

# Justifying the Existence of Mathematics Learning Support

## Measuring the Effectiveness of a Mathematics Learning Centre

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*The Mathematics Learning Centre (MLC) is an essential part of the Mathematics Teaching role of the Mathematics and Statistics Department as it makes a major contribution to discipline-based learner support at the University of Limerick (UL). The aim of the Centre is to strengthen the teaching function of the Mathematics and Statistics Department across the University. The MLC incorporates support services for all students, and adult learners in particular, studying mathematics across the university. These services impact positively on all Colleges in UL and include: Drop-in centre, Diagnostic testing, Individual consultation, Additional tutorial support, Computer-based tutorials, Supervised study, Access to special resources, exam preparation, On-line support. Since the Centre was established its services have impacted on in excess of 5000 UL students and this figure is expected to rise in the coming years. It can be difficult to quantify the effectiveness of such a resource as student success may be attributed to other factors such as student maturity, peer learning, students getting used to college life, good teaching etc. In this paper the authors look at various ways of measuring the success of such a mechanism and the facilities it provides.*

### Introduction

In October 2001, the University of Limerick's (UL) Mathematics Learning Centre (MLC) opened. The Centre carries out diagnostic testing and uses the results to identify and inform those students who would need supplementary help to complete first year successfully. Support tutorials are set up and taught on a weekly basis in addition to regular tutorials. Due to the high number of mature students/adult learners present, a special tutorial is also run for these students in each group (Science Mathematics, Technological Mathematics and more recently Engineering Mathematics, Business Mathematics and Mathematics for Access students) in

addition to the classes for the other students. The Drop-In Centre provides free one-to-one consultations and is open to everyone for four hours a day, five days a week. It is staffed by a director, a full time manager and 10 postgraduate mathematics students who are available for drop-in consultations. The staff are experienced and highly motivated which makes for an informal, non-judgemental atmosphere (Lawson, Croft and Halpin, 2001). In addition the MLC has a website with online support for all students who study mathematics in UL.

It is hard to gauge the success of such an establishment (Lawson et al, 2001) but it has proved very popular with students from all different faculties e.g. Colleges of Business, Education, Engineering, Science and Informatics and Electronics. In the following sections the authors discuss the positive features and outcomes of such a structure and how they can help justify the existence of such an enterprise for all students including mature learners.

### **Adults learning mathematics at UL**

The proportion of adults studying at UL has increased steadily every year for the past number of years and this is in line with university strategic goals. The UL Mathematics Learning Centre is a key selling point in the recruitment of adults since almost all of the degree programmes in UL require students to study mathematics for at least one semester. Consequently the learning centre has an adult learning focus and promotes mathematics learning through a self help model that integrates faculty, students and ICT support.

The centre makes a special effort to offer appropriate support to mature students on service mathematics modules. This involves mounting special support tutorials for small groups of mature student learners which are designed to shadow existing programme provision. The centre has pioneered research into methodologies for teaching advanced mathematics to adult learners that includes the use of small groups and topic maps (Golding, 2006). The centre has also designed mathematics courses for special groups of adult learners e.g. access courses for disadvantaged groups and certificate courses for women into science and technology.

The main thrust of our efforts on behalf of adult mathematics learners has been directed towards:

1. providing a safe and welcoming learning environment
2. locating/designing appropriate learning materials
3. developing appropriate teaching methodologies
4. providing out of hours ICT support.

The general methodological approach employed at the centre is to concentrate on developing self directed learners. This approach is underpinned by a development model of self directed learning based on a staged process (Grows, 1991).

The centre is familiar with the work of other authors which it finds useful in its work with adults especially in relation to methodological issues. This includes the work of Miller-Reilly (2006), particularly her work on connected learning; Benn's (1997) work on empowerment and critical education and FitzSimons (2002) work on curriculum.

### **Metrics for measuring success**

The authors suggest a number of 'success factors' which may be used for measuring success including:

- Student numbers/uptake
- Department and College Participation
- Independent reviews
- External department reviews
- Retention/grades
- Research output
- Development & expansion
- Associated projects
- Links with other MLC's

### ***Student numbers/uptake***

One of the key success factors of any learning support facility is student attendance (Lawson et al, 2001). The UL MLC keeps records of student attendances by means of



a sign in register. Each student who attends the centre or a support tutorial signs a book stating the date, their name, student identification number, degree programme and mathematics module they are seeking help with. This information is transferred to an excel spreadsheet where statistics of student attendance can be recorded.

The numbers of students in attendance at the UL MLC is indicative of a much valued and needed resource. Table 1 shows the increase in the numbers of students attending the MLC since it opened in 2001. In the first year of operation (2001/02) there was a total of 3353 attendances at the drop-in centre and support tutorials. In 2005/06, this number increased to a total of 6013 contacts.

**Table 1. Student attendance at the MLC**

	Autumn 01/02	Spring 01/02	Autumn 02/03	Spring 02/03	Autumn 03/04	Spring 03/04	Autumn 04/05	Spring 04/05	Autumn 05/06	Spring 05/06
No. of individual students availing of support services	279	388	600	490	698	919	1011	1308	988	1408
No. of support Service contacts	1432	1921	1592	1293	2093	2878	2457	2757	2984	3029
No. of support tutorials provided	140	110	*	*	85	121	134	132	122	146
Total no. of Degree programmes serviced	23	23	24	31	44	30#	27	31	37	29

- \* Unknown
- # Approximately

The enhancement of the mathematics education of adult learners is one of the main priorities of the MLC. These students are a welcome addition to the MLC and one that has been increasing in numbers in the past few years. Fifty-one mature students were admitted to first year undergraduate programmes in 1999-2000 and this number rose to 155 in 2004-5. A total of 474 mature students were registered in UL in 2004-05 (Callaghan, 2005). Almost all UL degree programmes (with the exception of humanities) have a mathematics element so most adult learners will study mathematics and/or statistics at some point during their studies. Special support tutorials are provided for mature students in all of the main service mathematics courses in addition to tutorials for traditional age students.



In the academic year 2005/06, the MLC provided a total of 118 support tutorials for adult learners of mathematics. A total of 909 attendances were made at these tutorials by 143 individual mature/access students (see Table 2).

**Table 2. Mature students attendance at support tutorials**

<b>SEMESTER 1</b>			
<b>MATH MODULE</b>	<b>NO. OF STUDENTS</b>	<b>NO. OF TUTORIALS</b>	<b>NO. OF ATTENDANCES</b>
MA2121 (ACCESS)	14	9	47
MA4001 MATURE	15	10	87
MA4003 MATURE	13	8	34
MA4601 MATURE	18	10	112
MA4701 MATURE	21	10	153
<b>TOTAL</b>	<b>81</b>	<b>47</b>	<b>433</b>
<b>SEMESTER 2</b>			
<b>MATH MODULE</b>	<b>NO. OF STUDENTS</b>	<b>NO. OF TUTORIALS</b>	<b>NO. OF ATTENDANCES</b>
MA4002 MATURE	15	12	85
MA4104 MATURE	15	8	61
MA4702 MATURE	19	10	58
MA4602 MATURE	14	10	88
MA2122/ MA2302 ACCESS	10	20	71
MA4006 MATURE	30	10	113
<b>TOTAL</b>	<b>103</b>	<b>71</b>	<b>476</b>
<b>TOTAL FOR 2005/06</b>			
	<b>143</b>	<b>118</b>	<b>909</b>

The sign in register for the MLC does not ask students to state if they are adult learners or not so there is no definitive number for mature students who attend the drop in centre.

Lawson et al (2001) suggest the counting of return visits as a measure of the success of a learning support centre. If a student attends more than once, this would imply they are satisfied with the service received on a prior visit and so would indicate that the facility was effective or at least had a positive effect on student learning. In the academic year 2005/06, 21% percent of the students who attended the drop-in centre attended more than once (a large proportion of students who attended once are those that attended for examination revision programmes the week before the examinations started).

### *Department and College participation*

Another way of measuring the success of a learning support centre is by counting the number of university departments and colleges the facility services. The MLC services over 18 departments in the university and all the UL colleges (Table 3).

**Table 3 UL departments and colleges serviced by MLC**

UL DEPARTMENTS	AUTUMN 03/04	SPRING 03/04	AUTUMN 04/05	SPRING 04/05	AUTUMN 05/06	SPRING 05/06	AUTUMN 06/07
Access	19	30	13	21	8	13	13
Chemical & Environmental Sciences	23	63	21	4	46	72	61
Computer Science & Information Systems	43	17	34	2	5	15	35
Electronic & Computer Engineering	92	53	100	11	60	61	45
History	0	1	0	2	0	7	0
Kemmy Business School	166	123	279	24	224	536	242
Law	0	11	0	4	0	99	0
Kemmy Business School/ Maths & Stats	2	0	4	3	6	2	3
Life Sciences	42	31	39	17	59	77	69
Manufacturing & Operations Engineering	65	57	96	20	65	27	53
Materials Science & Technology	21	46	45	9	75	47	89
Maths & Stats	7	1	30	7	20	4	15
Mechanical & Aeronautical Engineering	59	115	138	35	165	213	166
Physiotherapy	0	0	0	0	0	1	0
Physical Education and Sports Science	38	14	78	11	58	26	77
Nursing	2	0	0	0	1	0	0
Physics	4	12	17	3	11	11	20
Politics & Public Administration	0	1	0	0	0	0	2
Sociology	0	6	1	3	0	20	4
Unknown	20	192	28	286	36	12	12
<b>UL COLLEGES</b>							
Access	19	30	13	21	8	13	13
Engineering	145	218	279	64	305	287	308
Humanities	0	19	1	9	0	126	6
Informatics & Electronics	141	71	164	20	85	80	95
Kemmy Business School	166	123	279	24	224	536	242
Science	109	120	155	35	175	187	227
Kemmy Business School/I&E	2	0	4	3	6	2	3
Unknown	21	192	28	286	36	12	12

### *Independent reviews*

Lawson et al (2001) recommend the use of student questionnaires when evaluating a support centre. In 2004, the Office of the Dean of Teaching and Learning in UL

carried out a formal evaluation report on the MLC. The report was based on results from student questionnaires and from some focus group discussions (1 traditional age student group, 1 mature student group and 1 group of teaching staff from MLC).

It reported that

“The large majority of the students questioned were extremely positive in the feedback provided about the Maths Learning Centre. They fall into two categories- those who rely on the MLC for backup and those who rely on the centre as a fundamental part of the maths learning curriculum. To those students who rely on the MLC for backup, the centre offers tutorial help as well as extra grinds around the exam period. The second group contains a majority of mature students or students studying on the U.L Access course. Many of these students have been away from formal education for anything from 2 – 30 years and find themselves falling into a learning gap. These students state that the MLC was an ideal resource and in many cases state that it is a fundamentally important one” (Moore, 2004).

The response from the adult learners was profoundly positive and demonstrated the efficiency of the facility and its importance for them.

### *External department reviews*

The importance of the role of the Centre was recognised in the Quality Review of the Department of Mathematics and Statistics in 2004, and the reviewers urged that the University would guarantee the continued existence of the Centre if the targeted HEA funding ceased. Subsequently, the Executive Committee agreed to fund the Centre for a further 3 years at least (cf. minutes of meeting EC2005-06w 9 March 2005). This commendation can be tremendously valuable when weighing up the efficiency of a mathematics support centre (Lawson et al, 2001).

### *Retention/grades*

One obvious way of determining the effectiveness of a learning support centre is to look at student retention and grades. Again, it is impossible to say if a student's success can be solely contributed to the support he/she receives but it is a positive indication nonetheless. Table 4 shows the distribution of grades D1, D2 and F (fails) across the biggest service mathematics groups in UL over the period 2000-2004. The MLC opened in the academic year 2001/02 where one can see a dramatic decrease in the percentage of failure grades in these courses from the previous year.

**Table 4: Profile of failing grades for selected modules for selected years**

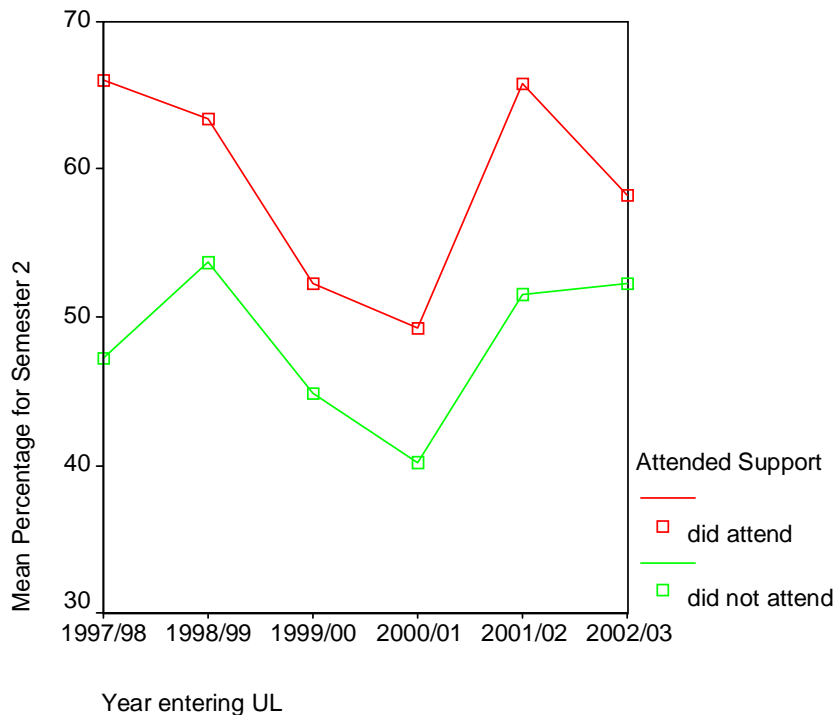
Module	Grades	AY	AY	AY	AY
		2000/01	2001/02	2002/03	2003/04
<b>MA4601</b> (Science Maths 1)	D1, D2, F	60/204 (29.4%)	28/150 (18.7%)	26/170 (15.3%)	19/173 (10.9%)
<b>MA4001</b> (Eng. Maths 1)	D1, D2, F	78/207 (37.7%)	45/213 (21.1%)	22/207 (10.6%)	19/193 (9.8%)
<b>MA4702</b> (Tech. Maths 2)	D1, D2, F	77/329 (29.8%)	33/227 (19.4%)	22/274 (10.6%)	33/203 (16.3%)
<b>MA4103 (Bus. Maths 2)</b>	D1, D2, F	16/372 (4.3%)	23/375 (6.1%)	16/369 (4.3%)	14/418 (3.3%)

A database of diagnostic test and end of semester results was initiated in the academic year 1997/98 in the MLC and is updated annually for research purposes. Any student who scores less than 20 (out of 40 questions) in the diagnostic test is categorised as being 'at-risk'. Many adult learners of mathematics fall into this category, as they have not studied mathematics for many years. It is these students that the Mathematics Learning Centre wishes to prioritise in terms of services supplied. All students are welcome but those who are at risk are one of the top priorities. Most of these students need extra tuition to pass their mathematics courses. If help is given, students can then spend more time keeping abreast of their other studies.

The authors were curious to follow these students to see if the support tutorials had a positive effect on student learning or success. As part of the author's (OG) doctoral research, the results of the end of term examinations of those students who are characterised as at risk and participated in the tutorials were compared with those who did not attend to see if there was a significant difference in examination performance. The Mathematics Learning Centre opened in October 2001. This fortuitous event certainly had an impact on many students' academic performance. Many prefer the one-to-one method of instruction and opted for this method instead of attending the support tutorials. Many used both.

Figure 1 shows one of the graphs which demonstrate the difference between the end of term grades of at risk students who attended support tutorials when compared with those who did not attend (Gill, 2006). One can see a clear difference. Again one cannot guarantee that the impact of the support tutorials caused students who attended to perform better but it is another positive indication.





**Figure 1 End of year mathematics grades of at risk students who attended/did not attend support tutorials**

### *Research output*

The MLC pursues an active programme of research into issues surrounding teaching/learning of mathematics with a special focus on issues in the transition from secondary to university mathematics and service teaching and understanding adults' approaches to learning and doing mathematics and interventions. In 2006 there were 3 Masters of Science, 2 PhD's, 9 conference papers published, 3 conference presentations, 3 journal papers accepted through the Mathematics Learning Centre. The MLC also maintains a longitudinal database of diagnostic test results for research purposes.

### *Development & expansion*

Since its inception in 2001, the MLC has continued to expand and develop its resources. The MLC has successfully attained a tutorial room next door to the drop-in centre to accommodate growing numbers of students. There have been many improvements to the MLC website (<http://www.ul.ie/~mlc>) adding an on-line support facility to accommodate students outside the opening hours of the drop-in centre. The

MLC has promotional /publicity materials including logo, and printed leaflets for distribution to incoming students during orientation week.

### ***Associated projects***

#### ***Regional CEMTL***

The University of Limerick, Mary Immaculate College of Education, Tralee Institute of Technology and Limerick Institute of Technology have come together in the Shannon Consortium to promote education in the region. These initiatives are being funded under the Strategic Innovation Fund (SIF), and each participating institution is leading one or more projects organised under various themes. The UL MLC is leading Project C: Regional centre for excellence in mathematics teaching and learning (Regional CEMTL) which aims to improve the mathematics education of third level students in the Munster region of Ireland.

#### ***European Virtual Laboratory of Mathematics (EVLM)***

The UL MLC is also involved in the EU Leonardo programme, a project entitled the European Virtual Laboratory of Mathematics (EVLM) which involves 9 universities across Europe to promote e-learning in mathematics for all students and teachers/lecturers of mathematics in second and third level education (<http://www.ul.ie/evlm/>).

#### ***Links with other MLC's***

Inter-institutional collaboration is promoted in a variety of ways including seminars, reciprocal visits, exchange of resources and ideas, and participation in the National Retention Colloquium. The MLC has established links with DCU, UCD, LIT, DIT, CIT, LYIT, IT, Tralee and Dundalk IT. The Centre also has links with designated Centres of Excellence in Mathematics Teaching at the University of Loughborough and Coventry University in the UK, and Freudenthal Institute, University of Utrecht in the Netherlands, a world-renowned mathematics education research centre.

The UL MLC is acknowledged throughout the HE sector as a model and exemplar of best practice in mathematics learner support. The Centre has hosted various visits by interested parties in HE and has advised several other HE institutions on mathematics



support and learning centres. This recognition and standing benefits the University by helping to raise profile.

## Conclusion

In conclusion, it is impossible to state that the Mathematics Learning Centre is the sole intervention which improves retention and mathematics grades in the university. However positive outcomes are indications of a job well done. We view the following achievements as key success factors:

- Drop-in centre (staffed and equipped 20 hrs/wk),
- Acquisition of additional space (Fittings/equipment/tutorial room),
- Take-up of services by students in large numbers (Tables 1 & 2),
- Number of programmes serviced (Table 3),
- Expressed levels of satisfaction by students and client departments (formal evaluation report, Office of Dean of Teaching and Learning, Quality Review of M&S Department, 2004),
- Evidence of improved grades/retention (Table 4),
- Contribution to retention, access, progression (Table 4),
- Contribution to overall quality of mathematics teaching in UL,
- Website and ICT platform (stages 1,2) (<http://www.ul.ie/~mlc>),
- Creation of largest active research group nationally in mathematics education
- Relevant research output (3 MSc, 2 PhD's; 9 conference papers published, 3 conference presentations, 3 journal papers accepted),
- Dissemination of ideas, advice, resources, practices and research to other HE institutions
- Longitudinal database of diagnostic test results.
- National reputation and standing in mathematics learner support/service mathematics teaching.

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