

Mathematics support: learning from past and present to prepare for the future

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Themes to be addressed...

- 1. The nature of the mathematics problem
- 2. The response of mathematics support
- 3. Who are the users and non-users?
- 4. What is its impact upon learners?
- 5. Who tutors?
- 6. Where is mathematics support 'positioned' within institutions?
- 7. A sustainable future?
- 8. The development of a community
- 9. Where next?

RESPONDING TO THE MATHEMATICS PROBLEM:

The Implementation of Institutional Support Mechanisms



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"...Now only a few years on ...the concept of mathematics support has not only become firmly embedded...but colleagues have moved on to gather data on the way students use such resources and look for optimal strategies for the delivery...this is perhaps the most convincing evidence of acceptance...What might once have been described as a cottage industry now plays a respected and widely adopted role in Higher Education."

Joe Kyle (2010)

The mathematics problem



Beveridge & Bhanot, 1994

"There is an increasing inhomogeneity in the mathematical attainments and knowledge of students entering science and engineering degree programmes."

"The decline in skills and the increased variability within intakes are causing acute problems for those teaching mathematics-based modules across the full range of universities."

Measuring the Mathematics Problem (2000)





Factors:

- 1. Changes in GCSE and A-Level syllabuses and structures.
- 2. Greatly reduced numbers taking A-Level Mathematics and Further Mathematics.
- 3. Changes in the teaching force and in society (widening participation agenda).

Impacts:

- 1. Lack of technical facility.
- 2. Lack of fluency and a decline in analytical skills when faced with multi-stage problems.

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 Changed perception of nature of mathematics – in particular precision and proof. *"Many students do not realise that mathematical facility will be necessary for success in a range of higher education subjects."*

ACME (2010)

"...universities are marginalising mathematical content in the delivery of degree courses because English students are not capable of studying it..."

RSA (2012)

"The British Academy is deeply concerned that the UK is weak in quantitative skills, in particular but not exclusively in the social sciences and humanities."

SOCIE

British Academy (2012)



An applied problem*?

"Unfortunately an applied mathematics problem has now become apparent in Higher Education. Evidence shows that while first year undergraduates in mathematics, physics and engineering are now generally more proficient in pure mathematics, many of them cannot apply it..."

Newton's Mechanics: Who Needs It? (2008)



A problem, but not <u>the</u> mathematics problem...

"Several independent research projects report that the enjoyment of mathematics by many undergraduate mathematicians decreases as they progress through their degree programme and this decrease is accompanied by increasing disillusionment and disengagement with their course and alienation from mathematics itself. These are students who choose to study mathematics at university and who are relatively well-qualified. Moreover, it is often the case that students who report such feelings are not failing students - indeed many are doing rather well."

Croft & Grove (2015)

What is mathematics support?

"...a facility offered to students (not necessarily of mathematics) which is in addition to their regular programmes of teaching through lectures, tutorials, seminars, problems classes, personal tutorials, etc."

Lawson, Croft and Halpin (2003)

Principles:

- Non-judgmental, informal, not credit-bearing
- Supportive and non-threatening
- Offers alternative ways of looking at problems that students find difficult
- Commonly provided through a mathematics support centre, but the reality now is more complex...





Extent of mathematics support provision

Year of survey	Number surveyed	Number responding	Number of institutions offering support	Percentage offering support (as a % of those responding)
2000 (Lawson et al., 2001, 2002)	-	95	46	48
2004 (Perkin & Croft, 2004)	106	101	66	65
2012 (Perkin et al., 2013)	119	103	88	85
2018 (Grove et al., submitted)	111	88	78	89

Grove, Croft & Lawson (submitted)



Does mathematics support work?

- □ Increasing body of literature:
 - Matthews et al. (2013): 56 sources and studies.
 - Lawson, Grove & Croft (in preparation): 114 sources and studies.
- □ The evaluation of mathematics support has evolved:
 - From a justification of existence, to identification of optimal delivery strategies and approaches to engage at risk learners.
- □ An evolution in evaluative methodologies:
 - Quantitative: Increasing range of studies seeking to establish causal links.
 - Qualitative: Care is needed when using student feedback (Pell & Croft, 2008).
 - Cross-institutional studies more commonplace.

□ Matthews et al. (2013) contains evidence of:

- Users and non-users.
- Impact on Student performance and retention.
- Impact on student satisfaction, wellbeing and mathematical confidence.
- □ Lawson, Grove & Croft (in preparation) contains:
 - Further evidence of its impact, including via delivery in nontraditional forms.
- □ O'Sullivan et al. (2014):

"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."

How is the support delivered?

- 82% (64/78) of institutions have drop-in provision.
 - 33% of these offer this support for more than 15hours per week during term-time.
- □ 55% (43/78) of institutions combine drop-in with 1-1 bookable appointments.
 - 30% of those with 1-1 bookable appointments offer this support for more than 15hours per week during term-time.



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A move towards diversified delivery...

68% of institutions (53/78) now offer mathematics support via organised workshops and lectures:

> "...targeted provision tailored at a school, programme or module level. This takes the form of embedded sessions within timetabled lectures or seminars or sessions which are promoted to particular cohorts taking place directly after lecture."

□ Availability of an additional service:

"Some colleges/departments also offer specific support just for their students"

"...many more biosciences students use our departmental service than go to the centralised alternative."

Grove, Croft, Lawson & Petrie (2019)

- 28% (22/78) institutions deliver mathematics support in ways extending beyond drop-in, one-to-one appointments, organised lectures and workshops, and online tutorials and resources. Common themes:
 - Facilitating group or peer support activities
 - Email and telephone support
 - Diagnostic testing
 - Supporting widening access or those with mathematics anxiety.

Is mathematics support moving online?

- □ 23% of institutions report using technology to offer online real-time support to learners:
 - Extent is limited. 66% (12/18) offer it for less than 1 hour per week.
 - Limited uptake by students.

□ However:

- Rice & O'Hare (2012): No students accessed piloted 1-1 online tutorials, but did notice increase in uptake of in-person support.
- Owen et al. (2011): Good usage of online support by students from institutions that did not provide own statistics support.

But. . .

"...there are many students who do not visit mathematics support centres. For some, the support provided by such centres is either not needed or does not align with their preferred learning style and their non-engagement is quite sensible. But for others, it seems highly likely that they would derive benefit from attending and yet they choose not to do so. When questioned such students often give shallow responses, such as not being aware of the centre's location, for their non-engagement. However, research indicates that there are sometimes deeper reasons underlying their behavior."

Lawson (2015)

Who uses mathematics support?

- Historically, in the early days of mathematics support, users were:
 - Students of engineering and physical sciences
 - Newly enrolled within higher education
 - The weaker ('at risk') students.

□ However now:

- Demand for mathematics support from students of other disciplines has grown.
- Increased demand for statistics support.
- Support for students with additional learning needs (Trott, 2015; Cliffe, 2015).
- The more-able student is known to use mathematics support to enhance their performance futher (Pell & Croft, 2008; Mac an Bhaird et al., 2009).

Why do students choose to access mathematics support?

□ In general:

- Convenient and flexible timing (drop-in).
- Personalised experience (drop-in).
- Friendly (informal) and welcoming environment.
- Flexible learning environment: study space and opportunity for peer learning.
- Skilled, knowledgeable and (pedagogically) experienced tutors.
- □ For the specialist and more-able student:
 - Advanced mathematical knowledge and familiarity.
 - Visibility of tutors amongst the undergraduate cohort.
 - Links with feedback, in particular pre-feedback and the opportunity to engage in dialogue about mathematics.

There is insight in the literature: Learning to learn mathematics

"Students often experience lectures at university as intimidating places and are not sure how to learn in them."

"Informal peer learning can be very important to some students. The development of peer support groups can be officially facilitated but this is not often the case."

"...it is not always clear what this [Independent Learning]... means, and many students...think it means they are expected not to seek help from staff."



The importance of dialogue

"...negative feelings are generally associated with a perception of poorer dialogue when students enter university programmes, and vice versa."

"...interactions with lecturers were often fewer and less engaging than students had expected, and this was associated with a negative view of the university experience and transition in particular."

Williams (2015)

Who tutors in mathematics support?

□ Historically:

"...the teaching needs are more akin to school teaching and university lecturers are not always the best people to be undertaking additional mathematics teaching and support".

Sutherland and Dewhurst (1999)

□ Now:

- A diverse user base (including postgraduate students and staff).
- Increased availability of provision (hours per week).
- Users with additional or specialist needs.

Providing mathematics support is not about 'telling' the student the answer, but about encouraging them to

identify their own mathematical problems, helping them tackle these for themselves with support and guidance, and providing suggestions and strategies for independent study. It requires individuals who are comfortable working on a one-to-one basis, who are patient, able to explain mathematical ideas in multiple ways, have excellent interpersonal skills, and are able to work with students of a range of abilities and from different disciplinary areas."

Croft & Grove (2016)

\Box Amongst the 63% (49) of institutions with dedicated staff:

- In 16 institutions, such individuals were the sole providers of mathematics support.
- In 6 of these institutions, this was a single member of staff.
- Postgraduates now have an important role in 42% (33) of institutions:
 - Seven institutions rely upon them as the sole providers.
- □ Undergraduates have a role in mathematics support:
 - 26% (20) of institutions use them, including one institution who was reliant upon them.
 - Overall number students used is small in institutions.
 - Is this mathematics support or peer support?

Supporting those new to tutoring

Croft, Gillard, Grove, Kyle, Owen, Samuels, & Wilson (2016)



- 52% of (48) responses indicated training was offered to those new tutoring in mathematics support.
- But even when training is available, it is not always taken up.
- Recognition of training provided by sigma.

Grove, Croft, Lawson & Petrie (2019)

Development of an accredited framework for mathematics support tutor training.

Led by Ciaran O'Sullivan & Ciaran Mac an Bhaird,

Maynooth, 12 April 2019



MATHEMATICS LEARNING SUPPORT: KNOWLEDGE AND SKILLS

The purpose of this badge is to clearly outline to a trainee tutor the typical mathematical ability of students who require Mathematics Learning Support (MLS) and how to interact effectively with them through the application of appropriate teaching and learning approaches relevant to MLS. It also enhances tutors' awareness of both the implications of the non-academic differences between students and the range of situations that can occur as a result of diverse student approaches to learning.

Where next for mathematics support?

- How can mathematics support influence mainstream teaching and learning?
 - Particularly important if staff employed solely to work in mathematics support.
 - 50% of respondents indicated they had mechanisms for informing departments in place (Grove, Croft, Lawson & Petrie (2018).
 - Examples: Reports, steering groups, institutional seminars, annual departmental meetings/boards, departmental away days, and periodic reviews.
 - There now exist examples of changed practices of enhanced approaches occurring ('Embedded Provision').



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Where next for mathematics support?

What is the impact of mathematics support in its new and different forms?

- The delivery of mathematics support is diversifying within institutions.
- How do they align with the aspects students value most?
- Exist evaluations of drop-in provision, less evidence of impact of mathematics support in its newer forms.
- How are students using these to aid their learning?
- In particular, how well do these approaches guide students towards becoming independent learners of mathematics?
- Why is there limited uptake by students of online real-time support?
- There are still students who do not engage (even with new forms) when they would benefit from doing so.



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Where next for mathematics support?

- How do we recognise (and reward) those working in mathematics support?
 - There are an increased number of specialist roles in mathematics support. But 60% are on non-academic contracts (Grove, Croft, Lawson & Petrie, 2019).
 - An evidence-based approach is important, as is freedom to engage in a community.
 - But, staff generally feel they have autonomy in their roles to engage with a national community.
 - How are colleagues supported to develop a researchbased approach to practice?
 - Maintaining a community events like this are important.



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Thank you (and with great thanks to Tony Croft & Duncan Lawson)

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