# Towards a culture of data collection & analysis in mathematics support centres

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## Abstract

The past decade or so has seen a huge growth in the number of mathematics support centres within UK higher education institutions as they come to terms with an increasing volume of students who are poorly prepared for the mathematical demands of their chosen courses. In other parts of the world we observe similar developments. In the early years many centres were short-lived enterprises staffed either by concerned volunteers who found a few hours in the week to offer additional support, or alternatively by part-time staff on short-term contracts. More recently, we have observed a trend to more substantial support centres many of which attract central funding and dedicated staff. Given this trend there is a need to ask whether our efforts are worthwhile, how we might know this, and whether we can justify ongoing funding. This talk will describe some of the challenges associated with acquiring data on effectiveness. Various ways in which we can measure our success will be explored. Finally, several exemplars will be provided of work being undertaken to capture the sort of evidence required to secure continued funding of mathematics support centres.

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The papers referred to in this talk have, as far as copyright restrictions allow, been made available on the staff area of the **math**centre website (see overleaf).

I would like to invite those present at the talk to inform me of other publications related specifically to the *evaluation* of mathematics support centres so that I can update this website accordingly for the benefit of the mathematics support community.

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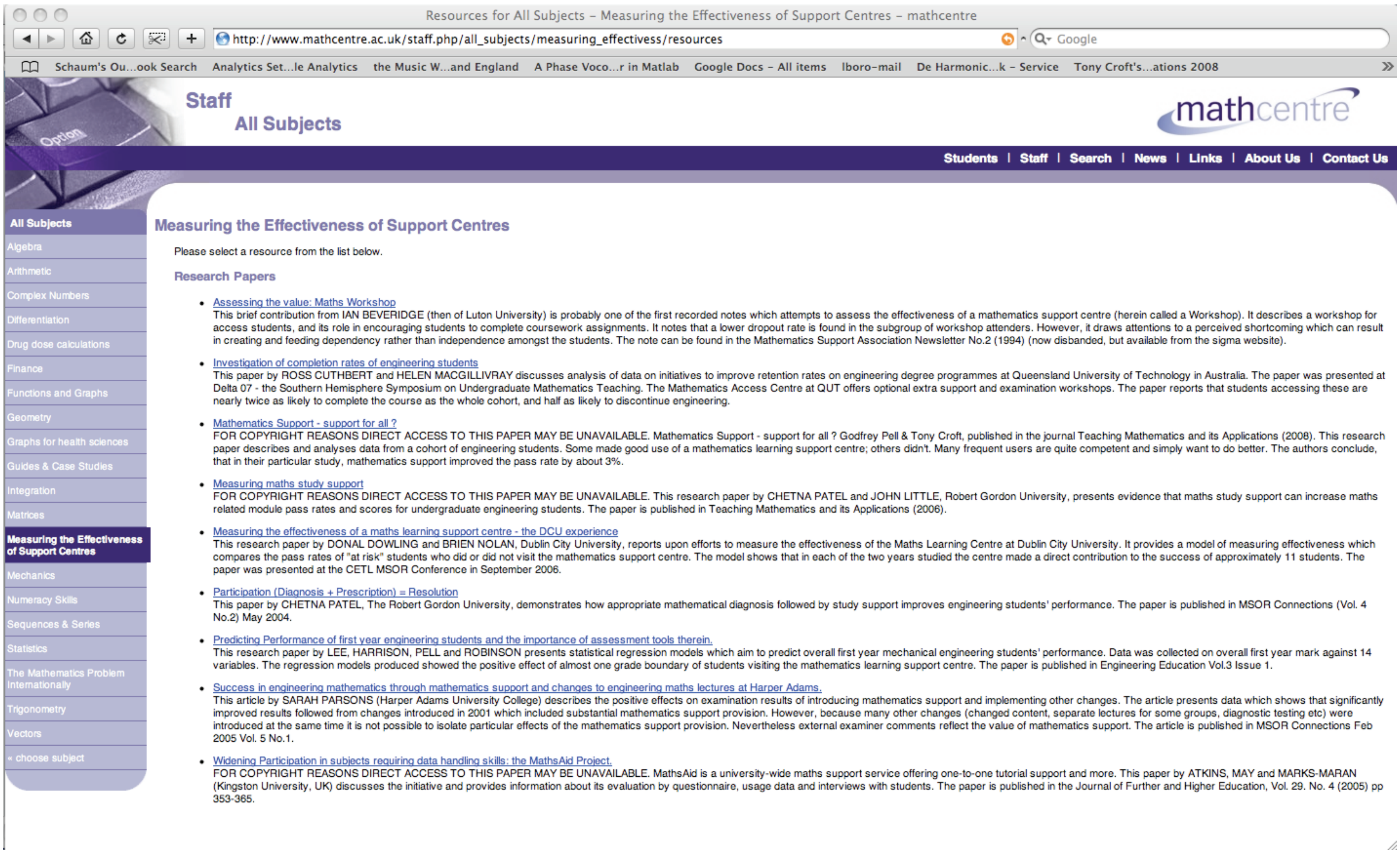

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## Measuring the Effectiveness of Support Centres

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### Research Papers

- Assessing the value: Maths Workshop
This brief contribution from IAN BEVERIDGE (then of Luton University) is probably one of the first recorded notes which attempts to assess the effectiveness of a mathematics support centre (herein called a Workshop). It describes a workshop for access students, and its role in encouraging students to complete coursework assignments. It notes that a lower dropout rate is found in the subgroup of workshop attenders. However, it draws attentions to a perceived shortcoming which can result in creating and feeding dependency rather than independence amongst the students. The note can be found in the Mathematics Support Association Newsletter No.2 (1994) (now disbanded, but available from the sigma website).
- Investigation of completion rates of engineering students
This paper by ROSS CUTHBERT and HELEN MACGILLIVRAY discusses analysis of data on initiatives to improve retention rates on engineering degree programmes at Queensland University of Technology in Australia. The paper was presented at Delta 07 - the Southern Hemisphere Symposium on Undergraduate Mathematics Teaching. The Mathematics Access Centre at QUT offers optional extra support and examination workshops. The paper reports that students accessing these are nearly twice as likely to complete the course as the whole cohort, and half as likely to discontinue engineering.
- Mathematics Support - support for all ?
FOR COPYRIGHT REASONS DIRECT ACCESS TO THIS PAPER MAY BE UNAVAILABLE. Mathematics Support - support for all ? Godfrey Pell & Tony Croft, published in the journal Teaching Mathematics and its Applications (2008). This research paper describes and analyses data from a cohort of engineering students. Some made good use of a mathematics learning support centre; others didn't. Many frequent users are quite competent and simply want to do better. The authors conclude, that in their particular study, mathematics support improved the pass rate by about 3%.
- Measuring maths study support
FOR COPYRIGHT REASONS DIRECT ACCESS TO THIS PAPER MAY BE UNAVAILABLE. This research paper by CHETNA PATEL and JOHN LITTLE, Robert Gordon University, presents evidence that maths study support can increase maths related module pass rates and scores for undergraduate engineering students. The paper is published in Teaching Mathematics and its Applications (2006).
- Measuring the effectiveness of a maths learning support centre - the DCU experience
This research paper by DONAL DOWLING and BRIEN NOLAN, Dublin City University, reports upon efforts to measure the effectiveness of the Maths Learning Centre at Dublin City University. It provides a model of measuring effectiveness which compares the pass rates of "at risk" students who did or did not visit the mathematics support centre. The model shows that in each of the two years studied the centre made a direct contribution to the success of approximately 11 students. The paper was presented at the CETL MSOR Conference in September 2006.
- Participation (Diagnosis + Prescription) = Resolution
This paper by CHETNA PATEL, The Robert Gordon University, demonstrates how appropriate mathematical diagnosis followed by study support improves engineering students' performance. The paper is published in MSOR Connections (Vol. 4 No.2) May 2004.
- Predicting Performance of first year engineering students and the importance of assessment tools therein.
This research paper by LEE, HARRISON, PELL and ROBINSON presents statistical regression models which aim to predict overall first year mechanical engineering students' performance. Data was collected on overall first year mark against 14 variables. The regression models produced showed the positive effect of almost one grade boundary of students visiting the mathematics learning support centre. The paper is published in Engineering Education Vol.3 Issue 1.
- Success in engineering mathematics through mathematics support and changes to engineering maths lectures at Harper Adams.
This article by SARAH PARSONS (Harper Adams University College) describes the positive effects on examination results of introducing mathematics support and implementing other changes. The article presents data which shows that significantly improved results followed from changes introduced in 2001 which included substantial mathematics support provision. However, because many other changes (changed content, separate lectures for some groups, diagnostic testing etc) were introduced at the same time it is not possible to isolate particular effects of the mathematics support provision. Nevertheless external examiner comments reflect the value of mathematics support. The article is published in MSOR Connections Feb 2005 Vol. 5 No.1.
- Widening Participation in subjects requiring data handling skills: the MathsAid Project.
FOR COPYRIGHT REASONS DIRECT ACCESS TO THIS PAPER MAY BE UNAVAILABLE. MathsAid is a university-wide maths support service offering one-to-one tutorial support and more. This paper by ATKINS, MAY and MARKS-MARAN (Kingston University, UK) discusses the initiative and provides information about its evaluation by questionnaire, usage data and interviews with students. The paper is published in the Journal of Further and Higher Education, Vol. 29. No. 4 (2005) pp 353-365.

## 1. The extent of support centre provision.

The past decade or so has seen a huge growth in the number of mathematics support centres within UK higher education institutions as they come to terms with an increasing volume of undergraduates who are poorly prepared for the mathematical demands of their chosen courses. The earliest known survey of such provision in the UK was that of Ian Beveridge in 1993 [1]. Working from Luton University, Beveridge established the *Mathematics Support Association* in a first attempt to draw together those interested in and practising mathematics support. The Association produced the *Mathematics Support Association Newsletter* from 1994 -1999, copies of which have been archived on the **sigma** website http://www.sigma-cetl.ac.uk. In his survey, a questionnaire was sent to 800 further and higher education institutions to ascertain current practice in mathematics support. 142 replies were received, 42 from higher education institutions and 100 from colleges of further education. All responding institutions had at least one form, and most commonly three forms, of mathematics support. 76% offer drop in workshops, 47% offer open-learning opportunities, 40% foundation and bridging courses, 34% computer-assisted-learning and 23% supplemental instruction by students. The survey found that mathematics support was more readily available in further education and Beveridge noted that students moving to HE might be discouraged from pursuing courses of study requiring mathematical skills as a consequence.

A more substantial survey of the situation in higher education was carried out by Duncan Lawson, Tony Croft and Margaret Halpin in 2001 [2,3] which revealed that of the 95 UK higher education institutions replying 46 (48%) had some kind of mathematics support centre provision. 41 of the 46 completed a questionnaire describing the operation of their facility. Since 2001 a number of projects (e.g. the LTSN MathsTEAM project [4], and **math**centre [5]) have raised awareness of the role of mathematics support centres and have made resources available for those interested in establishing them. There were then further reports including some from government which made it clear that the mathematics problem had been recognized and that universities should be taking action to deal with it. By 2004 it was timely to conduct another survey and this was undertaken by Tony Croft and Glynis Perkin. In their survey [6] 106 UK institutions were selected. A response rate of 95% was achieved. Of the 106 universities, 62% stated that they offered some form of mathematics support provision over and above that normally provided. What was particularly interesting was that support centres were now to be found in the full range of institutions including some of the most prestigious *"Russell Group"* institutions. Since the 2004 survey new centres have been opened at other universities. For example, since 2005 we are aware of centres opening at Sheffield, Bath and Leeds Universities as part of the **sigma**[1] dissemination programme.

[1] **sigma** is one of the UK's Centres for Excellence in Teaching and Learning (http://www.sigma-cetl.ac.uk)

Outside the UK there has been similar growth of activity. Helen MacGillivray reported in 2008 [7] that in Australia there are 39 universities of which 32 have some form of mathematics learning support. In the Republic of Ireland,13 institutions with mathematics support provision are reported in the 2008 audit of Gill, Donoghue & Johnson [8].

## 2. Challenges associated with evaluation of mathematics support centres

To understand how the process of evaluating mathematics support centres has evolved it is important to recognise their origins. Centres were originally established in response to local needs and were usually very small scale operations. Typically, a concerned lecturer, recognising the difficulties that many students were having, would establish 'maths clinics' or drop-in sessions for perhaps one or two sessions per week. There would have been little or no attempt to gather data except perhaps to record which students attended and, maybe, the departments which they came from. At the next level, some institutions recruited former school teachers, or retired lecturers to offer a greater level of support. These staff were usually part-time, often worked term time only, and were recruited because of their interest in teaching and their longing to work with students. They probably had little knowledge of or interest in collecting and analysing data on their efforts. Anecdotal evidence would suggest that their efforts have been invaluable in developing the confidence and competence of individual students and in enhancing their experience of mathematics at university. However, such evidence is rarely sufficient to convince those who allocate funding. With such huge and rapid growth of mathematics support activity it is now right and proper to ask whether our efforts and the costs of providing support are worthwhile. If they are, how do we know this ? Which components of the support we provide are most cost-effective ? This leads to questions such as 'What data is it possible to collect ?', 'Is trying to collect this data worth the effort ?', and 'How can we interpret what we do collect ?'.

On this matter, Helen MacGillivray [op cit] writes:

*Mathematics Learning Support needs sufficient security to attract, train and retain staff, and to play its part in the ongoing and longitudinal data collection and analysis that should be an integral part of its contribution to the university. All universities should ensure that such data collection and analysis are undertaken and performed correctly to provide vital information for university academic management. However, as reported, few of the facilities currently have the resources to undertake this important work.*

Helen MacGillivray (QUT, Australia 2008)

Even where there is a will to try to do this, there can be great difficulties. For example, in my university some departments in the past have been reluctant to provide data on the academic background (prior qualifications) of individual students. Historically, this has meant it has been impossible, for example, to correlate diagnostic test marks with prior qualifications. Just recently, in my University our management information systems have improved significantly. One effect of this is that I can log onto a computer system which enables me to look at individual students and their A level and AS level grades. However earlier qualifications (e.g. GCSE) are not available. Many of the students we support stopped taking mathematics at 16 and so we don't have access to their prior mathematics qualifications. Even the newly upgraded system does not enable me to access the prior qualifications of a group as a whole, for example to see the entry profile in mathematics of all students studying Economics. This sort of data might be quite important if we want to look at trends over time.

Longitudinal studies, even resource permitting, are difficult. Minimum entry qualifications change year on year. In some departments we have seen an increase in mathematical requirements, but in others a decrease. To study Electronic & Electrical Engineering students need 320[2] points from 3 A levels, two of which must be in a scientific or numerate discipline (not necessarily mathematics), whereas in Civil Engineering a standard offer is ABB *including* mathematics. Syllabi change, not infrequently. Lecturing staff change quite often, and of course the students change every year! It's never possible to set up a control group whereby support can be offered to one group but not offered to an 'identical' group. Moreover, the individual students we see in the support centres come from many different departments, come at different stages in their studies, and for varying lengths of time. All have different levels of motivation. Some are frequent users, others may come only once or twice. All these factors make a scientific analysis of our efforts very difficult.

Nevertheless we must try – and there are now a number of examples around of where efforts have been made in this respect. In the remainder of this paper we will explore some of these. I have divided these efforts into two sorts – one sort I call 'soft' measures. These include usage data, feedback from students etc. The other I call 'hard' measures – these are tangible and to some extent objective measures of improvement of performance. Often, hand-in-hand, it is necessary to make some 'modelling assumptions' in order to make progress and with all mathematical models the underlying assumptions are open to question.

[2] e.g. A =120 points, B=100 points, … E=40 points; ABB = 320 points

## 3. Soft Measures

We have gathered usage data for many years. Figure 1 shows the cumulative number of visits to the centres at Loughborough over a six year period. The diagram is taken from the Mathematics Education Centre's Annual Report in August 2008. This and reports from previous years can be found on the Centre's website http://mec.lboro.ac.uk.

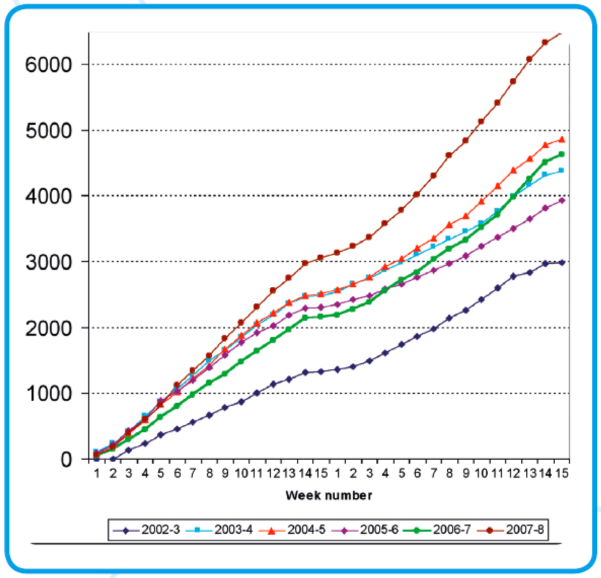



Figure 1 – Comparison of MLSC Usage, 2002-3, 2003-4, 2004-5, 2005-6, 2006-7 and 2007-8

Number of visits (cumulative) is shown.

Figure 1. Cumulative number of student visits to the Loughborough Centres

Figure 2 shows the number of students, the number of visits they made and the departments from which they came.

**Total Usage By Department – 2007-8**

| Department | Students | Visits | Percentage (Students) | Percentage (Visits) |
|---|---|---|---|---|
| Aeronautical and Automotive Engineering | 81 | 165 | 5.59% | 2.54% |
| Business School | 64 | 187 | 4.41% | 2.88% |
| Chemical Engineering | 53 | 225 | 3.66% | 3.47% |
| Chemistry | 33 | 76 | 2.28% | 1.17% |
| Civil and Building Engineering | 99 | 310 | 6.83% | 4.78% |
| Computer Science | 22 | 51 | 1.52% | 0.79% |
| Design and Technology | 2 | 2 | 0.14% | 0.03% |
| Economics | 105 | 373 | 7.24% | 5.75% |
| Electronic and Electrical Engineering | 138 | 490 | 9.52% | 7.55% |
| English and Drama | 1 | 1 | 0.07% | 0.02% |
| European and International Studies | 7 | 7 | 0.48% | 0.11% |
| Geography | 28 | 45 | 1.93% | 0.69% |
| Human Sciences | 92 | 208 | 6.34% | 3.20% |
| I.P.T.M.E. | 34 | 99 | 2.34% | 1.53% |
| Information Science | 7 | 11 | 0.48% | 0.17% |
| Mathematical Sciences | 338 | 2754 | 23.31% | 42.43% |
| Physics | 108 | 776 | 7.45% | 11.96% |
| Social Sciences | 16 | 57 | 1.10% | 0.88% |
| Sport and Exercise Sciences | 24 | 41 | 1.66% | 0.63% |
| Wolfson School | 197 | 612 | 13.59% | 9.43% |
| Grand Total | 1449 | 6490 | 100% | 100 % |

Table 1 – Numbers of students and visits to the MLSC, 2007-8, grouped by department

Figure 2. Numbers of students and visits in 2007/8

The advantages of collecting such data are that they are relatively easy to collect; they shows trends over the years; they provide a measure of *demand*; they can demonstrate to departments that their students are making use of the facility. The disadvantages are that the data don't tell you anything about what goes on in the centre, the quality of the teaching and learning, what the students gain, how long they spend there and whether their performance improves.

Gathering feedback from students is important but should not be overvalued. When staff spend time giving one-to-one help with students it should come as no surprise that students appreciate this and say so on feedback forms. It is rare to find negative feedback from students regarding the provision of mathematics support (except perhaps to say that it should be even more available!). However, when qualitative data is gathered *externally* it may be more valuable. For example, in the UK we now have the National Student Survey [9] carried out annually, and independently of the University. When the results of the 2008 survey were published we trawled these for any mention of mathematics support. We found several instances:

> *Department: Mathematical Sciences:*
>
> *2 positive comments referring to MLSC (unspecified)*
>
> *Department: Economics*
>
> *Two positive comments citing excellent maths support and superb support in the form of the maths support centre*
>
> *Department: Electronic and Electrical Engineering:*
>
> *One positive comment: ***embargoed*

Universities in the UK are also subject to Quality Audits by the QAA (Quality Assurance Agency). The **Institutional Audit** report of 2008 records:

> *sigma CETL has its origins in the Mathematics Education Centre but has widened its concern from the teaching of mathematics to engineers to include support for mathematics education across the University. The ready accessibility of useful help was praised by both undergraduate and postgraduate students that met the audit team. Other students described the benefits of the support rooms and associated equipment. Postgraduate students were appreciative of the one-to-one help and individual study programmes provided for them by the Centre.*

The full report is available publicly at [10]. *The **Institutional Audit** report of 2004* [11] *records:*

> *"The audit team identified the following areas as being good practice in the context of the University: the work of the Mathematics Education Centre..."*
>
> *"Having discussed the work of the MEC with members of staff across the University, the team came to the view that [its] contributions to the University's resources for staff development, and their work more generally, constituted a feature of good practice."*

On numerous occasions over the last few years we have either interviewed individual students or ran focus groups when further information has been elicited. During the talk I will show a video clip or clips of interviews with students who came to University particularly maths anxious and with very disturbed mathematical pasts.

VIDEO CLIP

So, as general guidance and as a minimum, centres should gather data routinely on who uses the centre. A recent improvement at Loughborough has been the incorporation of a swipe card system which makes this much easier, though of course someone needs to interface this with the University database, and maintain the records – an activity with resource implications. Centre managers or others who are responsible should be alert for external messages of support such as those provided above and where appropriate ensure these are brought to the attention of the senior management of the institution, for example in Annual Reports.

## 4. Hard Measures

Studies with more substance are now beginning to emerge. These usually involve more extensive data collection and analysis.

Carol Robinson at Loughborough gathered data on engineering students in 2002/3 and how well they performed when they accessed/did not access additional support. Her diagram (published in [12]) shows that students who performed poorly on a diagnostic test and who went on to access additional support (in the form of Action Planning, and regular meetings with a maths support tutor) went on to succeed in their end of semester mathematics examinations. Most of those students who did not respond to offers of intervention in this way went on to fail (see Figure 3).

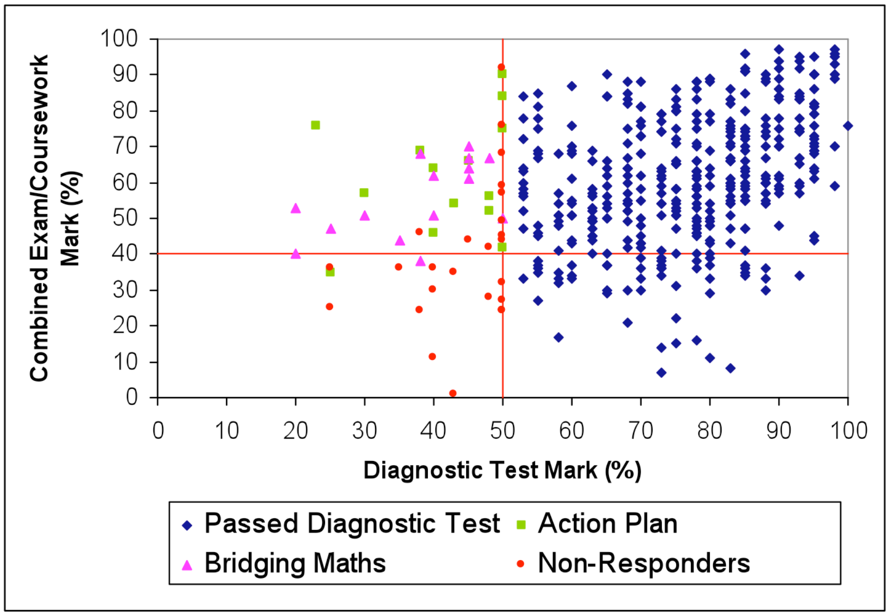



Figure 3. Weak students who took advantage of support went on to succeed.

Sarah Bamforth, also at Loughborough, has analysed the results of engineering students who attended a special summer school aimed at improving preparedness. She was interested in how these students performed if they did/did not use additional support throughout the year. The 2003 results are very encouraging. See Figure 4.

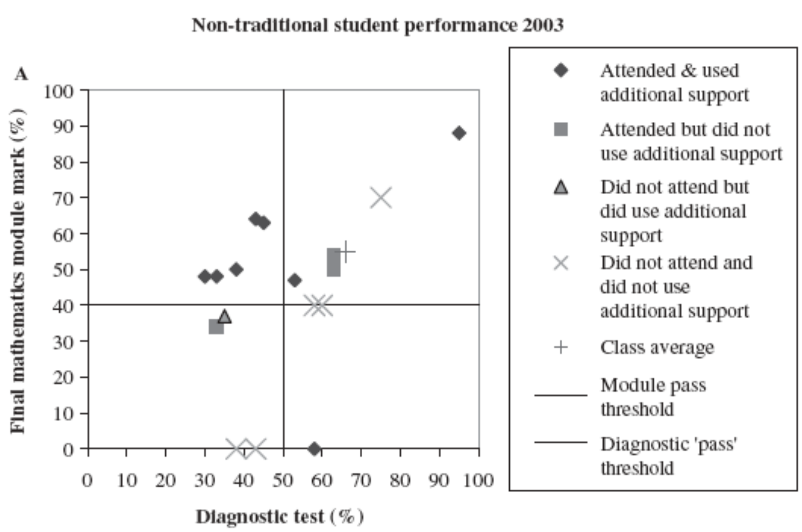



Figure 4. Weak students who attended a summer school and engaged with support went on to succeed.

However, when we look at the same results for 2004, these are disappointing (Figure 5).

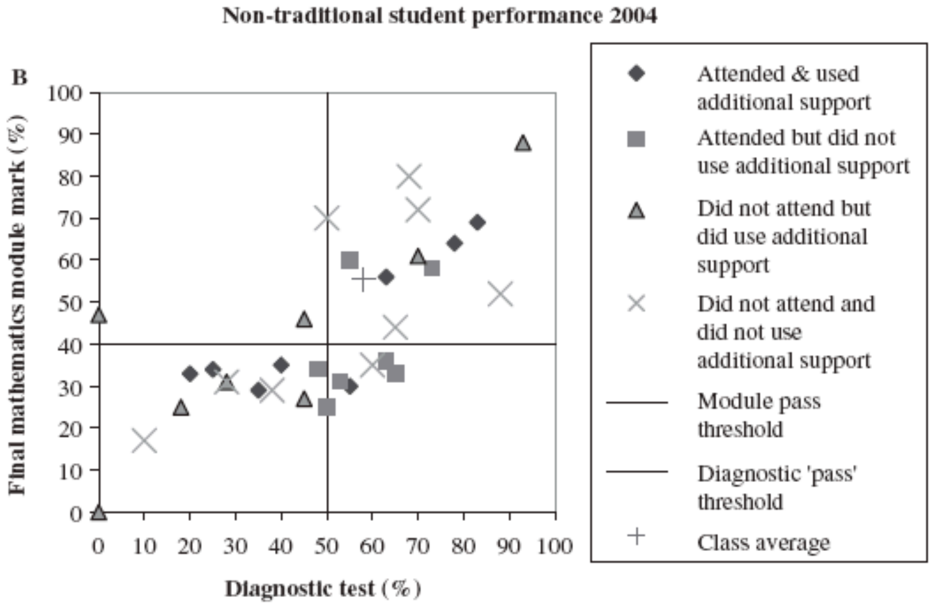



Figure 5. The positive outcome of 2003 was not repeated in 2004.

But there is a lesson here about the need for more detailed data collection.

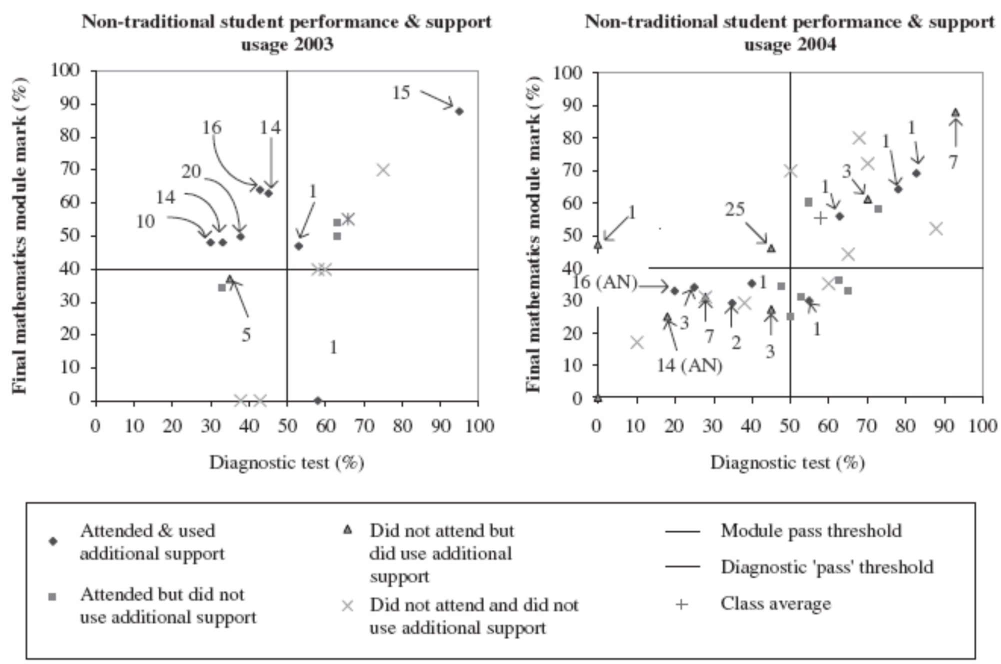



**Fig 3.** First year performance of non-traditional electrical engineering students and their usage of additional support 2003/04.

Figure 6. A successful outcome depends upon students regularly engaging with mathematics support.

Referring to Figure 6 we see that in 2003 the actual number of visits made by these successful students was much greater than in 2004. The message we take from this is that those students who attend regularly (e.g. weekly, or more often) have a very high likelihood of succeeding, whereas those weak students who make just an occasional visit are perhaps wasting their time and ours. Bamforth's work, from which these diagrams are taken is published in [13].

Dowling and Nolan from Dublin City University, Ireland, have attempted to do some modelling [14]. The pass rates of "at risk" students who did / did not visit the centre were compared over two years (Figure 7).

| | **2004/5** | **2005/6** |
|---|---|---|
| Number at risk | 80 | 161 |
| Number at risk who visited MLSC | 41 | 95 |
| Pass rate at risk who visited | 53% | 60% |
| Pass rate at risk who did not visit | 25% | 49% |

Figure 7 from Dowling & Nolan.

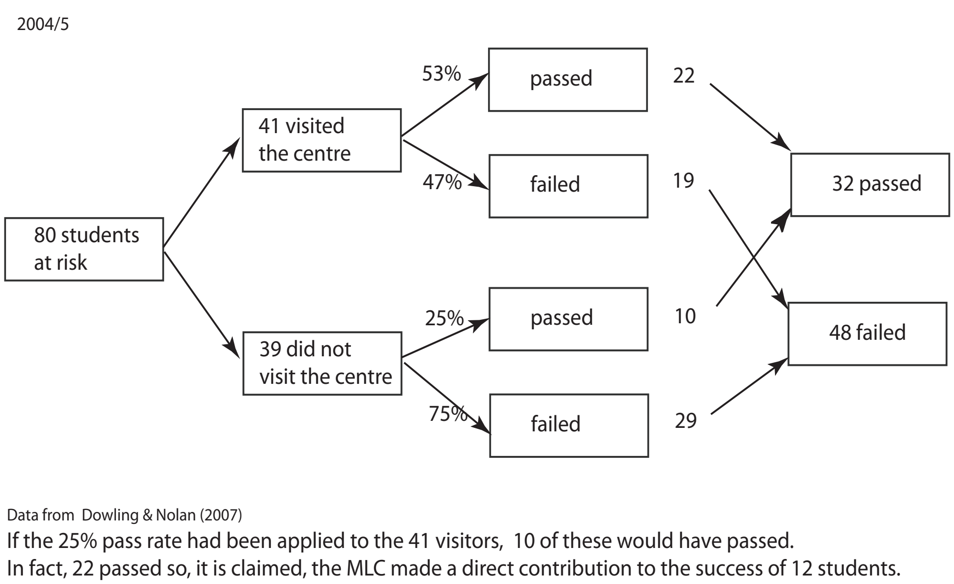
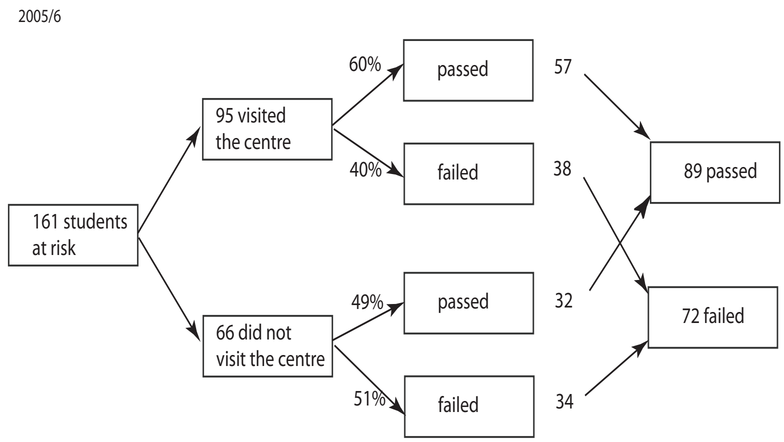



Figure 8

In 2004/5 according to their model the support centre made a direct contribution to the success of 12 students (Figure 8). In 2005/6 a similar number of successes were attributed to the presence of mathematics support (Figure 9).




Data from Dowling & Nolan (2007)
If the 49% pass rate had been applied to the 95 visitors, 47 of these would have passed.
In fact, 57 passed so, it is claimed, the MLC made a direct contribution to the success of 10 students.

Figure 9

Godfrey Pell and Tony Croft [15] describe and analyse data from a cohort of engineering students. Some students made good use of the mathematics learning support centre; others didn't. Many frequent users are quite competent and simply want to do better. The authors conclude, that in their particular study, mathematics support improved the pass rate by about 3% (Figure 10). 21 students attended at least twice and achieved grade D. 63 out of 74 failing students did not attend more than once.

**Table 2.** Attendance at the mathematics support centre by module and module grade achieved

| Module | Visits | Grade | | | | | | | Total *N* |
|---|---|---|---|---|---|---|---|---|---|
| | | A* | A | B | C | D | E | F | |
| a (120) | 0–1 | 7 | 13 | 19 | 14 | 19 | 10 | 9 | 91 |
| | 2–9 | 7 | 3 | 6 | 2 | 0 | 1 | 4 | 23 |
| | 10+ | 0 | 1 | 1 | 0 | 2 | 1 | 1 | 6 |
| b (125) | 0–1 | 16 | 12 | 16 | 15 | 11 | 10 | 8 | 88 |
| | 2–9 | 17 | 3 | 6 | 3 | 2 | 1 | 1 | 33 |
| | 10+ | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 4 |
| c (127) | 0–1 | 25 | 35 | 31 | 24 | 5 | 0 | 1 | 121 |
| | 2–9 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 6 |
| | 10+ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| d (130) | 0–1 | 9 | 12 | 27 | 18 | 22 | 5 | 10 | 103 |
| | 2–9 | 5 | 4 | 4 | 4 | 7 | 0 | 0 | 24 |
| | 10+ | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 3 |
| e (142) | 0–1 | 12 | 23 | 21 | 24 | 17 | 3 | 7 | 107 |
| | 2–9 | 2 | 5 | 9 | 5 | 4 | 2 | 0 | 27 |
| | 10+ | 0 | 1 | 2 | 2 | 3 | 0 | 0 | 8 |

Figure 10.

**Table 3.** Attendance at the mathematics support centre by grade. MS = number using mathematics support two or more times

| Module | A* | | A | | B | | C | | D | | E | | F | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MS | Total | MS | Total | MS | Total | MS | Total | MS | Total | MS | Total | MS | Total |
| a (120) | 7 | 14 | 4 | 17 | 7 | 26 | 2 | 16 | 2 | 21 | 2 | 12 | 5 | 14 |
| b (125) | 20 | 36 | 3 | 15 | 6 | 22 | 3 | 18 | 3 | 14 | 1 | 11 | 1 | 9 |
| c (127) | 2 | 27 | 1 | 36 | 1 | 32 | 1 | 25 | 1 | 6 | 0 | 0 | 0 | 1 |
| d (130) | 6 | 15 | 5 | 17 | 4 | 31 | 4 | 22 | 8 | 30 | 0 | 5 | 0 | 10 |
| e (142) | 2 | 14 | 6 | 29 | 11 | 32 | 7 | 31 | 7 | 24 | 2 | 5 | 0 | 7 |
| Total (644) | 37 (35%) | 106 | 19 (17%) | 114 | 29 (20%) | 143 | 17 (15%) | 112 | 21 (22%) | 95 | 5 (15%) | 33 | 6 (15%) | 41 |

Figure 11.

From Figure 11, 35% of those achieving A* sought maths help more than once. Only 15% of E Grade students and 15% of F Grade students sought help more than once. The proportions of fail grade students seeking mathematics support is less than those in pass grades seeking mathematics support – this would indicate that fail grade students, in addition to having ability problems, have attitudinal problems which we (they ?) need to overcome as well. The main argument being made in Pell's paper is that the mathematics support provision he studied was used rather more by the better students who are seeking excellence than the less able looking to avoid failure. This finding suggests that the provision of mathematics support is more wide ranging in its level than traditionally conceived and that mathematics support has moved from one of remedial support to one of enhancement for all. This is in line with recommendations made in the UK's National Audit Office report [16] on retention. It states that a university's approach to retention should be a positive one and that it should provide students with opportunities to improve their grades rather than just addressing gap within their knowledge. The data of Pell suggests mathematics support centres are already doing this rather well!

## 5. Concluding remarks

In this talk I have tried to set out ideas for ways in which the effects our mathematics support efforts might be measured. Some of these measures are soft and others hard. Increasingly, more and more practitioners are trying to develop hard measures. Several of these, which I have not had time to describe in this talk are Parsons, Lee, and Patel and references to their work can be found on the **math**centre website as indicated earlier. However, throughout all of my talk I hope that my over-riding message is one of balance – we need to balance the time and resource we spend in supporting our students and the time and resource spent in measuring them (and us). After all, we only measure what we are able to measure, and there are some things you just can't measure:

*I just wanted to share my good news that after five years of study at Loughborough I managed to gain a first class honours in Product Design and Manufacture. I believe that without the hours you dedicated to the maths learning support centre I would not have been able to pass the maths modules on my foundation year and first year. Your support, patience and encouragement were invaluable when it came to a subject that I had little confidence in when I first arrived at Loughborough.*

*Kathryn*

## 6. References


[1] Beveridge, I. (1994) *Maths Support Survey – an Examination of Maths Support in Further and Higher Education*. Maths Support Association Newsletter – Issue 1 – Spring 1994 p13. Archived on the sigma website.

[2] Lawson., D., Halpin, M., & Croft., T. (2001) *After the diagnostic test – what next ? Evaluating and Enhancing the Effectivess of Mathematics Support Centres.* MSOR Connections. Vol.1 No.3. August 2001. pp19-23.

[3] Lawson., D., Halpin, M., & Croft., T. (2002) *After the diagnostic test – what next ? Evaluating and Enhancing the Effectivess of Mathematics Support Centres Part 2.* MSOR Connections. Vol.2 No.1. February 2002. pp23-26.

[4] LTSN MathsTeam Project. http://www.mathstore.ac.uk/index.php?pid=60

[5] **math**centre – the UK virtual mathematics learning support centre, http://www.mathcentre.ac.uk

[6] Perkin, G., & Croft, T. (2004) Mathematics Support Centres, the extent of current provision. MSOR Connections Vo.4. No.2. May 2004 pp 14-18.

[7] MacGillivray, H., (2008) *Learning Support in mathematics and statistics in Australian universities – a guide for the university sector*. The Australian Learning and Teaching Council.

[8] Gill, O., O'Donoghue, J., Johnson, P., (2008) *An Audit of Mathematical Support Provisions in Irish Third Level Institutes*. CEMTL, University of Limerick, ROI.

[9] The National Student Survey. http://www.hefce.ac.uk/learning/nss/

[10] Institutional Audit by the QAA 2008. http://www.qaa.ac.uk/reviews/reports/institutional/Loughborough08/RG378Loughborough.pdf

[11] Institutional Audit by the QAA 2004. *http://www.qaa.ac.uk/reviews/reports/institutional/loughborough2004/Rg063loughboroughUni.pdf*

[12] Croft., A.C., Harrison, M.C., & Robinson, C.L., (2009) *Recruitment and Retention of students – an integrated and holistic vision of mathematics support,*
International Journal of Mathematical Education in Science and Technology Vol. 40 No.1. pp109-125.

[13] Bamforth, S.E., Robinson, C.L., Croft, T., & Crawford, A. (2007) *Retention and progression of engineering students with diverse mathematical backgrounds*.
Teaching Mathematics and its Applications Vol. 26. No.4. pp156-166.

[14] Dowling, D., & Nolan, B. (2007) *Measuring the effectiveness of a maths learning support centre - The Dublin City University experience*. Proceedings of the CETL MSOR Conference 2006. Publ. MSOR Network. Pp51-54.

[15] Pell, G., & Croft, T., (2008) *Mathematics support – support for all!* Teaching Mathematics and its Applications (to appear).

[16] National Audit Office (2007) *Staying the course: the retention of students in higher education* (http://www.nao.org.uk/publications/nao_reports/06-07/0607616.pdf)