switch. 223 (36.8%) of these 606 students who switched from HL to OL LC mathematics also reported that they used MLS. There is an association (chi-square test, $p=0.03$) between switching from HL to OL and availing of MLS.



4.2 Focus on non-engaging students

Initial analysis (Section 3.3) of responses to Question 16 seems to suggest that most students are not using MLS because they believe they do not need the help. However, as is clear from Section 3.1, the survey participants have diverse educational backgrounds, so to gain further insight, we considered the following research questions:

1. Does the prior mathematical attainment and experience of students influence responses to Question 16?

2. Does the type of HEI attended influence responses to Question 16?

Key Findings

- There was a significant relationship between LC mathematics results and reasons students gave for not availing of MLS. The better the prior mathematical attainment of the student the more likely they are to say that they did not need help.
- A significant proportion of OL students who did not avail of MLS attributed reasons associated with low self-efficacy for not engaging with extra support.
- There was a significant relationship between the reasons given by non-users for not availing of MLS and the type of institution (IoT or University) that they attended.
- For University students, there was a significant relationship between the reasons given by non-users for not availing of MLS and their LC level of mathematics and grade.
- For students who switched LC mathematics level, the later they switched the more likely they are to say that they did not seek help in the form of MLS as they felt they did not need it.

4.2.1 Responses to Question 16 analysed using Leaving Certificate level and grade

First of all the answers broken down by the students' Leaving Certificate (LC) mathematics level were considered. As outlined in Section 3.1.5, typically a minimum of OL mathematics is required to take service mathematics courses in HEIs and this is evident from the breakdown of HL and OL non-users of MLS in our survey, where 396 had taken LC mathematics at HL and 602 had taken OL. The remaining 27 respondents had either initially done Foundation Level, did not give their grade, or had done their second level education outside of the Republic of Ireland and are excluded in the analysis which follows. A breakdown of the 522 responses from the 396 HL students and the 903 responses from the 602 OL students is given in Table 34.

Table 34: Breakdown of answers to Question 16 based on LC level

Question 16 response options	Do not need help	Never heard of the MLSC	Did not know where it was	Times do not suit	Embarrassed or afraid to go	Hate Maths	Other Reason
No. of HL responses	274	20	55	71	29	22	51
As a % of HL respondents	69.19%	5.05%	13.89%	17.93%	7.32%	5.56%	12.88%
No. of OL responses	205	65	130	211	88	125	79
As a % of OL respondents	34.05%	10.8%	21.59%	35.05%	14.62%	20.76%	13.12%

A chi-square test shows that there is a significant relationship ($p<0.001$) between LC level and answers given, thus giving a partial answer to the first research question. For example, students doing HL were more likely to say that they did not need help than those doing OL. HL students were less likely to say that they were afraid or embarrassed to go or to say that they hated maths when compared to OL. None of this is unexpected, students who have taken HL would generally be considered to have greater ability, and have more confidence in their ability than OL students. OL students were more likely than HL students to say that they had never heard of the MLSC, did not know where it was, the times did not suit them, they hated mathematics or that they were afraid or embarrassed to go. This is concerning as OL students are a main target of MLS and it highlights the range of issues involved in increasing student engagement.

The responses to Question 16 were also examined based on the grade breakdown within the LC levels. This ranges from A1 to D3 and was asked in Question 5 of the survey. This analysis shows that there is a statistically significant relationship (Exact test $p<0.001$) between LC grades in HL and answers given; for example the higher the HL grade, the more likely students were to say that they did not need help. However, this response was still the main answer in lower HL grades. When the responses of students with OL grades were examined, there was also a statistically significant relationship (Monte Carlo test $p=0.009$), so again the higher their OL grades, the more likely they were to say that they did not need help. This gives further clarification to our first research question.

4.2.2 Responses to Question 16 analysed using type of HEI attended and LC level

In this section the breakdown of responses (see Table 35) based on the type of institution that the students attended, either an Institute of Technology (IoT) or a University is considered. We consider the responses of the 299 IoT and 699 University students who had an OL or HL LC result. See Section 3.1.1 for a full description of the different roles of IoTs and Universities.

Table 35: Breakdown of answers to Question 16 based on type of HEI attended

Question 16 response options	Do not need help	Never heard of the MLSC	Did not know where it was	Times do not suit	Embarrassed or afraid to go	Hate Maths	Other Reason
No. of IoT responses	150	53	49	96	27	40	17
As a % of IoT respondents	50.17%	17.73%	16.39%	32.11%	9.03%	13.38%	5.69%
No. of University responses	329	32	136	186	90	107	113
As a % of University respondents	47.07%	4.58%	19.46%	26.61%	12.88%	15.31%	16.17%

A chi-square test shows that there is a significant relationship ($p<0.001$) between the response given and the type of institution attended. For example students in University were more likely than in IoTs to be afraid or embarrassed to go to the MLSC, but they were more likely to have heard of the MLSC than IoT students. This addresses our second research question.

As outlined previously, IoTs have a different mission to that of Universities (Hunt Report, 2011), and so tend to have a lower threshold of entry requirements. They usually teach a range of programme levels (6-8) to first year students whereas Universities teach almost exclusively undergraduate students on Level 8 programmes. This bias is reflected in the breakdown of HL and OL LC level by HEI from the survey data as outlined in Table 36.

Table 36: Breakdown of the LC levels of non-users of MLS in the two types of HEI

	Higher Level	Ordinary Level
IoT students (n=299)	13.38%	86.62%
University students (n=699)	50.93%	49.07%

To deal with the lack of homogeneity in LC profile it was decided that breaking down responses in each type of HEI by LC level might prove informative. Firstly the analysis for the IoTs is considered (Table 37).

Table 37: Breakdown of answers to Question 16 from IoTs based on LC level

Question 16 response options	Do not need help	Never heard of the MLSC	Did not know where it was	Times do not suit	Embarrassed or afraid to go	Hate Maths	Other Reason
No. of HL responses	26	6	5	11	1	2	1
As a % of HL respondents	65%	15%	12.5%	27.5%	2.5%	5%	2.5%
No. of OL responses	124	47	44	85	26	38	16
As a % of OL respondents	47.88%	18.15%	16.99%	32.82%	10.04%	14.67%	6.18%

A chi-square test on IoT students shows ($p=0.263$), there was no significant relationship between LC level and answers given. This is not unexpected due to the diverse mathematical backgrounds of these students. Next the analysis for the Universities is considered (Table 38).

Table 38: Breakdown of answers to Question 16 from Universities based on LC level

Question 16 response options	Do not need help	Never heard of the MLSC	Did not know where it was	Times do not suit	Embarrassed or afraid to go	Hate Maths	Other Reason
No. of HL responses	248	14	50	60	28	20	49
As a % of HL respondents	69.66%	3.93%	14.04%	16.85%	7.87%	5.62%	13.76%
No. of OL responses	81	18	86	126	62	87	64
As a % of OL respondents	23.62%	5.25%	25.07%	36.73%	18.08%	25.36%	18.66%

A chi-square test shows that there is a significant relationship ($p<0.001$) between the LC level of University students and types of answers, again this is not unexpected. For example HL students were more likely than OL to state that they did not need help, but OL students were more likely to state that they had not heard of the MSC, did not know where it was or that the times did not suit, they were embarrassed or afraid to go or that they hated mathematics. Among the HL students there is a significant relationship between the grade they got and the type of responses they selected (Monte Carlo test, $p=0.005$) and this was also the case amongst the OL University students (Monte Carlo test, $p=0.013$). Of the 81 OL students who said that they did not need help, 78 gave a grade breakdown and 48.7% (38) of these were B1 or lower. In other words, they would generally be considered to be at-risk of failing using a criterion used at some universities in Ireland (Grehan, 2013).

The breakdown of responses by both institution and mathematical background gives further insight into our research questions, but the different relationships again highlight the complexity of the situation.

4.2.3 Responses to Question 16 analysed using data on students changes to LC level

In Question 6 students were asked if they had dropped down from HL to OL, when they had done this, see Section 4.1.3. Of those students who changed to OL the percentage of each group who said that they did not need help with mathematics is given in Table 39. There was a statistically significant (Monte Carlo test, $p=0.005$) relationship between when students dropped down to OL and the answers they gave; in general, the later they made the change, the less likely they were to say that they required help. This provides additional insight to our first research question.

Table 39: Breakdown of answers to Question 16 if students had changed LC level

When changed from HL to OL	Before Christmas in 5th year	Before the end of 5th year	Before Christmas in 6th year	After mocks in 6th year
% who said they did not need help	30.8%	28.3%	32%	59.1%

In this section we considered the responses of students who had not engaged with MLS, and in particular their responses to Question 16 which sought to explore reasons for non-engagement with MLS. Notwithstanding the fact that this very broad cohort of students came from 9 different HEIs, with different entry requirements, different service mathematics courses and different levels and types of MLS provision, our preliminary analysis of the data has given additional insight into the issue of non-engagement with MLS on a large scale basis. The results are consistent with results found elsewhere in smaller studies and in individual institutions, and so the outcomes will provide possibly beneficial insights to the wider MLS and mathematics education community. Further discussion of these results and their impact is contained in Chapter 5.

4.3 Focus on gender differences in the usage of MLS

In this section of the report, we analyse the engagement levels of male and female students with MLS. We explore the reasons given by both genders for either using or not using the services provided across a range of disciplines and HEIs, with the aim of ensuring that the optimum support is provided to all students who may need such help. While work has been done investigating students' reasons for non-engagement with MLS (notably in Grehan et al., 2011 and Symonds et al., 2008), this issue has not been considered from a gender perspective to date.

Key Findings

- A statistically higher proportion of females than males availed of MLS regardless of prior mathematical achievement levels or discipline of study.
- There was a significant association between gender and the categories that emerged from the reasons given for use of MLS. The incentive to do as well as possible in assignments and examinations emerged as the most significantly distinguishing feature (45% for female respondents as against 26% for male).
- Once they have engaged with MLS, male and female students did not report any difference in the academic impact of MLS or in their experience of MLS.
- For students who did not use MLS there was a statistical difference in the reasons given for not availing of MLS in 2 of 7 categories. A significantly higher proportion of females than males reported that they did not know where MLS was provided in their institution whereas more males than females said that they had never heard of the service.
- For non-users of MLS, males were more likely than females to indicate that they would avail of MLS if they needed it whilst females were more likely than males to suggest more suitable opening times were needed to encourage them to avail of MLS.

4.3.1 Background

The details of the gender breakdown of the participants in the survey, their prior educational achievement and areas of study are contained in Section 3.1.4. Initial analysis of the data in this survey revealed some differences between male and female levels of engagement with the services provided. 1629 of respondents had indicated their gender, of these 586 (35.9%) indicated in Question 8 that they had availed of MLS. The breakdown by gender is given in Table 40.

Table 40: Comparison of gender with using MLS

		Total	**Availed of MLS**
Male	**No.**	939	276
		57.6% of total population	29.5% of Male population surveyed
Female	**No.**	690	310
		42.4% of total population	45.1% of Female population surveyed

More males than females completed the survey but females are more willing to avail of MLS. In fact, there is a significant association (chi-square test, $p<0.001$) between reported gender and availing of MLS. This result encouraged us to take a closer look at gender differences in MLS usage and we postulated the following research questions:

- Is there a significant difference between male and female students' level of engagement with MLS?
- Do male and female students report different reasons for using/not using MLS?
- Is there any evidence of a differing impact upon male and female students who use MLS?
- Are there different approaches that could be taken to encourage male and female non-users of MLS to engage with the service if needed?

Before presenting the results of the analysis of gender difference in the survey first we present a brief overview of some aspects of engagement with MLS which need to be considered when examining the data analysis from a gender perspective:

The use of MLS in HE is generally at the student's own discretion; while certain students may be advised to use the service based on their level of mathematics upon entry, no extra credit is awarded for using the service and no penalties apply for failing to do so. If a student feels they need extra help, they are free to attend. Therefore, when investigating the use of MLS from a gender perspective, there are a large number of potentially influential factors, including possible gender differences in mathematical self-confidence (Nurmi et al., 2003; Mura 1987; Fennema 1980), pre-examination anxiety (Kosmala-Anderson & Wallace, 2007), personal motivation, expectations and attitudes in relation to mathematics (Skaalvik & Skaalvik, 2004), influence of peers (Han & Li, 2009) and so on. Given that students voluntarily use MLS, their perception of their mathematical ability can have a major impact on their decision to attend, whether this perception is high or low (Gillard et al., 2012). As early as 1987, Mura noted that, when asked to predict their final grades for their mathematics course, male undergraduates were more likely than females to overestimate their grades (and females were more likely to underestimate theirs), although the expectations of both genders were overly high (Mura, 1987). More recently, Nurmi et al. (2003) echoed results first found by Fennema (1980) in second-level students, observing that "*boys had remarkably higher self-confidence than girls*" (Nurmi et al., 2003, p. 3–459) in relation to mathematics, at similar levels of achievement. Jones and Smart (1995), when faced with such results, subsequently found that "*as a group, the girls had far more confidence in their female peers than they had in themselves as individuals*" (Jones & Smart, 1995, p. 164). Guimond and Roussel (2001) found that "*women may be led to downplay their own performance in math while men may be led to brag about their relative success*"

(Guimond & Roussel, 2001, p. 278), and go on to discuss how "*instead of evaluating themselves by the marks they obtained, these students seemed to use gender stereotypes as a basis for self-evaluation*" (Guimond & Roussel, 2001, p. 291).

Brandell and Staberg (2008) in their review of recent literature on the topic of mathematics as a "*male domain*" concluded that although some recent studies (Forgasz, 2001; Leder, 2001) have reversed the trend and found that a majority of second-level students perceive mathematics as gender-neutral, with a considerable minority even perceiving it as a "*female domain*", the majority of researchers have shown that "*mathematics is gendered as a male domain, both historically and currently*" (Brandell & Staberg, 2008, p. 499). They suggest that this is as a result of the fact that "*attitudes towards mathematics are not static but influenced by…development in school and society*" (Brandell & Staberg, 2008, p. 498). Forgasz et al., (2004) observe that, due to the different measurement scales used to determine gendered perception of mathematics, "*it is not possible to argue definitively about change in attitudes over time*" but that "*the responses to the new instruments show some change, particularly in situations in which females are doing better or have more positive attitudes than males*" (Forgasz et al., 2004, p. 416). This is echoed by Rodd and Bartholomew (2006), who observed that "*(t)he position of girls and women with respect to mathematics has changed significantly over the past few decades and continues to change*" (Rodd & Bartholomew, 2006, p. 36), and as a result, it is possible that these studies on confidence differences between male and female students in respect of mathematics may be becoming less relevant in the current landscape.

4.3.2 Focus on students who used MLS

When considering the spread of students who used MLS, one of our initial points of interest was to consider their prior mathematical achievements, as we would expect that those with lower grades would be in greater need of support. In Section 3.1.4 we saw that gender and LC mathematics levels were independent for the full cohort of students in this study. However, when we focused only on those who used MLS there is a significant association between the two (p=0.02). The most pronounced difference occurs between males and females who have HL LC mathematics, with 17.25% of male respondents using MLS, compared with 47.09% of females. If we look more specifically at the grades obtained by students within each level, there is a stronger association (chi-square=39.652, 7df, p<0.001). The spread of grades is shown in Figure 10, where it can be seen that females for all levels and grades, except OB, avail of MLS at a higher percentage rate than males.

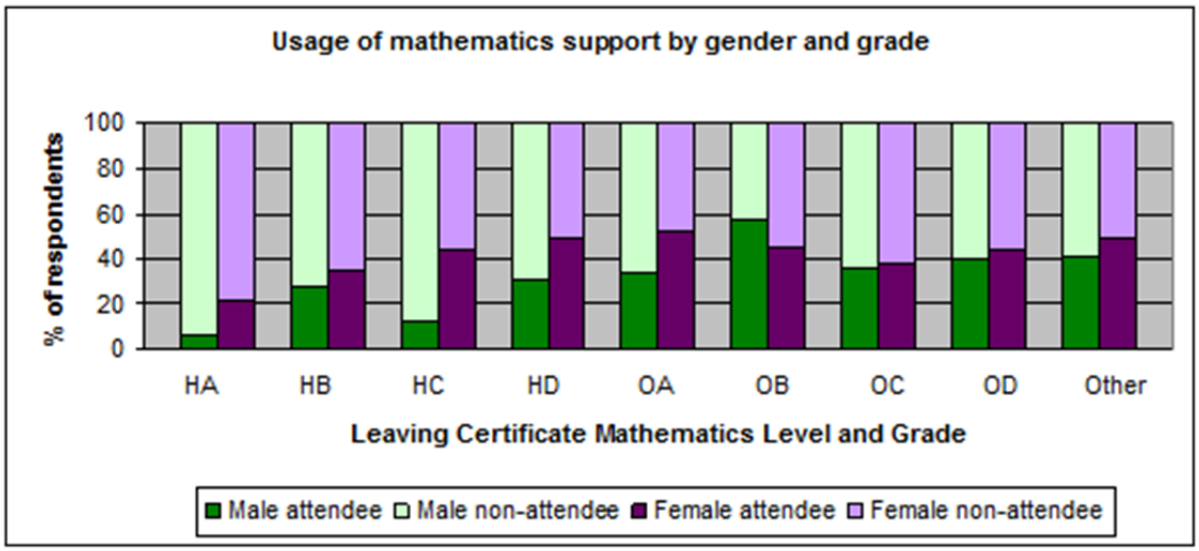


Figure 10: Percentage of students of each gender and LC mathematics grade who used MLS

When we considered (Question 1) the disciplinary background of the students, we saw in Section 3.1.4, that there was a significant association between gender and discipline area. Further analysis for MLS users revealed that there was also a significant association between gender and discipline studied (chi-square=52.022, 4df, p<0.001). A breakdown is given in Figure 11.

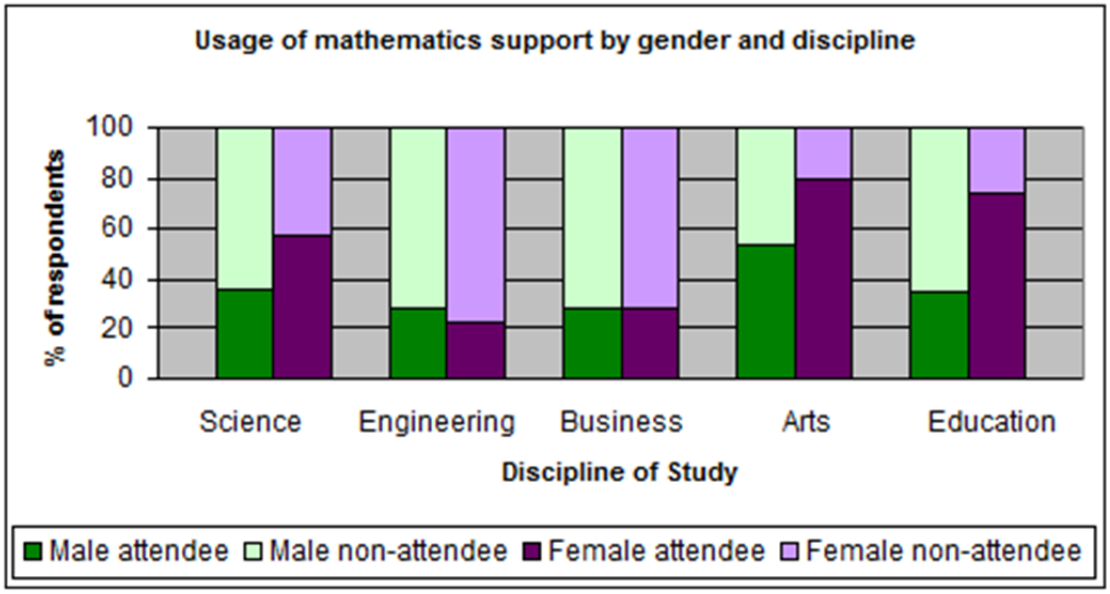
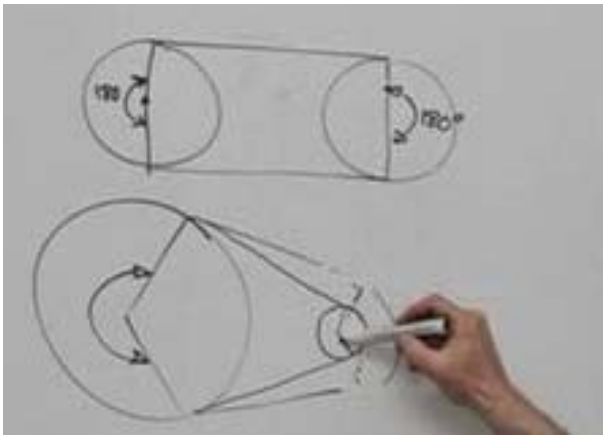


Figure 11: Percentage of students from each discipline who used MLS, given as a proportion of students of each gender in the discipline within our study

Females from Science, Arts and Education in our study were more likely to attend MLS than males, while the proportions were almost equal in Engineering and Business. An answer to our first research question is provided by the fact that there are significantly different levels of engagement between male and female students with MLS for three of the disciplines. Both females in similar disciplines to males and females with equal or higher levels of prior mathematical attainment to males demonstrate higher levels of availing of MLS. This also led us to investigate confidence and self-perception issues for females in relation to mathematics, in line with the research previously mentioned (Nurmi et al., 2003; Jones and Smart, 1995; Fennema, 1980). For this reason, we next consider the reasons given by students of both genders for using MLS and examine whether any differences could be perceived in their responses.

4.3.2.1 Reasons for using MLS

In Section 3.2.1 we discussed the reasons given by MLS users on why they first decided to avail of MLS. The responses were coded into six main categories: Assignments/Examinations; Extra help; Improve understanding; Mathematics difficult; Background/Ability; Struggling. 543 of the respondents also indicated their gender, 300 were female and 243 male, and a breakdown of the categories by gender is given in Figure 12. There was a significant association between gender and the categories (chi-square=21.64, 6df, p<0.001).



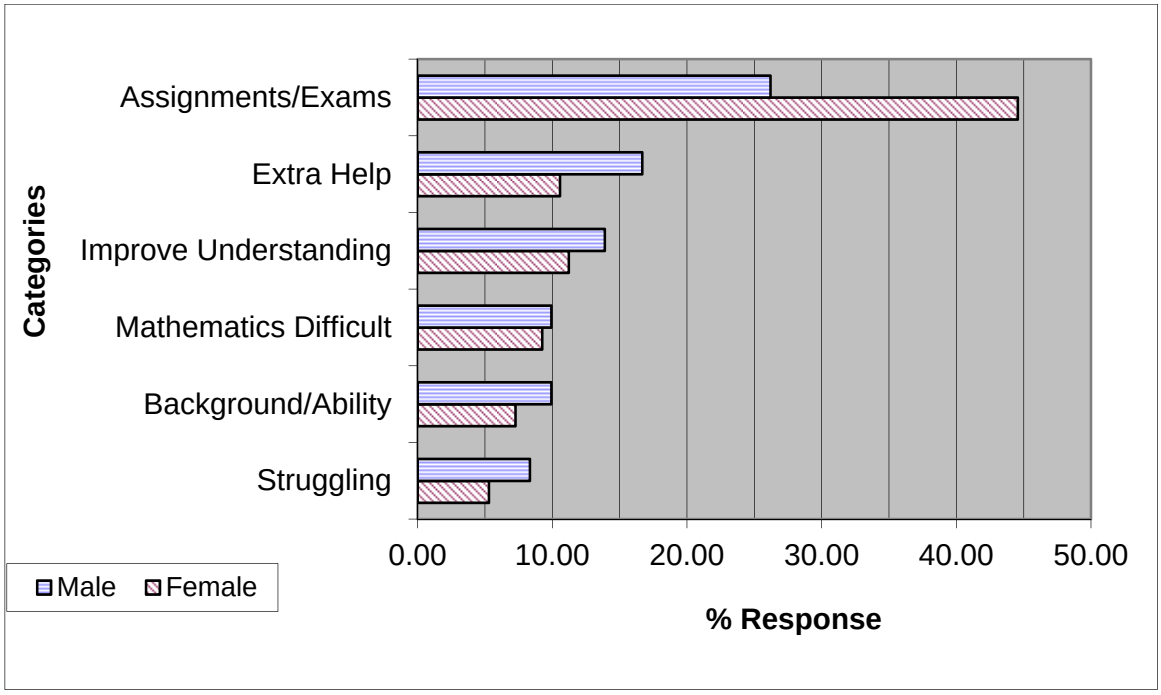


Figure 12: Proportion of reasons given for first deciding to use MLS broken down by gender

The most striking difference can be seen where almost 45% of female respondents identified assignments or upcoming examinations as being the main reason they decided to use MLS; this compares with only 26% of males citing this reason. These students typically made comments such as "*I couldn't do the maths assignment*" or "*I had a class test coming up*".

Male students were more likely than females to mention a generic need for extra help, with 17% of males specifying this as opposed to 11% of females. Some of these students were non-specific about the help they required "*Because I needed some help*" while others gave more particular information such as "*To get help at the start of the year*" or "*Because I needed help with maths and it was there and free*".

The difference between the genders was less striking in the remaining categories: 14% of males and 11% of females (a total of 12% of respondents) mentioned improving their understanding of mathematics as their primary motivation, commenting "*I felt I needed better understanding of certain topics*" and "*because I wanted to further my understanding of the maths done in lectures*". In terms of the difficulty of mathematics, male and female students responded in similar proportions, with 10% and 9% of respondents respectively alluding to this in comments such as "*I was finding maths very difficult*" and "*College maths became very difficult*". However, contrary to what might have been expected from the prior research, females were even less likely than males to mention their prior background in mathematics or their perceived ability as a primary incentive for MLS. Only 7% of females, and 10% of males (8% of respondents overall), focused upon prior background "*Background in maths was weak*" or perceived ability "*Because I'm not great at maths*". Some of these students were Mature Students, returning to education after a significant break "*Found it hard to get back into it after 17 years of not using my brain*" while others had recently completed their secondary-school education, but displayed low confidence in their mathematical ability "*I was not confident on solving maths problems*". Finally, 8% of males and 5% of females (7% of respondents overall) felt that they were struggling so much with mathematics that this motivated them to use MLS. Most of these students gave little detail in their responses beyond observing that: "*I was finding that I was struggling with the material*".

4.3.2.2 Potential impact of MLS

In addition to the open-ended question on why students used MLS in the first place, there were a number of questions in the survey about the potential impact of MLS, from the students' point-of-view. Question 15 asked students to rate how they perceived MLS had helped them to cope with the mathematical demands of their course and is discussed in Section 3.2.5. Figure 13 gives the relative percentages of male (245) and female (284) respondents for this question.

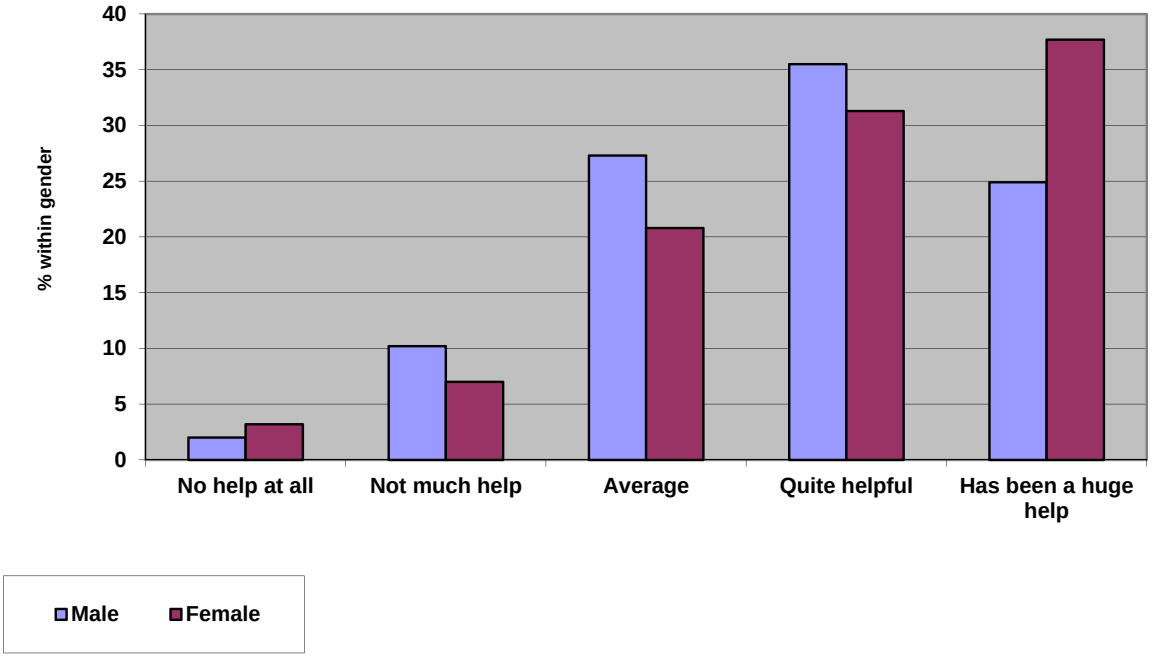


Figure 13: Student perceptions by gender on how they felt the MSC has helped them cope with the mathematical demands of their course

There was a significant link between gender in terms of the responses given (chi-square=12.014, 4df, p=0.017). Females were more likely than males to find that MLS had been a "huge help" or "no help at all" in coping with the mathematical demands of their course, while males were more likely to choose one of the three middle options ("not much help", "average" or "quite helpful").

Responses to 3 other questions in the survey (Questions 11, 13, 14) about the potential impact of MLS were independent of gender, showing no significant differences between male and female respondents. These included whether students had considered dropping out of their degree programme due to mathematical difficulties (chi-square=0.954, 1df, p=0.329); whether MLS had improved their confidence in mathematics (chi-square=2.165, 4df, p=0.705); and whether it had impacted upon their performance in examinations (chi-square=5.03, 5df, p=0.412).

Therefore when considering the 4 survey questions in this area, it seems that there is no real evidence of a differing impact upon male and female students who use MLS, with students of both genders appearing to benefit equally once they engage with the services provided. This is an important finding in that it can provide some reassurance to those in charge of such services that there does not appear to be an inherent bias towards one gender within MLS; however, the question remains as to why male students are not engaging at similar levels to females, and so we now turn our attention to the responses of students who do not avail of MLS.

4.3.3 Focus on students who did not use MLS

While there should always be a significant cohort of students for whom MLS is unnecessary, the differences in attendance rates between male and female students with similar prior mathematical achievements and studying the same subject areas means that it is of particular interest to ascertain the opinions of those who did not engage these services. As such, the group of 1039 respondents who did not use MLS for whom gender could be identified (661 male and 378 female) deserve specific attention. The mathematical background and discipline of origin for these students can be seen in Figures 10 and Figure 11 at the start of Section 4.3.2 under "male non-attendees" and "female non-attendees".

4.3.3.1 Reasons for not using MLS

In Question 16 students who did not engage with MLS were asked why they had not done so (see Section 3.3.1). Figure 15 gives the breakdown by gender of the respondents who picked one of the 7 fixed options. (Note each student could select more than one reason). Given that students had the option of selecting more than one response here, the data was analysed by running a series of chi-square tests on each of the seven options available to students and then performing the Bonferroni-Holm correction on the data, to control for the number of false positives that might otherwise appear in the results. This correction is quite conservative and so we only see the most significant differences appearing in the results. This gives us a statistically significant difference between the responses for males and females for two of the categories: "*I did not know where it was*" (adjusted p=0.007, 1df) and "*I never heard of the Mathematics [Learning] Support Centre*" (adjusted p=0.024, 1df).

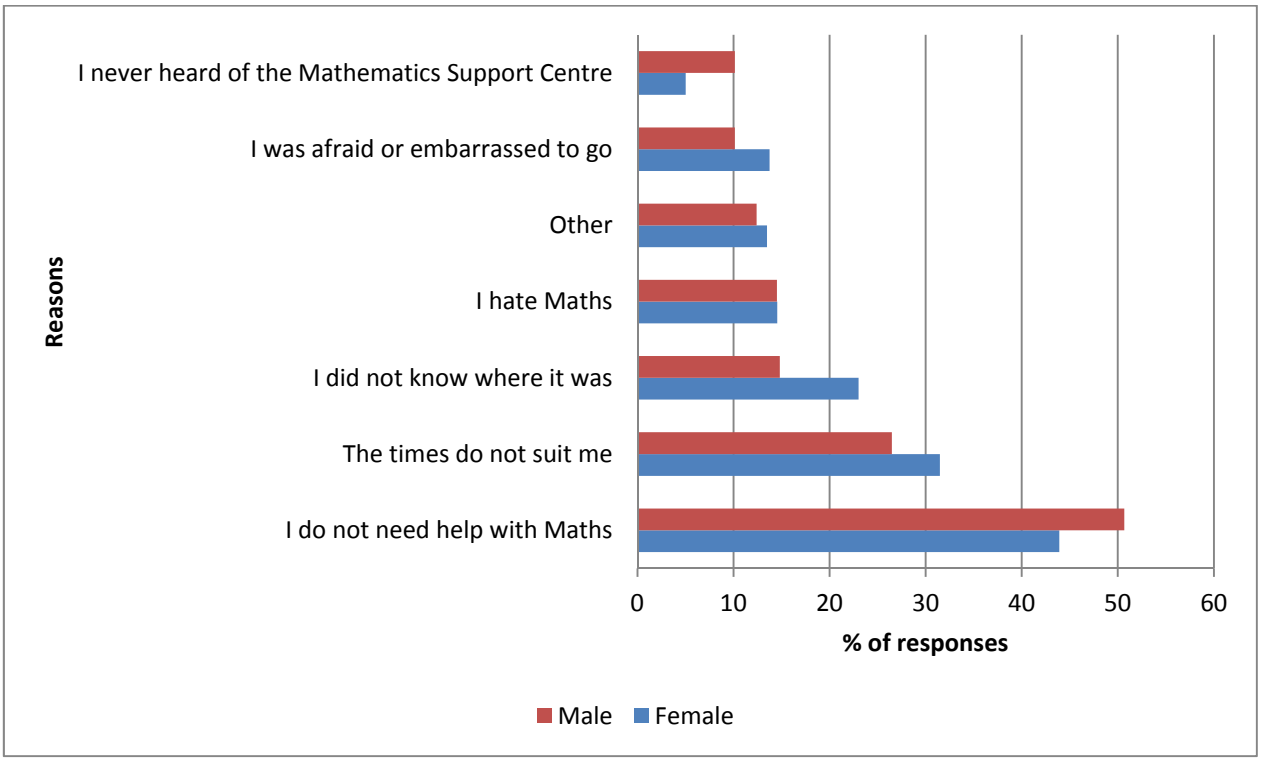


Figure 14: Percentage of respondents of each gender per option in response to Question 16

If we consider the responses in terms of frequencies, almost half (48%) of students who had not availed of MLS felt that they did not need to, with 51% of males and 44% of females choosing this response. Although there is a noticeable difference between the genders here; it is not as pronounced as we might have expected based on research mentioned in Section 4.3.2 (adjusted p=0.18, 1 df). The next most common response was that the times when support was available were not suitable, with 28% of respondents selecting this (27% of males and 31% of females). A much higher proportion of females than males stated that they did not know where MLS was held in their HEI, with 23% of females as opposed to

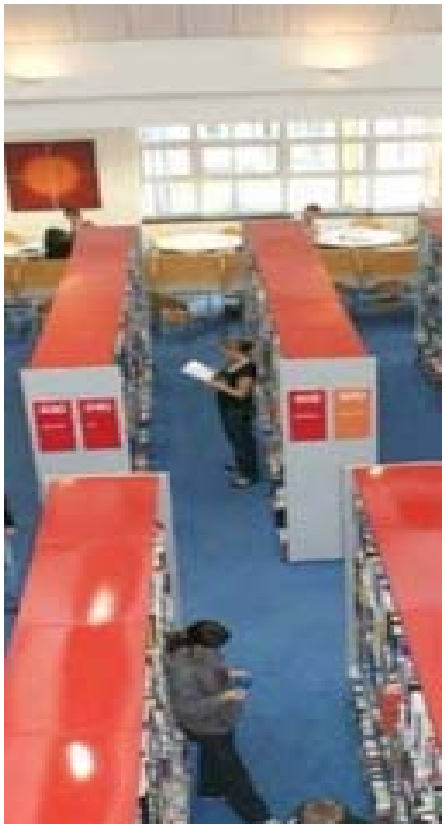
15% of males citing this reason (this was one of the two responses that showed up as significant in our conservative test). Males were twice as likely as females (10% as opposed to 5%) to say that they had never heard of the MLSC, though the overall percentage of students choosing this response was small (6% in total). The proportions were similar in both genders when it came to choosing options such as "afraid/embarrassed" and "I hate maths". A breakdown of the 992 responses from the 661 males and 499 responses from the 378 females is given in Table 41.

Table 41: Breakdown of answers to Question 16 from IoTs based on gender

Question 16 response options	Do not need help	Never heard of the MLSC	Did not know where it was	Times do not suit	Embarrassed or afraid to go	Hate Maths	Other Reason
No. of male responses	335	68	99	175	67	96	82
As a % of male respondents	50.68%	10.28%	14.98%	26.48%	10.14%	14.52%	12.41%
No. of female responses	166	19	87	120	52	55	51
As a % of female respondents	43.92%	5.03%	23.02%	31.75%	13.76%	14.55%	13.49%

However, if we then omit those students who chose more than one option and look at the 686 students who selected exactly one reason for non-attendance, a statistically significant difference emerges overall between male and female responses (chi-square=18.196, 6df, p=0.006).

As this was also the case for students who used MLS, we now have an answer to our second research question, showing that male and female students report different reasons for using or not using MLS, although this difference is non-uniform, with some responses resulting in much larger differences than others. Almost half (48%) of students who had not availed of MLS felt that they did not need to, with 51% of males and 44% of females choosing this response. Although there is a noticeable difference between the genders here; it is not as pronounced as we might have expected based on some of the research mentioned in Section 4.3.2. The next most common response was that the times when support was available were not suitable, with 28% of respondents selecting this (27% of males and 31% of females). A much higher proportion of females than males stated that they did not know where MLS was held in their institution, with 23% of females as opposed to 15% of males citing this reason. Males were twice as likely as females (10% as opposed to 5%) to say that they had never heard of the service, though the overall percentage of students choosing this response was small (6% in total). The proportions were very similar in both genders when it came to choosing options such as "afraid/embarrassed" and "I hate mathematics".



4.3.3.2 Reasons which would encourage usage of MLS

In Question 17, non-users of MLS were asked what would encourage them to use MLS if they needed to (see Section 3.3.2) and responses were coded in 7 categories. 676 respondents identified their gender, 419 male and 257 female. The breakdown of responses by gender and category are in Figure 15.

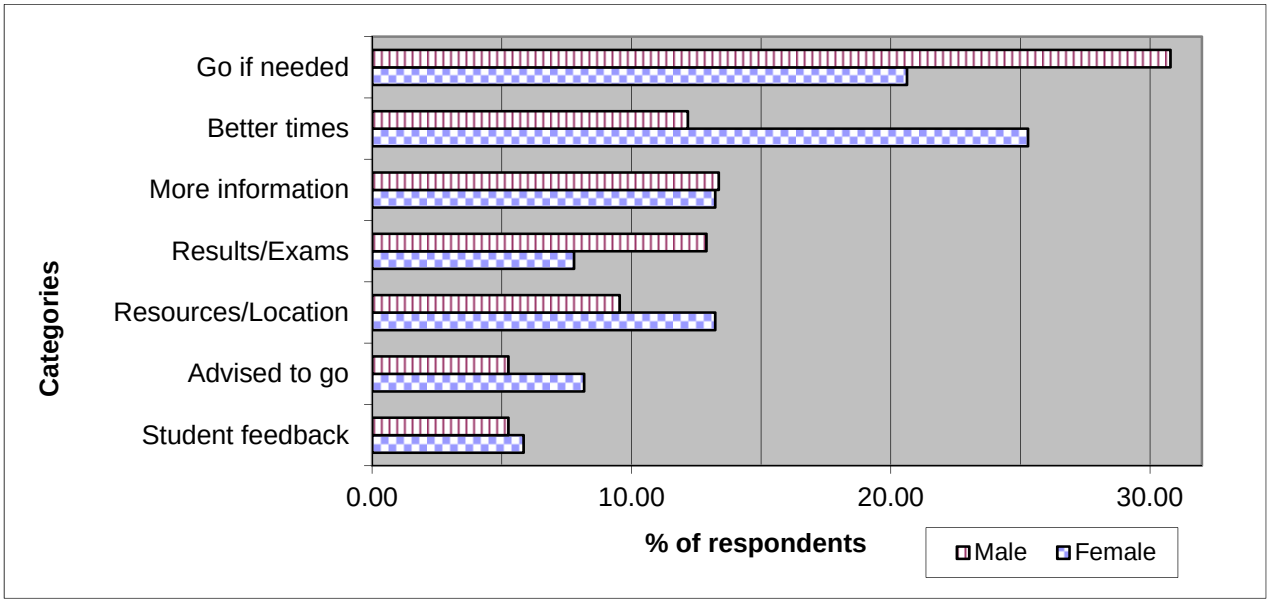


Figure 15: Percentage of students' comments about what would encourage them to avail of MLS broken down by gender

There was a statistically significant difference between responses for males and females (chi-square=32.84, 8df, p<0.001), 31% of males versus 21% of females (29% of respondents overall) said that they would attend MLS if they themselves felt they needed to: "*I would use it if I needed it without hesitation*". In contrast, 25% of females compared with 12% of males (17% of respondents overall) requested opening times that suit them better, with some being non-specific: "*If the times suited better*" while others gave conflicting suggestions regarding the hours that would be more appropriate: "*If the times were earlier in the day, it would encourage me to go*"; "*If there were more hours during the day when I'm in college already, it would suit better*"; "*Evening opening hours instead of daytime opening hours*".

An equal split of 13% of each gender felt they needed more information about MLS, both in terms of advertising the existence and location of the service: "*More advertisement on where and when it's on*" and in terms of specific information of how the support would operate: "*Knowing more of what's involved and what I would be spending my time doing*".

Surprisingly, given that assignments or upcoming examinations were cited as the main reason for attendance for 45% of the female students who used MLS, only 8% of females (and 13% of males, giving 11% of respondents overall) felt that obtaining poor results in an assessment: "*If I wasn't doing well and getting bad results, then I would need help*" or concern about results in a forthcoming examination: "*If I thought I was going to fail*" would be a driving force for them to attend MLS. In fact, more females (13%) cited a need for specific resources being in place instead: "*Solutions and sample papers*"; "*A Moodle page in maths*"; "*If they could possibly create easy or simplified notes on certain topics that are thorough and contain many different examples*" or commented on the physical setting of the MLSC: "*More central location*" than mentioned examinations.

A larger percentage of females than males (8% versus 5%) would like to be advised or incentivised to attend MLS, usually by a lecturer: "*If I was advised by my lecturer that it would be useful to me if I needed*

help"; "*If you got a percentage of final grade for going*". Again, somewhat surprisingly, only 5% of each gender mentioned feedback from other students "*If I heard good reviews of it*" as being a primary potential motivator for them to attend, where it would often be imagined that peer influence would be a more important factor than is shown in this response.

The analysis of differences in usage of MLS along gender lines has shown some interesting results, namely that females with a similar mathematical background and studying the same subject areas as male students are more likely to attend MLS. Importantly, among those who attend, there is no gender disparity in terms of the level of help they perceive they obtain as a result as measured by questions in the survey regarding impact on mathematical confidence, performance in examinations or their consideration of dropping out of their degree programme due to mathematical difficulties. However, it should be noted that a larger proportion of females than males were more positive regarding the impact that MLS had been in helping them cope with the mathematical demands of their course. Female students were far more likely to cite upcoming examinations as a reason for using MLS, but less likely to cite these as an incentive to attend if they have not done so before. While equal numbers of males and females cited the unsuitability of the timetabling of MLS as a reason for non-attendance, twice as many females as males felt that more suitable times would make them more likely to attend.

4.4 Focused Study of Mature Students and MLS

Given the increasing number of Mature Students in mathematics in first year courses and that research indicates they will have different needs and motivations to traditional students, a detailed analysis of Mature Students responses in the survey was conducted and the results are outlined in this section.

Key Findings

- A statistically significant higher proportion of Mature Students (62%) than traditional students (32%) availed of MLS.
- The mathematical background of both users and non-users of MLS amongst Mature Students was very similar. In each subject discipline, the proportion of Mature Students using MLS was very similar to the proportion of all Mature Students.
- Mature Students reported different needs and motivations for seeking MLS. Mature students were more likely to use MLS simply because it was there for them and they wanted to access extra help. In contrast, the traditional students were more motivated by assessment demands.
- Qualitative feedback illustrated that for Mature Students MLS is a mathematical lifeline.
- Mature Students were more positive in their praise of MLS than their traditional counterparts and their experiences with MLS played a more significant role in their retention than in that of other students.
- Low self-efficacy in mathematics seemed to inspire Mature Students to avail of MLS rather than shy away from it.

4.4.1 Background

One effect of the economic downturn has been the welcome increase in Mature Students returning to HE (Golding & O'Donoghue, 2005). A Mature Student, or Adult Learner, 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). Students not in this category will be ascribed the descriptor of traditional learners. Entry to a HEI for Mature Students who have not got the minimum requirement for entry to their chosen course of study is typically 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 UL since diagnostic testing began in 1997. The increase in Mature Students in mathematics in these programmes was quite pronounced. In 1997 there was one registered Mature Student in Science and Technology Mathematics, two of the biggest service mathematics modules provided by this University; in 2008, there were 55 Mature Students. This statistic is supported by Gill (2010) who states that in 2009/10, Mature Students in UL constituted 14% of the entire cohort, a jump of 49% on the previous year. In Dublin Institute of Technology (DIT), Mature Students constituted one fifth of the attendants at the MLSC in its opening year (Ní Fhloinn, 2007). In 2012 Mature Students accounted for 15.3% of full-time students enrolled in HE in Ireland and 21% of full and part-time students.

Given this increasing proportion of Mature Students in mathematics in first year courses, it was considered key that Mature Students should be identifiable in the survey so that their responses regarding the evaluation of MLS could be studied in detail. This section of the report presents the analysis focusing on Mature Students to find answers to the following research questions:

1. What are the motivational factors of Mature Students who seek MLS?

2. Why do some Mature Students of mathematics not seek MLS?

Before presenting the results of the analysis from Mature Students first we present a brief overview of 3 aspects of adults learning mathematics which need to be considered when examining the data analysis:

Mature Students in mathematics who return to education constitute quite a heterogeneous cohort. For example, participants on the 'Head Start Maths' bridging programme at the UL range from 23 years of age 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 sat the Leaving Certificate examination at all (Gill, 2010). In DIT, Ní Fhloinn (2007) outlines how Mature Students 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. For many adults returning to HE, mathematics presents an obstacle. Many find the idea of studying mathematics intimidating and this can have a potential negative impact on their mathematics confidence and subsequent performance (Golding and O'Donoghue, 2005). Diez-Palomar, Rodriguez and Wehrle (2005) acknowledge the difficulty in adult mathematics education in efficiently addressing the needs of diverse cohorts. 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).

Under-preparation of adults in mathematics is a grave issue at HE (FitzSimons & Godden, 2000) as students with an array of previous qualifications, on vastly different courses with a series of attainment and performance levels often present with a range of problems (Elliot & Johnson, 1994). The literature indicates that many Mature Students in mathematics exhibit maths anxiety when faced with mathematical tasks and can lack confidence in their mathematical abilities (Gill, 2010; Ní Fhloinn, 2007; Klinger, 2006). This anxiety may impact adversely on their participation and performance in mathematics activities (Ashcraft, 2002). In fact Gill (2010) reported that mathematics is often the main worry/concern of students returning to University. Singh (1993) attributes this anxiety on the part of Mature Students partly to examinations and a fear of failure. It has been well documented that mathematics learning is related to student confidence in their abilities (Coben, 2003). Many adults who are well capable of

learning mathematics are inhibited from doing so because of their fear of the subject (Klinger, 2005; Benn, 2000).

Diez-Palomar et al. (2005) and O'Donoghue (2000) acknowledge the difference between Mature Students in mathematics and traditional learners. Mature Students carry an abundance of experiences that need to be considered in pedagogical practices. This view is supported by Tusting and Barton (2003) who add that Mature Students 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 both deliberate and their own (FitzSimons & Godden, 2000). Though Mature Students may lack confidence in their own abilities, they tend to be highly motivated (Ní Fhloinn, 2007; FitzSimons & Godden, 2000). According to Gordon in 1993, as cited in FitzSimons and Godden (2000), traditional lectures and assessments are not conducive to learning for many Mature Students and so many rely on MLSCs for support. In 2009-10 Mature Students of mathematics at UL constituted 54% of the attendance at the drop in centre in UL, though they represented just 14% of the entire student population (Gill, 2010).

4.4.2 Relationship between Mature Student status and use of MLS

As outlined in Section 3.1.6, 221 (13.5%) of 1633 respondents indicated that they were Mature Students. 73% of these were male and 91% (221) of Mature Students were full-time students.

The majority of Mature Students 136 (61.5%) availed of MLS. This compares to traditional learners, only 32.2% of whom availed of MLS. A chi-square test for independence carried out on the overall data collected in this investigation indicated a statistically significant association exists between type of student (i.e. Mature Students or traditional learners) and whether a student uses MLS ($p<0.001$), Mature Students are more likely to seek MLS than traditional learners. This supports the findings of Ní Fhloinn (2007) who states that Mature Students in DIT seek support much earlier than traditional learners, even as early as the first day of term. It is also worth noting that of the 85 (38.5%) Mature Students who did not avail of MLS, 44% of these stated that they did not need help. In comparison, for the 941 (67.8%) traditional learners who did not avail of MLS, 48.9% of these stated that they not need help.

In terms of gender, 68.3% of all female Mature Students in comparison to 43% of female traditional learners use MLS facilities. Also 59.4% of all male Mature Students in comparison to 23.3% of all male traditional learners avail of MLS facilities.

When considering the spread of students who used MLS, our initial point of interest was to consider their prior mathematical achievements, as we would expect that those with lower grades would be in greater need of MLS. The mathematical background of the Mature Student users is displayed in Table 42. The mathematical background of both users and non-users of MLS among the Mature Student sample is very similar (note for 19 Mature Students prior mathematical background was unavailable).

Table 42: Comparison of mathematics LC level of Mature Students users and non-users of MLS

	Higher Level LC	**Ordinary Level LC**	**Foundation Level LC**	**Other**	**Totals**
Surveyed	9.90% (20)	73.76% (149)	4.46% (9)	11.88% (24)	202
Users of MLS	8.00% (10)	76.00% (95)	4.80% (6)	11.20% (14)	125
Non-Users of MLS	12.99% (10)	70.13% (54)	3.90% (3)	12.99% (10)	77

Finally, in each subject discipline, the proportion of Mature Students using MLS is very similar to the proportion of all Mature Students, see Table 43.

Table 43: Subject discipline of all Mature Students and Mature Student users

	No. of Mature Students	%	Mature Students who used MLS	%
Science	80	36.2	42	30.9
Engineering	50	22.6	30	22.1
Business	55	24.9	34	25.0
Arts	7	3.2	7	5.1
Education	6	2.7	5	3.7
Computing	23	10.4	18	13.2
Total	**221**	**100.0**	**136**	**100.0**

4.4.2.1 Mature Student reasons for using MLS

The students who availed of MLS services were asked in an open–ended question to supply comments as to why they first decided to use MLS. 122 of the 136 Mature Student attendees responded. The comments were categorised as shown in Table 44.

Table 44: Frequency of Mature Student reasons for using MLS

Categories of comments	% of 122 comments	Sample comments
Assignments/Examinations: Looking for help with specific aspects of coursework assessment during the semester or attending for revision or prep 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*".
Extra help	38.52%	"*I had gone to the tutorials and still had trouble with a particular area*"; "*I wanted help with a maths 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*".
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*".
Mathematics Difficult	2.46%	"*Because I find maths very difficult*".
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*".
Struggling	9.02%	"*I was struggling with the subject*"; "*Was lost with maths*".
Comment about time the students went but with no further information about why they used MLS	10.66%	"*Autumn Semester 2010*"; "*First week*".

A comparison of the frequency of responses from Table 44 of reasons given by Mature Students for availing of MLS and those given in Table 11 for the overall population of users provides some interesting differences. The frequency of responses from Mature Students shows 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 7.45% frequency of response);
- seek general extra help (38.52% as against 20.62% frequency of response);
- are struggling (9.02% as against 5.03% frequency of response).

In contrast, the frequency of responses from Mature Students shows that students in this survey are much less likely to make comments indicating that they:

- seek help specifically to get help with specific coursework assessment or revision for tests (13.93% as against 41.25% frequency of response);
- attend MLS to improve or gain better understanding (5.74% as against 15.94% frequency of response);
- state they find mathematics difficult (2.46% as against 9.71% frequency of response).

Finally there was one category of response that was unique to Mature Students. These 13 responses (10.66%) were statements about the time at which MLS was accessed but offering no further insights into why the support had been accessed.

4.4.2.2 Rating of and comments about MLS services by Mature Students

Students who availed of MLS were asked to rate a list of MLS services. The students were also given the opportunity to provide an open–ended comment/suggestion on each MLS available in that institution.

Rating of MLS services by Mature Students

Figure 16 demonstrates the satisfaction levels of Mature Students with the Drop-In Centres (this was asked in Question 10 and was answered by 119 Mature Students). 89% of these students rated the Drop-In Centres as quite or extremely worthwhile.

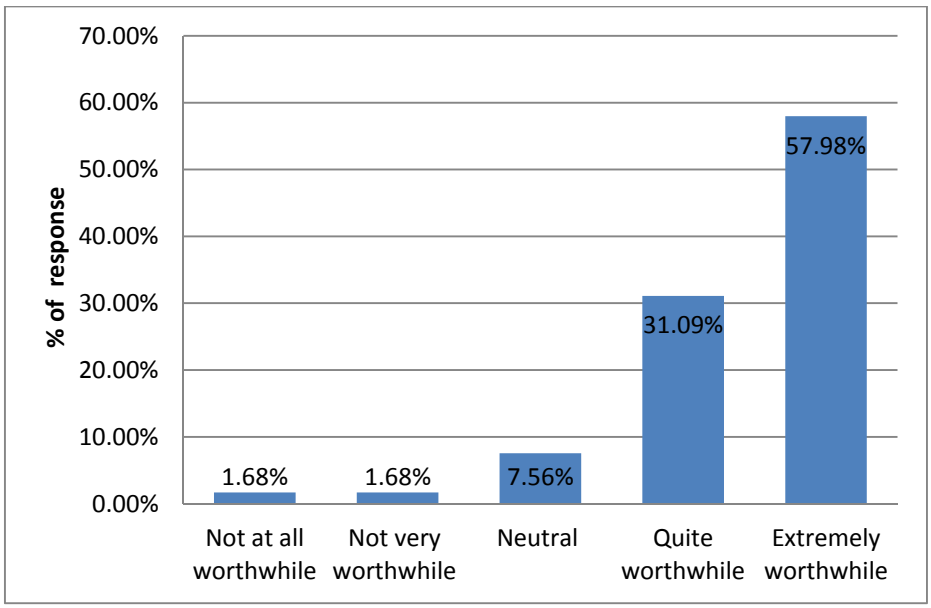


Figure 16: How Mature Students users of MLS rate the Drop-In Centre

90% of the 50 Mature Students who attended Support Tutorials rated them as worthwhile and 61% of the 66 Mature Students who stated that they used ICT enabled Supports rated the service as worthwhile.

Comments relating to the Drop-In Centre

There were 57 general comments relating to the Drop-In Centre. Coding of responses fell into the four categories outlined in Figure 17. The distribution of responses from Mature Students among the 4 categories is in line with that for the overall cohort (see Table 13).

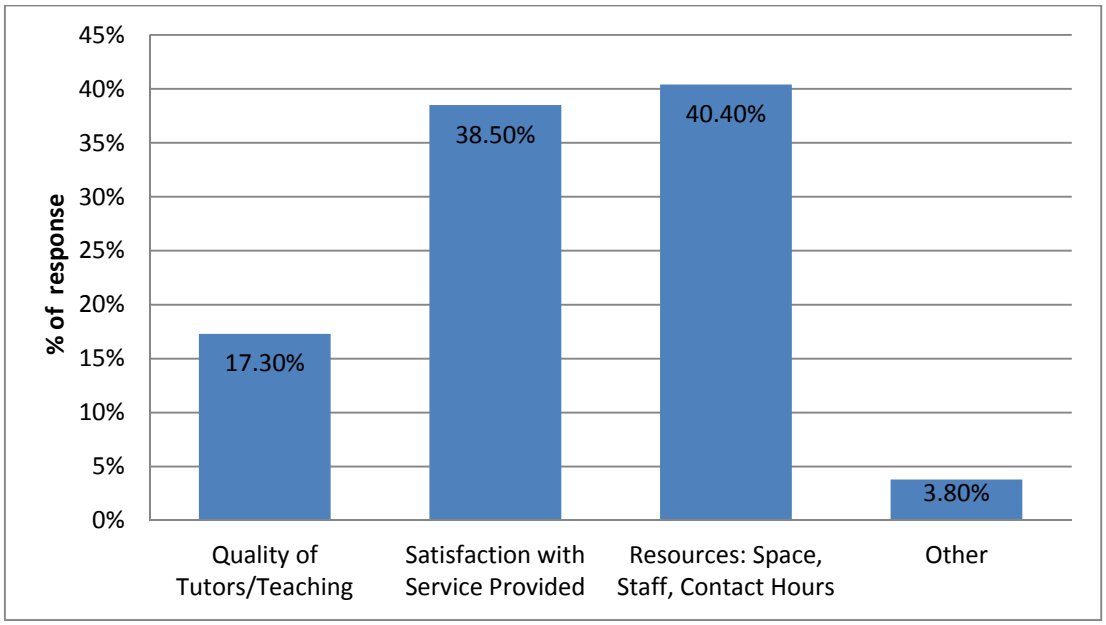


Figure 17: Mature Students Comments on Drop-In Centres

20 (38.5%) comments were made by Mature Students relating to satisfaction levels with the service provided, 19 of which were positive: "*Very helpful – I am even starting to enjoy maths now*". It is clear from the comments that MLS provides a mathematical lifeline, so to speak, for many Mature Students: "*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*"; "*Would not have a clue what I was doing if it was not for support*".

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: "*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*".

9 (17.3%) comments related to the quality of tutors; 5 positive, 1 negative and 3 which were positive and negative: "*Always as helpful as they can be with the exception of one of the tutors who tends to be very rude and arrogant*".

4.4.2.3 Impact on Mature Students' mathematical education

In Questions 11-15, MLS users were asked about their perception of the impact of MLS on various aspects of their education. See Section 3.2.3 for full results.

Impact on mathematical confidence: In Question 13, students were asked to rate the impact the MLS services had on their confidence. 124 Mature Students responded and 67% of these rated the impact as helpful in comparison to 56% when all student responses were considered (see Section 3.2.3.1), while 27% rated the impact as average. There were 21 additional comments and 20 of these were 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*". The remaining comment stated that they did not use the services that much.

Impact on mathematical performance: Question 14 asked if MLS had impacted on their mathematics performance in examinations to date. 115 Mature Students responded and 65% of these stated that it had an impact, in comparison to 56% when all student responses were considered (see Section 3.2.3.2). 21 additional comments were made to this Question, 16 of which were positive: "*I would have failed if the extra help had not been there*"; "*They make maths sound easy*".

Impact on coping with mathematical demands of course: In Question 15, students were asked to rate how MLS had helped them cope with the mathematical demands of their courses. 119 Mature Students responded and 72% of these indicated that MLS had been helpful, in comparison to 65% when all student responses were considered (see Section 3.2.3.3). 14 comments additional comments were made to this question, 12 of which were positive: "*Wouldn't be able to do maths without all the extra services and wouldn't have a hope of passing the year*"; "*Definitely vital for weaker maths students*". There were only two negative comments: "*Some of the tutors in the centre might be good at understanding maths but not good at teaching it*"; "*It's encouraging but we need more support*".

Impact on students considering dropping out: In Question 11 students were asked if they had ever considered dropping out of their studies for mathematics-related reasons. 128 of the 136 Mature Students answered this question with 25 (19.5%) stating that they did consider dropping out because of difficulties with mathematics. This is a similar proportion to that of the overall student population (see Section 3.2.4). This question was followed by a related question (Question 12) asking if MLS had been a factor in them not dropping out. 22 of the eligible 25 students answered and 17 (77%) of these stated that MLS was an influencing factor in their decision not to drop out compared to a 62.7% response rate when considering the overall population (see Section 3.2.5). Additional comments included: "*Greatly. It has given me the confidence to turn maths as my worst subject into one of my best*"; "*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*"; "*No, but did worry about failing maths before using these facilities*".

4.4.2.4 Mature Student reasons for not using MLS

85 (38%) Mature Students stated that they did not use MLS services provided by their institution. In Question 16, non-attendees were asked to select from fixed options, as to why they did not avail of MLS. The frequency of response in each category is interesting when compared with that of the frequency of reasons for the overall 1041 students who did not use MLS, see Table 45.

Table 45: Comparison of frequency of reasons for not using MLS between Mature Students and all students

Category of response	% of Mature Students who did not avail of MLS (n=85)	% of all students who did not avail of MLS (n=1041)
I do not need help with Maths	43.5%	48.13%
The times do not suit me	29.4%	28.34%
I did not know where it was	1.2%	17.87%
I hate Maths	1.2%	14.51%
Other	8.2%	12.78%
I was afraid or embarrassed to go	4.7%	11.43%
I never heard of the MLSC	11.8%	8.36%

44% stated that they do not need any help which is in line with the overall population. A similar proportion of Mature Students 29.4% and the overall population stated the times did not suit them. However, it is interesting that the proportions responding that they hated maths, did not know where the MLSC was or were afraid or embarrassed to go, were much lower than in the overall population.

Students were also given the opportunity to comment on their answer to Question 16. 34 comments were made by Mature Students. 20 comments stated that they didn't need help or were able to work it out by themselves; 8 stating that the timing of sessions did not suit them due to timetable or living circumstances; 2 stating that they never heard of MLS; and 2 comments relating to a reluctance to go: "*Procrastination*"; "*Just felt a bit uncomfortable; felt the questions I had may seem a bit irrelevant*".

In response to Question 17, students who did not use MLS commented on what would encourage them to use the MLS facilities. The coding of these comments was presented in Table 24, Section 3.2.2. Table 45 below gives the breakdown of responses from the 41 Mature Students who answered Question 17 using the same categories and themes as Table 24. Compared with the overall responses, Mature Students 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 avail of MLS. No Mature Students mentioned examinations or results as a prompt for them to access MLS.

Table 46: Frequency of comments from Mature Students who are non-users of MLS about what would encourage them to avail of MLS

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

In light of this data for Mature Students from the survey outlined above, responses to our initial research questions are summarised below.

1. What are the motivational factors of Mature Students who seek MLS?

The data from this study illuminated some of the reasons Mature Students engage with MLS including issues with content within lectures and assignments, examination help and issues with mathematics as a subject area. The data suggests that Mature Students are more likely than traditional students to mention the following reasons for availing of MLS: having been a long time away from education; poor confidence in their mathematical ability; seeking general extra help; struggling with mathematics. In contrast, the data suggests that Mature Students are much less likely than traditional students to mention the following reasons for availing of MLS: to get help with specific coursework assessment or as revision for tests (13.93% as against 41.25% frequency of response); to improve or gain better understanding; to state they find mathematics difficult. While the reasons given do align with those of traditional learners, what is interesting is that a fear of mathematics or a lack of background knowledge inspired these students to seek support rather than shy away from it.

2. Why do some Mature Students of mathematics not seek MLS?

In our survey, the largest proportion (43.5%) of the Mature Students who did not engage with mathematics learning support stated that they simply did not need to: *"Good service for students – just didn't need to avail of it"; "I do not need it at present"; "I would definitely find time to attend if I needed to".* Another significant reason cited by 29.4% of Mature Students for not availing of MLS was unsuitability of times: *"I always seem to have lectures or labs on around the times the MLSC is open so I don't get a chance to go"; "I think if it was available on Saturdays it would be used more".*

Chapter 5. Discussion, Recommendations and Future Work

In this chapter certain key aspects of results from this survey and their implications for the implementation, development and evaluation of MLS in the future are considered. Key insights gained as a result of the study are listed in the Executive Summary and what now follows is a discussion of aspects of these and a consideration of recommendations which arise from that discussion. (Note for clarity in this discussion chapter recommendations arising from the discussion are written in italics and then summarized in bullet form at the end of the section.)

5.1 Discussion

The Study

This study sought to gather, on a large scale cross–institutional basis, information on student perceptions of MLS and its impact on their work for those students who availed of it. In addition, we set out to gain insights from students who had not availed of MLS as to why they had not done so and to ascertain if there were any actions that might encourage them to engage if needed. To begin with it should be noted that this was the first time a standardised questionnaire on student evaluation of MLS was developed for use in HEIs providing MLS in Ireland. Indeed, to the best of our knowledge, this is the first such large scale evaluation developed and carried out internationally. The survey was made available for distribution to HEIs involved in the provision of MLS and responses were received from 9 HEIs. The decision to seek responses to the questionnaire from all first year students taking service mathematics modules was also significant as it ensured that responses were elicited from the groups that have the largest groups of at-risk students and thus are the main target of MLS. We also distributed the questionnaire in lectures to ensure that we received feedback from both those who had used MLS and those who had not availed of MLS thus avoiding the bias inherent in 'user only' surveys that many individual MLS providers conduct. The questionnaire developed and employed in this study was successfully used to complete this student evaluation of MLS. We would recommend that:

> *The questionnaire used in this survey provides a standard template to be used for such work in HEIs so that data generated in each institution can be easily compared in future collaborative work in this area particularly among HEI clusters.*

Two aspects of the challenges that conducting such a large scale cross-institutional study present are worthy of consideration: the challenge of collecting responses across institutions and the complexity of the respondent profile. Firstly, as this is the first such large study in the area of MLS, it proved difficult to completely control all aspects of the distribution of the survey. The optimal timing of the distribution of the questionnaire was agreed to be in appropriate lectures during the second semester of the academic year to any first-year students who were studying at least one service mathematics module. However, the distribution of questionnaires was subject to some local variations which could not be controlled. Acknowledging that the manner in which the data was collected was dependent on local factors we do not claim that the results of this survey are representative, but they give an invaluable first insight at the state of MLS on a large scale. Also, since this survey was conducted, the IMLSN has become firmly established and recognized as a network and it will be easier to ensure increased uniformity in all future similar studies and hence reduce local variation.

The second challenge to consider, given the large scale cross-institutional nature of this study is the complexity of the respondent profile. As detailed in Section 3.1, of the 1633 respondents, 1201 were University students, 432 were IoT students with the proportion of level 6:7:8 IoT students being in line with the proportions nationally for the year in question; 98.2% were full-time students; 42.4% female, 57.6% male; 13.5% Mature Students; and finally of the 1601 students who indicated prior educational attainment, 33.8% had completed Higher Level (HL) Leaving Certificate (LC) mathematics, 62.7% Ordinary Level (OL) LC mathematics, with the remaining 2.5% indicating either Foundation LC or Other. It is clear that there is a complexity of respondent profile due to the multi-dimensional aspect (type of HEI, area, of

study, gender, level of program of study, level of mathematical ability/prior performance and as a covert dimension the level of mathematical confidence/self-efficacy) and that these dimensions will impact on the student experience to varying extents. Whilst this complexity of respondent profile is important to be aware of in considering the results from the survey and any implications drawn from them, nevertheless the unifying aspect that all the respondents were first year service mathematics students responding to MLS services which they will have had no experience of prior to college has led to some insights that may be of benefit in the provision of such MLS services. As noted earlier in the report, some of the research outcomes from this survey are also available in Ní Fhloinn et al. (2014); Mac an Bhaird et al. (2013); Fitzmaurice et al. (to appear), see Appendix C for details.

Finally, a word of caution for anyone considering conducting a large scale paper-based survey. While we are very thankful for the funding we received, the analysis of the results and the production of this report have been extremely time-consuming for the authors and editors. The committee of the IMLSN volunteer their time in the interests of MLS and the wider community. Ideally, any future project would have proper funding which would enable people to be dedicated to it on a full-time basis. In particular, this would allow a much faster turn-around between the planning, implementation, analysis and reporting parts of the project. We recommend that:

> *A further large scale cross-institutional study of student evaluation of MLS be conducted within a structure that enables the data collection and analysis of the survey to be completed* expeditiously.

MLS – Reach and Impact

Firstly, it is clear from the survey responses that MLS services are used by a significant proportion of students as 36% of the participants indicated that they had used MLS. A further 31% of respondents indicated that they did not avail of MLS as they did not need the help and the remaining 33% cited other reasons for not using MLS. This indicates that in the HEIs in question, MLS has a significant reach as it is being used by approximately one third of the respondents whilst approximately another one third may need the services but are not engaging currently with them. Also in terms of the reach of MLS it is of note that results in this survey challenge the common misconception that MLS is only relevant to weaker students. The relationship between prior mathematical attainment and use or non-use of MLS was revealed in the study to be more subtle than might have been expected. On the one hand, the majority of students who availed of MLS had OL or lower mathematics (see Table 28), whilst almost 40% of students who did not avail of MLS had completed HL LC mathematics and an additional 15.3% of non-users had achieved an OL A. On the other hand, 25% of students who availed of MLS also had HL mathematics. Also, while 21% of students indicated that they had first engaged with MLS to seek extra help in general, a further 16% of users indicated that they had accessed MLS to improve or gain a better understanding of underlying mathematical concepts. It is clear that students with a broad range of mathematical backgrounds are availing of the opportunities that MLS provides them to become active independent learners.

One indication of the impact of MLS are ratings given by students for the services of which they have availed. Students rated the four types of MLS services (Drop-In Centre, Topical or Examination Revision Workshops, Support Tutorials and ICT enabled Supports) positively (see Section 3.2.2). The three services which involved 'face-to-face' interaction between a student and a member of MLS staff were the most positively endorsed with approximately 80% of respondents who had rated them indicating that they were worthwhile. These positive ratings were reinforced by student comments which were also overwhelmingly positive in nature about these three types of face-to-face support.

In addition, the results of this survey strongly indicate that students not only rated the MLS services positively but also identify MLS as having a positive impact on their mathematical experience. Three questions from the survey related to student perception of the impact of MLS upon their confidence in

mathematics, their performance in mathematics, and their ability to cope with mathematical demands of their course. (As noted previously it is acknowledged that this is self-reported data based on students' perception of this impact and that in addition these questions were applicable only to students who had used the MLS in their institution, a total of 587 of the 1633 respondents.) As observed by Green & Croft: *'When investigating the impact of a service to students, such as mathematics and statistics support, there is the danger of confusing impact with student satisfaction'* (Green & Croft, 2012, p3). However as Green & Croft also observed *'Finding out what perceived benefits visiting a centre brings is clearly important – getting much closer to "impact" than just asking why the student came or what resources were used'* (Green & Croft, 2012, p9), and so we structured the questionnaire and its subsequent analysis to enable some insights of the impact of MLS to emerge. By asking specifically about these "perceived benefits" and subsequently analysing the open-ended responses given to the questions, key themes that emerged in each area were identified. It is clear from Section 3.2.3, that the majority of students who used MLS perceived that it had a positive effect on their mathematical confidence, performance and ability to cope with the mathematical demands of their course. In addition, several categories overlapped in students' additional comments about these three aspects. The helpfulness of MLS emerged as a category in responses in all three aspects whilst the fact that students felt their understanding improved; that it was useful for examinations and assignments; and the fact that some students felt they had not used the service enough emerged as common categories in responses given regarding both mathematical confidence and performance. This overlap in categories is not unexpected, given the prior work done by Parsons et al. (2009) showing a link between increased confidence and improved performance. In addition, it is worth noting that over 75% of students who answered positively for one of these three questions also answered positively for the other two. Therefore it is clear that users of MLS in this survey were extremely positive about their perception of the impact of MLS upon their confidence and performance in mathematics, and their ability to cope with mathematical demands of their course.

Another indication of the impact of MLS is the degree to which it plays a role in the retention of students who might be considering leaving their course due to difficulties with mathematics. 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. and Green and Croft observe that *"(p)roving irrefutably that support has prevented drop-out (usually through averting failure) is very difficult to achieve"* (Green & Croft, 2012, p13). However, by asking students mid-way through their first year, we found that more than a fifth of respondents reported that they had considered dropping out of their course due to mathematical difficulties at this point. Many cited the overall difficulty of the subject as well as its time-consuming nature. Fear of failure also came through as a strong concern for these students. This aligns with the results from other research, e.g. a major study on retention in the U.K. (Yorke & Longden, 2008) in which *"concern about their study skills", "feelings of not making adequate academic progress"* and *"failure of assessments"* were all cited as significant issues for students who dropped out in the period after Christmas of first year. It is striking that twelve students in our study volunteered the information that, as a direct result of the effectiveness of MLS for them, they did not consider dropping out, suggesting that without support, the overall number of respondents thinking of dropping out would be notably higher. It is also encouraging to observe that over 60% of respondents who had considered dropping out felt that MLS had influenced their decision to stay on their course: *"It was a very valuable experience, whereby without it I would have certainly failed"; "Keep it up guys, we need you!"; "I've had a fear of maths all my life so with MLC help I've become more confident"; "Excellent service – my bible".* Despite the difficulty of evaluating the many factors that impact upon student retention, this is a positive indicator that the students themselves identify MLS as an important lifeline during their vulnerable initial months in Higher Education and the findings from this study indicate a high level of satisfaction with the services provided by MLSCs surveyed.

Arising from this discussion of the considerable influence of MLS, the positive students' endorsement of MLS services and the positive impact of MLS which students across a spectrum of abilities reported in this study, we recommend that:

> *MLS should be embedded as a permanent fixture in every HEI in the country and should be properly resourced in order to ensure the best mathematical experience for all students.*
>
> *The positive contribution of MLS, both in terms of student transition and retention and improved student confidence in their mathematical ability and a more positive student attitude towards mathematics as a subject, should be made clear to both new first year students to encourage them to engage with MLS and also to HEI authorities to highlight the benefit in terms of student retention from a financial perspective.*

Optimising Engagement with MLS

In this section insights from the report which may help to optimize the benefits of MLS to students are discussed.

The common theme which emerges from the feedback about the MLS services is that the quality of the one-to-one interaction and the staff involved in MLS service provision are crucial. This is not surprising and it agrees with previous research, for example Gill (2006), who states that the one-to-one attention students receive in Drop-In Centres is most highly favoured. More generally, one-to-one interaction has been demonstrated to play an important role in mathematics learning as it allows for intense interaction between teacher and student (LaCroix, 2010). Therefore, the quality of the staff is crucial to the success of MLS (Lawson, et al., 2003) and in particular in relation to the education of Mature Students (FitzSimons & Godden, 2000). Lawson (2008) states that in addition to providing MLS, students attend MLSCs precisely because staff offer emotional support to students who suffer from mathematics anxiety. Cordner & Trussler (2005), FitzSimons & Godden (2000) and Safford (1994) recommend the provision of this warm supportive environment in which individual needs are met. So the crucial role of the quality of tutors in students' experience of MLS is clearly stated in the literature and highlighted again in the evaluations of the services in this survey. We recommend that:

> *Priority should be given by staff in charge of MLS to the bespoke training and development of their MLS staff*.

The IMLSN is developing strategies and resources (including collating existing appropriate materials) to enable providers of MLS to further improve the quality of tutor training and also to augment the available pool of appropriate and experienced tutors by means of a tutor internship scheme for suitably qualified candidates. This will be described in the Future Work section of this chapter.

As outlined earlier, the one third of the respondents who availed of MLS found it to have a positive impact, one third were not engaging because they felt they did not need to and approximately another one third may have needed the services but were not engaging with them. Therefore, we were interested in any insights that would emerge from analysis of the survey data that would lead to these students availing of MLS. In the first instance, there is the very practical issue of accessing MLS either in a 'face-to face' or virtual manner. 28.8% of students who had not engaged with MLS indicated that the times MLS was provided did not suit them. Furthermore, when non-users were asked to indicate what would encourage them to avail of MLS, 17% of 667 responses indicated that more suitable opening hours would encourage them. We feel that this should be a source of reflection for providers of MLS. While we acknowledge that the extension of staffing and resources can prove difficult in an era when budget cuts are commonplace, the significant proportion of such responses in this survey leads us to recommend that:

A re-alignment of opening hours (e.g. early morning/ lunch–time, evening) may be necessary in individual HEIs to meet the needs of a significant cohort of students[5].

The alternative to 'face-to-face' supports is virtual or ICT enabled Supports (e.g. online support/website, email questions service, CALMAT). These types of services were available in some configuration in 8 out of 9 HEIs surveyed, but they were less positively endorsed than 'face-to-face' services (only 56% of the students rated them as worthwhile, while 19% indicated they were not worthwhile). However, the additional student comments on these ICT enabled Supports provide interesting insights. The largest proportion of comments expressed satisfaction with the ICT enabled Supports provided but 28% of the comments indicated that students had difficulty accessing and using the services provided. 12.5% of the comments highlighted that some students much prefer 'human' help with mathematics, with a further 9% commenting on issues related to the extra time it requires to engage with online materials. Given that ICT enabled Supports play an increasing role in MLS services, the rating and comments would suggest that issues regarding the digital literacy skills of students and the practical issues of accessing the online materials/services provided require further consideration if these services are to be of maximum benefit to students. We recommend that:

Further investigation be undertaken to explore how MLS providers can enhance the online resources and services available to students, and increase student awareness of and improve student accessibility to these ICT enabled Supports.

A key challenge facing practitioners in MLS is improving the engagement of students who need help but are not using MLS, and in particular, how to encourage them to do so. As we have highlighted already, it is important that students are made aware of the potential positive impact that availing of MLS can have on them, in terms of their grades, their progression, an increase in their mathematical confidence etc. In the 2014 report on a series of studies on the mathematical and statistical needs of undergraduate students across seven discipline areas for the UK Higher Education Academy, Hodgen et al. (2014) reported that "*Many universities provide support in Mathematics and Statistics at institutional level but too few students make use of it*". They went on to make a recommendation that "*Teaching staff should be made aware of the additional support in Mathematics and Statistics that is available to students. Students should be actively encouraged to make use of these resources and opportunities*" (Hodgen et al., 2014). This report also found that "*Diagnostic testing linked to purposeful interventions can be an effective tool but it is not widely used in the disciplines*" and recommended that "*University staff should consider the benefits of diagnostic testing of students' mathematical and statistical knowledge and skills at the start of degree programmes, and of using the results to inform feedback and other follow-up actions*". Therefore we recommend that:

There should be an increased collaboration between those teaching mathematics in HEIs and those providing MLS.

One practical demonstration of this collaboration would be to ensure that students are made aware of MLS as soon as possible after they enter their HEI, particularly in a way that communicates that accessing MLS is a key element of students' initial mathematical learning in HE and in their development as HE learners who take active responsibility for their own learning. On this basis we recommend that:

The positive value of using MLS services is communicated clearly to incoming to first year students as part of their induction and their first mathematics lectures.

The results from this study and results from other retention research suggest a further avenue in which this increased collaboration might be achieved. In our survey, users of MLS were asked what first

[5] : In one of the HEIs which participated in this survey, the timing of the MLS sessions were adjusted due to student feedback, resulting in increased levels of engagement. This highlights the importance of regular and appropriate evaluation of MLS for establishing best practice.

provided a prompt for them to avail of MLS and 41% of comments indicated that they were seeking help with upcoming assessments such as assignments or examinations. The importance of early engagement for students in HE as a key avenue to ensuring student retention is a well-established concept, see for example Felder (1995) and Tinto (2006). Thus, given this high response rate, our second practical recommendation regarding increased collaboration between MLS and first year mathematics lecturers is that:

> *Staff undertaking the delivery of first year mathematics modules might benefit from implementing an assessment strategy that involved at least some element of assigned work or short test that occurs very early in the module, and continues regularly throughout the semester.*

This approach might be effective in prompting students to work independently and to seek to use the MLS services to support this independent study. Indeed, several MLSCs which have high engagement levels are in HEIs where students have compulsory weekly assignments. It is important to note that in these HEIs, students are made aware that the MLSC will not complete their assignment for them, but they consider students' initial attempts, discuss strategy, and advise on related material from notes etc.

The measures outlined above, based on current best practice, should increase appropriate student engagement. However, they will not encourage all students, in particular weaker students, to avail of MLS. A common finding of research on student non-engagement is that fear of embarrassment or mathematics anxiety can dissuade learners from attending MLSCs (Lawson, 2008) or impact unfavourably on engagement with and performance in mathematics (Ashcraft, 2002; Bibby, 2002), even resulting in many students avoiding contact with the subject altogether (Ashcraft and Moore, 2009). In a study carried out at NUI Maynooth, fear was the main category which emerged in traditional student feedback on their lack of engagement with mathematics learning supports (Grehan et al., 2011). Although being afraid or embarrassed to go was mentioned in only 11.6% of responses by students in this study as why they had not engaged with MLS, it should also be noted that the weaker the mathematical background of the non-engaging student, the more likely they were to give reasons which were to do with the structures of MLS (lack of information or suggestions on how specific services could be provided) for not availing of MLS. In tandem with this, the weaker the mathematical background of the student the more likely they were to make suggestions about MLS structures when asked what would encourage them to engage with MLS, while the stronger the mathematical background of students, the more likely they were to say that they would avail of help if needed. Symonds (2008) postulated that because at-risk students were unwilling to attend a Drop-In Centre that a more proactive approach might have worked better with such students. So, while it is difficult to generalise at this stage, there appear to be some issues with how MLSCs are advertising their services to students, particularly to the weaker students. These issues (and others) are dealt with extensively in the 2012 **sigma** report on setting up MLSCs (Mac an Bhaird & Lawson, 2012), with a section on how different types of MLS should be publicized. We recommend that:

> *The recommendations regarding promotion of MLS in this report should be considered for implementation in the Irish context and suggest that investing resources in extensive and more 'sensitive' advertising and promotion of MLS could be of significant benefit.*

A key insight that this survey has revealed is that there were significant differences in attendance between male and female respondents. Overall, 35.9% of respondents had made use of the MLS available within their own institution. When broken down by gender, 45.1% of females as against only 29.5% of males had availed of MLS, and there was a significant association between gender and the use of MLS (chi-square=41.884, 1df, $p<0.001$). The analysis of differences in usage of MLS along gender lines has shown some interesting results, namely that females with a similar mathematical backgrounds and studying the same subject areas as male students are more likely to avail of MLS. Females are far more likely to cite upcoming examinations as a reason for using MLS, but less likely to cite these as an incentive to attend if they have not done so before. While equal numbers of males and females cited the unsuitability of the timetabling of MLS as a reason for non-attendance, twice as many females as males

felt that more suitable times would make them more likely to attend. Importantly, among those who attend MLS, there is no gender disparity in terms of the level of help they perceive they obtain as a result. It is undoubtedly complex to attempt to ascertain the real reasons behind male and female students' engagement with support services and based on the results of this survey we would recommend that:

> *The area of gender and engagement with MLS would benefit from further research to explore the issue more deeply and to ascertain further insights that may be of benefit to the optimal provision of MLS to all genders.*

There is a stated policy aim of increasing Mature Student participation in HE from 15% to 25% over the next 10 to 15 years (HEA, 2011) and so the issue of providing high quality MLS to this student cohort is of particular significance. Mature Students made up 13.5% of the survey participants and this is in line with the proportion of Mature Students nationally in the year of the survey (15%). Mature Students might be expected to avail of MLS because they may not have studied mathematics in any formal sense for a long time leading to gaps in knowledge due to forgotten or perhaps never learned material. However, they have also made a focused active decision to engage with a particular higher level education course and so might be expected to seek to address these gaps using whatever resources are available. Safford (1994, p50) supports this view stating that while Mature Students may carry 'intellectual baggage', they are generally self-directed and making the decision to return to education implies a motivation for change and growth. In this study 61.5% of Mature Students availed of MLS with another 17% stating that they did not need help, and the remaining Mature Students citing other reasons for not availing of MLS. The engagement of Mature Students with MLS in this study provided interesting contrasts with that of traditional students. This MLS usage figure for Mature Students is in contrast to the 32.2% figure for traditional students and there is a statistically significant association between the type of student and use of MLS (chi-square test, $p<0.001$). The higher proportion usage of MLS by Mature Students noted in this study coupled with the stated policy aim of increasing Mature Student participation in HE will undoubtedly lead to increased demand for MLS. Therefore we recommend that:

> *Adequate additional MLS services should be provided for as part of a learning infrastructure for the planned expansion of the Mature Student population in HE*.

Another key aspect that emerged from this study is the difference between the prompts for first using MLS reported by Mature and traditional students. For Mature Students, seeking extra help and concerns about their underlying mathematical background/ability far outweighed the response of seeking help with upcoming assessments which was the main prompt in comments from the overall group. In contrast to traditional student respondents, Mature Students respondents appear to engage with MLS when they need it. The gap in their mathematical knowledge seems to act as an impetus rather than an obstacle for the Mature Students in this study to engage with support: *"As I have been out of the education system for many years I felt I needed the extra support"*. Wolfgang and Dowling (1981) may partially explain this finding as they maintain that traditional learners and Mature Students have different motivations and different approaches to study. It appears that the nature of these self-directed learners is to face their challenges and fears head on, and MLS is helping them do so. We recommend that:

> *The differences in motivation for availing of MLS should be highlighted in the training of MLS staff so as to enhance the learning experience of Mature Students.*

In terms of prior educational achievement, the relationship between the switching of Leaving Certificate (LC) levels and the use of MLS also emerged as an important outcome in this study. A large proportion of respondents in the survey (37%) had switched from HL to OL LC mathematics. There is a statistically significant association (chi-square test, $p=0.03$) between switching from HL to OL and availing of MLS. In addition, for students who stated that they did not engage with MLS as they did not feel they needed the help, the later they made the change the less likely they were to say that they required help (Monte Carlo test, $p=0.005$). However, since this survey was conducted, two major structural changes have occurred

which have impacted on the prior educational achievement in mathematics for students now entering HE. Firstly, there have been significant changes to the second level curriculum in mathematics in the Republic of Ireland with the introduction of 'Project Mathematics'. Secondly, to incentivise the uptake of HL mathematics in the LC, an extra 25 LC Central Application Office (CAO) points is now allocated to all students who pass LC HL mathematics. These changes have coincided with the proportion of candidates taking HL mathematics in the LC increasing from less than one in every 6 in 2010, to more than one in every 4 in 2014, (www.examinations.ie). Therefore, given the positive association between switching from HL to OL and availing of MLS and the changes that have taken place recently at second level in mathematics we recommend that:

> *Future studies in the area of MLS consider any changes to the patterns of switching between mathematics Leaving Certificate levels and also the impact of having higher proportions of students completing Higher Level Leaving Certificate mathematics.*

5.2 Recommendations

- MLS should be embedded as a permanent fixture in every HEI in the country and should be properly resourced in order to ensure the best mathematical experience for all students.
- Evidence of the positive contribution of MLS in terms of student transition and retention should be widely disseminated to HEI authorities to highlight the benefit from a financial perspective.
- Evidence of the positive contribution of MLS in terms of both student transition and retention, and improved student confidence in their mathematical ability and a more positive student attitude towards mathematics as a subject, should be communicated to incoming first year students in order to encourage engagement with MLS.
- Evidence that MLS services were used by one third of the first year students in this study with another one third possibly needing them should be communicated to incoming first year students to promote the accessing of MLS services as a key element of taking active responsibility for their own learning mathematical learning in HE.
- MLS providers should consider more extensive and innovative promotion of MLS to students using best international practice.
- Re-alignment of hours when MLS is provided should be considered to meet the needs of a significant cohort of students.
- There should be an increased collaboration between those teaching first year mathematics in HEIs and those providing MLS.
- First year mathematics modules should have an element of continuous assessment scheduled to occur very early in the module.
- Priority should be given to bespoke training and development of all MLS staff to ensure the optimal student experience.
- Digital literacy skills of students and practical issues of accessing online materials/service require further consideration in MLS to be of maximum benefit to students.
- Adequate MLS provision should be put in place as part of the learning infrastructure for the expanding population of mature students entering HEIs.

- The stark differences in motivation for availing of support should be highlighted in the training of MLS staff so as to enhance the learning experience of Mature Students.

- HE and the MLS community should be prepared for the high levels of Mature Student engagement. This trend will have resource implications when coupled with stated national policy objectives to increase the numbers of Mature Students in HE.

- Further research should be undertaken in the area of gender and engagement with MLS to explore the issue more deeply and ascertain further insights in order to provide the optimal MLS service to all users.

- The questionnaire used in this study should be used as a standard template in HEIs to facilitate easy comparison of data from each institution in future collaborative work.

- Any future study in this area should consider the impact of a higher proportion of students completing HL LC Mathematics and the patterns of switching LC levels in mathematics, due to changes in the second level curriculum and LC points allocation for HL mathematics.

- A further large scale cross-institutional study of student evaluation of MLS be carried out within a structure that enables the data collection and analysis of the survey to be completed expeditiously.

5.3 Future Work

Currently the IMLSN is involved in a number of collaborative projects for the mutual benefit of practitioners of MLS on the island of Ireland and further afield. Indeed this is the remit of the IMLSN and one of the main reasons that it was established, to help share resources and ideas, based on the very successful **sigma**-network model in the UK (http://www.sigma-network.ac.uk/). The 2013 **sigma** report highlights the importance and benefits of such a network:

> *'There is a massive benefit to the HE sector in the existence of a network of mathematics support practitioners. With so many HEIs having only recently established mathematics support provision, there is a real need for inexperienced colleagues to be able to draw on the expertise of colleagues from other institutions. There are also major efficiencies to be gained through adopting good practice and resources already developed and through such activities as shared training and staff development events.'* (Fletcher, 2013, p49-50).

The projects we are currently working on include:

- Continued analysis and dissemination of data from the student evaluation:

The wealth of data that has been generated from the large scale survey is continuing to be analysed and should generate several more insights and recommendations. Part of the future work in mining the data from the survey is to continue with the Grounded Theory analysis of responses to see if further patterns and subcategories emerge, and also to break down the comments and recommendations based on the type of HEI attended, to get a clearer picture of what is going on in each individual HEI. We also believe that this report can be used by the wider MLS community to highlight (to both their students and institutional colleagues) the benefits that MLS can provide.

- Addressing issues related to staff recruitment and training:

One of the main issues impacting on the majority of individuals involved in the provision of MLS is securing suitable levels of staffing. This is usually connected to the level of funding available within individual HEIs. While we have made this point previously, we emphasise again that it is crucial that the

benefits of MLS to an individual HEI is imparted to the people who have financial control. We hope that the results from this report can be used to assist in this discussion. Apart from the benefits to students' learning and understanding, it very important to make clear that the provision of MLS is, based on anecdotal evidence, extremely cost effective. According to the 2012 **sigma** report:

> '*There is also evidence which suggests that mathematics support also contributes to improved retention and progression rates, and though this is much harder to prove, institutions lose money for each student that drops out, so if support saves only a few such students then it will pay for itself*.' (Mac an Bhaird & Lawson, 2012, p 28).

Securing appropriate funding and subsequent adequate staffing levels is a very good start. However, as emphasised by the importance given by the students in their evaluation of MLS services in this study to one to one interactions which are at the core of MLS, you also need the right staff and they need appropriate training.

> '*The people who staff a centre are undoubtedly a key resource and are highly influential in the success (or otherwise) of the centre… Not all members of academic staff are well-suited to working in a* [MLSC]*. The key point made was that building students' confidence is of huge importance. This requires staff who are patient and accepting. If a student visits the* [MLSC] *and goes away with the impression that their questions were regarded as stupid or trivial then they are unlikely to return for further help*.' Lawson et al. (2003, p12).

To try and address these issues we are in the process of:

- Developing and disseminating templates for tutor training sessions:

IMLSN committee members are currently (Autumn 2014) developing four template tutor training sessions which will be available from the IMLSN website during the 2014-15 academic year. These sessions bring together materials used in existing training sessions, including expert materials from **sigma** and other organisations in the UK and Ireland. They will be freely available for any practitioner of MLS to use as they deem appropriate for their own staff.

- Discussions on a trial second level teacher internship programme.

We are also in the early stages of discussions about the possibility of an internship programme for qualified second level teachers of mathematics who are out of work. The proposed scheme would enable teachers to get experience and share their expertise in the provision of MLS initiatives in HEIs.

In terms of other long-term projects, these will be dictated by the needs of members of the wider MLS community in Ireland. There is interest in investigating the impact on MLS on student learning, and enhancing the teaching and learning experience through increased collaboration and scholarship. It is important that we ensure that as a community we are taking advantage of students' digital learning capacity. In the near future, members of the IMLSN will undertake work in this area. Work planned includes the following:

- Conducting a survey of digital resources in use across both the MLS and wider mathematical communities.
- Investigating how best to improve the digital literacy of students in the context of MLS.
- Stream lining access for students to online resources.
- Increasing collaboration across the network on issues of digital resource sourcing and development.

The outcomes of this survey highlight both the importance and benefit of increased large scale collaborative work in Ireland and internationally. There is certainly scope for further large scale surveys.

For example, in our survey, responses mentioned fear or embarrassment and issues of personal motivation, which though these are low in this survey, require further investigation as they are a major factor in other studies (Grehan, 2013; Hannula 2006). In our survey, we also looked at the student cohort in terms of gender and Mature Student status. The richness of the insights that emerged from the analysis of these groupings would suggest that future work should also consider analyzing the MLS engagement of students who have entered HE through the HEAR (Higher Education Access Route) and DARE (Disability Access Route to Education) routes.

In the immediate future we hope to work closely with organizations in Ireland, e.g. The National Forum for the Enhancement of Teaching and Learning in Higher Education (http://teachingandlearning.ie/) and the National Centre for Excellence in Mathematics and Science Teaching and Learning (www.nce-mstl.ie) and to continue to collaborate with our colleagues in the UK, e.g. **sigma**, on various projects. Consistent and significant funding of a network for MLS makes sense, it benefits everyone, and we aspire towards the **sigma** model which receives significant funding in the UK. According to Lawson et al. (2012), 'the need for mathematics support remains and is highly unlikely to disappear in the foreseeable future'.

The implementation of this survey and the subsequent analysis of the data have been a significant achievement and give a good insight into the health of MLS in Ireland. Ultimately, to borrow a phrase from **sigma**, there can only be one winner as a result of the success of MLS, the students who avail of it appropriately. In our survey, as indeed in other smaller qualitative and quantitative evaluations, students are overwhelmingly positive about the MLS provided to them.

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Appendix A: 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

4. Leaving Certificate Mathematics Grade (if applicable):

   Leaving Cert 1991 or before: A B C D E Other

   1992 or after: A1 A2 B1 B2 B3 C1 C2 C3 D1 D2 D3 Other

5. 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 N/A

6. Are you registered as a mature student? **Yes No**

7. 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)

9. Why did you first decide to use the MLSC or its services?

10. 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:

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

Yes **No**

Comments:

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

Yes **No**

Comments:

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

1 **2** **3** **4** **5**

Comments:

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:

15. 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)

16. 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:

17 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!

Appendix B: Glossary of abbreviations.

AISHE: All Ireland Society for Higher Education

CAO: Central Applications Office

DARE: Disability Access Route to Education

DCU: Dublin City University,

FL: Foundation Level

GIA: Grounded Inductive Analysis

HEA: Higher Education Authority

HEAR: Higher Education Access Route

HEI: Higher Education Institute

HL: Higher Level

ICT: Information Communication Technology

IMLSN: Irish Mathematics Learning Support Network

IoT: Institute of Technology

IT Carlow: Institute of Technology Carlow

IT Tallaght: Institute of Technology Tallaght

IT Blanchardstown: Institute of Technology Blanchardstown

IT Tralee: Institute of Technology Tralee

LC: Leaving Certificate

MLS: Mathematics Learning Support

MLSC: Mathematics Learning Support Centre

NCE-MSTL: National Centre for Excellence in Mathematics and Science Teaching and Learning

NDLR: National Learning Digital Repository

NUIG: National University of Ireland Galway

NUIM: National University of Ireland Maynooth

OL: Ordinary Level

QUB: Queen's University Belfast

sigma: The Centre of Excellence in Mathematics and Statistics Support

SPSS: Statistical Package for the Social Sciences

UCD: University College Dublin

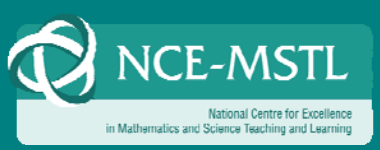
UL: University of Limerick

Appendix C: Details of publications containing prior dissemination of data and analysis contained in this report.

Paper Title	Student non-engagement with mathematics learning supports.
Publication	*Teaching Mathematics and its Applications*
Publisher	Oxford University Press
Published in Issue	32: pages 191-205.
URL	http://teamat.oxfordjournals.org/content/32/4/191.abstract
Authors	Mac an Bhaird, C., Fitzmaurice, O., Ní Fhloinn, E. and O'Sullivan, C.
Tables	
	Table 22
	Table 35
	Table 37
	Table 38
	Table 39
Text	
	Section 1.1
	Section 3.3.1
	Section 3.3.2.1
	Section 4.2.1
	Section 4.2.2
	Section 4.2.3

Paper Title	Student perception of the impact of mathematics support in higher education.
Publication	*International Journal of Mathematical Education in Science and Technology*
Publisher	Taylor & Francis
Published in Issue	DOI: 10.1080/0020739X.2014.892161
URL	http://www.tandfonline.com/doi/abs/10.1080/0020739X.2014.892161#.VD0O3vldWSo
Authors	Ní Fhloinn, E., Fitzmaurice, O., Mac an Bhaird, C. and O'Sullivan, C.
Figures	
	Figure 5
	Figure 6
	Figure 7
Text	
	Section 3.2.4.1
	Section 3.2.4.2
	Section 3.2.4.3
	Section 3.2.5
	Section 3.2.6

Paper Title	Adult Learners and Mathematics Learning Support
Publication Name	*Adults Learning Mathematics – An International Journal*
Publisher	ALM
Submitted for publication	20th June 2014
Authors	Fitzmaurice, O., Mac an Bhaird, C., Ní Fhloinn, E and O'Sullivan, C.
Tables	
	Table 44
	Table 45
	Table 46
Text	
	Section 4.4.1
	Section 4.4.2.1
	Section 4.4.2.2
	Section 4.4.2.3
	Section 4.4.2.4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