MATHEMATICS SUPPORT NEWSLETTER

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Bleeding to death from 1,000 cuts

Last Year's budget cuts bite and a deafening hush descends on us when a primeval scream might be healthier.

Their focus has been disproportionately hard on new universities, maths and maths-support in particular.

The list of departments where maths degrees are no longer run is long. The current need is to meet the growing numeracy needs of students outside maths departments, and if maths departments are to be involved, then they must overcome myopic accounting systems that discourage them.

Sean O'Broin (South Bank) analyses secondary school maths texts to provide a compelling argument for FHE to get involved.

Consider how university tables measure traditional values, as opposed to an evaluation of how different students' needs are met. This issue presents an account of an Ofsted inspection run on these lines.

One consequence is that many staff 'want to keep their heads down' and are not disposed to devise new maths courses or classes which might cost money and then fail. This feeling is not helpful.

The high number of merged classes with larger and more diverse student backgrounds, the lowering of class contact time, the large size of 'tutorials', all demand we rethink the learning process of our students and then act on that. Gill Kerr (U.C.L.) provides an example with a new year 1 module, entitled, "Lying with Numbers".

Dearing threatens to even up the disparity of resources currently existing in FE and HE, where those less in need get vastly more. Penny Wolff (Huddersfield) makes clear a growing gulf between FE and HE sectors in her article, "The GNVQ Timebomb".

Maths workshops have been meeting the need for bridging courses between the growing non-academic routes in FE academic. Two significant case studies from John Brooks (Bradford & Ilkley College) and Marilyn Goudge (Luton Sixth Form College) document this approach. The suggested expansion of HE entry from 30% to 40% of all 18 year olds in the UK is to be achieved without a third extra money being spent and quality standards maintained! The credibility of this belief lies in dramatic advances in IT. However, Bland Tomkinson, (UMIST), sums up recent research in learning support and cautions, "The clear message is that (resource based learning) methods only work well when there is a high level of tutorial support."

An Interview with Sybil Cock (UNL)

IB. Is the whole issue of maths support misconceived?

SC. On that I do agree—as you know I've never liked the term as it implies something remedial and absolves maths lecturers from doing anything different—"the problem is the students"!! It's to do with entry level maths and how to teach it to a wide variety of students.

IB. On the 'up' side of maths support, it looks increasingly like there is an opportunity to develop it with the concern on (poor) numeracy standards being part of HE's debate about transferable skills. This idea of 'graduateness' seems to include numeracy and problem-solving skills and a quantitative outlook.

SC. Yes, I agree — and it's happening here. But again I'd prefer to avoid terms which are pejorative and I think numeracy is in the context of graduateness.

IB. How can the MSA develop so as to move us forward?

SC. I think an organisation should be set up but at a very low key level — I can't overestimate the amount of time involved in proper membership organisation. Maybe look at some form of institutional membership?

IB. How can the gulf between FE and HE be bridged?

SC. FE will get hooked up soon (onto the academic network) and develop this debate.

Setting up a Maths Workshop

Tackling the need for additional support for GCSE students at Luton VI Form College.

Additional support was set up because of a growing concern for the large number of students who arrive at college with E and F Maths grades at GCSE and fail to improve their grades at the end of the first ear.

This is despite them attending a year long revision course of three hours a week. Many students find it difficult to obtain a university place without a Maths qualification.

The college has long held Section 11 funding and employs a Language and Curriculum support team. The problems in Maths are partly dependent on the language difficulties of the students, but it is felt that providing specialist Maths support would enhance the overall support for students. The college claims FEFC additional support units for those students as long as they attend regularly.

In September, all students with E and F grades are given a short talk about the benefits of working in small groups of four or five people. Attendance is voluntary and they are given the chance to choose times which suit them.

They can also choose a friend they would like to work with. About fifty students responded positively last year and they signed a contract stating that they were willing to attend weekly. Complete records of each student's work and attendance have been kept to provide evidence for the auditor.

Students are encouraged to participate fully in the workshop and help develop the support to meet their needs. They feel comfortable asking for help with homework and clarification on topics covered in lessons.

At the beginning of the year, students take a diagnostic test and significant weaknesses are dealt with in the first term. The students take short progress tests and choose to spend a good deal of time working through past papers.

Very few new resources are required, apart from the diagnostic test which we purchased from Wakefield college and a limited amount of photocopying of past papers. The material used to cover each topic and progress tests are tailor-made to suit the ability of each group. Students can refer to their class text books too.

In March they are given the opportunity to take UCLES Certificate in Basic Numeracy on the grounds that if they passed then it was a qualification in Maths for their CV's. If they failed, they had still had the experience of taking an exam and the result need not appear on their CV's.

About 75% of the students passed last year, some with merit, and their self esteem and confidence was given a boost. One student remarked 'this is my best achievement in Maths ever'.

Marilyn Goudge
Luton Sixth Form College

MATHEMATICS SUPPORT

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The next issue will be:
Spring 1998

The deadline for contributions for inclusion in the next issue is March 1st, 1998

To Ofsted, to Ofsted...

The first Ofsted sweep inspection caught us off-guard, as it did everybody, I think. The only real criticism the inspector had was that we didn't have any procedure in place for auditing the mathematical strengths and weaknesses of our non-mathematicians.

For this they gave us a 4, which surprised us. After all, we were perfectly aware that some of our students were not particularly mathematically gifted, even though all of them had a GCSE level C or equivalent, and we had always used some of our 150 hours to increase their knowledge.

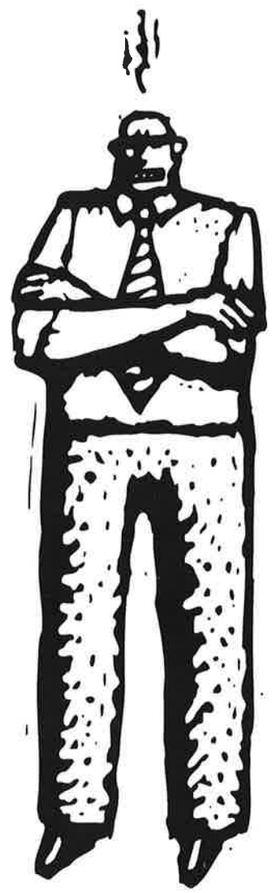
Moreover, other colleges we knew were in a similar position. Anyway, you can't argue with these people—quis custodiet ipsos custodies?—so we set about remedying the situation before they came back.

For some reason Ofsted had chosen to see the old B.Ed., a 24/89 course which we had never liked but had been forced into by Sir Keith Joseph, and, although they never admitted as much they examined it on different (14/93) criteria.

We knew that they would be back the following year, i.e. 1997, and that once again they would be looking at what by that time would be the last cohort of the old B.Ed.. Didn't they want to see the P.G.C.E. or the B.A./ B.Sc. Q.T.S.? No, that would be too fair.

So the first thing we had to do was audit the mathematical skills of our year 3 B.Ed., as these would be the ones to be inspected on the revisit.

We reasoned that the most difficult thing any of these teachers would ever have to face in the classroom was K.S. 2 level 6, so we gave the students the most recent K.S. 2 level 6 test. We marked this for each N.C. attainment target separately in order to give the students a profile of their strengths and weaknesses. A series of five extra lectures was timetabled above the 150 hours and students were required to attend if their test result was poor. We also started looking into self-study material.



We had made two mistakes here: (1) the test itself is far harder than the K.S.3 equivalent; (2) lectures are not the answer. Workshops would be much more productive.

Some students, mainly those who were going to be infant teachers, found the test so difficult that they were immediately demoralised; an outcome we had been striving to avoid with all our students for years.

We were more successful with the self-study material. We started with a book we had always recommended — Duncan's What Primary Teachers Should Know about Mathematics [1].

To this we added some units provided by our new chap in Learning Resources, and most useful of all, the Walrus' Revision Guides [2].

Obviously, we had to cater for our other students as well. We decided to test the P.G.C.E. students on entry, provide extra workshops and self study material, and test them again before they left college. We decided to test our QTS students at the beginning of year 2, and retest in year 4. That way they would have a year to prepare for the first test.

In addition, we would provide sample tests and access to self-study material from the start of the course. This would take a year to implement, and in that year we tested years 2 and 3.

In 1996-97 we had to set and mark summative exit tests for 300 students, formative diagnostic tests for 550, and provide 20 hours of workshops. All this was on top of 400 major maths assignments and over 1000 other school-related directed tasks. To accomplish this we had just two and one-half staff. In this condition we prepared for the Ofsted reinspection.

The test needed changing. We looked through old K.S.2 and K.S.3 tests and selected questions which were fair and would act as a reliable indicator of student strengths and weaknesses. We reasoned that if we used N.C. questions, it would kill two birds with one stone; it would familiarise our students with N.C.

testing, and create empathy with children in their position.

The Ofsted inspector was most enthusiastic about it all when he came back saying we were well ahead of the field and that when the I.T.T. National Curriculum came in we would already be doing it.

There remained the 'level 8' problem. While believing that it is totally unrealistic and unnecessary to get all primary teachers to a genuine level 8, we reckon we can devise tests to show that students are showing above level 8 competence in the understanding of primary mathematics concepts. For example in the associative, distributive and commutative laws.

We told the inspector that our level 6 was an interim measure. He was very pleased that we were teaching the structural laws, and concluded that we had come a long way since the previous inspection. I didn't like to tell him that we had been doing it for over14 years.

In the final report we got a '2' in the T1 cell, but this didn't help us. The inspector used the poor results of our original diagnostic test, now changed, to say that our students' mathematical ability was poor. This criticism was enough, with other relatively minor points, to sink La Sainte Union, which has now been closed down.

Year 4 never got to take the summative test — we decided they had enough on their plates — but P.G. students took it and did very well.

All our Education staff have been made redundant. Well, nobody ever told me life was fair so why should I expect it?

I've gone for early retirement, and am going to keep the wolf from the door by being an Ofsted inspector. Ironic, isn't it? And the rest of you, watch out! There is a sneaky, underhand, and totally integrity-free political agenda out there.

References:

[1] Duncan, Al., What Primary Teachers Should Know about Maths. Hodder & Stoughton. 1993.

[2] Newlands, L., Russell, S., and Joyner, R., A Revision Guide for the National Curriculum, Mathematics Levels 3 to 6. Walrus Books. 2nd edition with corrections, Sept. 1995. £1.40 and available from 4 Folly Lane, Hingham, Norfolk, NR9 4JE.

Brian Espiner
La Sainte Union

A GNVQ Time Bomb and NVQ Depth Charge?

This article is designed to highlight what the author considers to be major concerns in relation to the unpreparedness of staff in higher education to respond realistically to the demands of a mass higher education system.

This problem is unlikely to resolve without a marked rethink in terms of the way student learning is delivered and supported. Indeed, although Dearing recommends greater participation in Higher Education, it seems that further resources to support the transition of an increasingly diverse population of students to academic learning are unlikely to be forthcoming.

In essence, the diversity of student prior experience will increase, as the participation rate increases further, and students are able to access higher education with very different learning experiences. That this is desirable is unquestionable; it fits comfortably with the widespread support for the notion of lifelong learning.

The CVCP, in a strategy paper on vocational higher education in 1994, stated that: '...the assumption that universities are primarily for the education of an elite of school-leavers is gradually losing ground to a recognition of the value of mass HE and the need for lifelong learning'

The thrust of my concerns in this article centres on those non-conventional students who will increasingly access HE by the GNVQ or NVQ route alone (i.e. without any accompanying A level or AS level subjects studies and/or passed at a minimum level).

Such students have not yet reached 'critical mass' to warrant a clear and extensive evaluation of the problems they may encounter. However, many, though by no means all of these students, will have had little or no previous experience of 'traditional' approaches to teaching, learning, and assessment. The long academic essay, the use of academic referencing, and the 2-3 hour unseen examination in particular, will not form part of their background experiences in the same way as for an A level or Access course student.

The first GNVQ students have now graduated from higher education, and a recent report (the UCAS Gate Project Tracking Advanced GNVQ students into HE [1]) provides an insight into student perceptions of their difficulties.

The report found that according to students, their GNVQ Courses "lacked sufficient depth for HE". In addition, essay-writing skills had been neglected and students were ill-prepared for "the form of assessment often used within higher education". This situation is likely to be compounded as the first recruits from Modern Apprenticeship schemes and others with NVQs at level 3, begin to apply for HE courses from 1997 onwards.

The basic approach to assessment for NVQs, as for GNVQs is evidential assessment, via a learning portfolio. However, in the case of NVQs the evidence of learning will derive predominantly from the workplace and not from any formal course.

In order to provide appropriate support for these students, academic staff will need to be familiar with such methods of supporting and assessing learning.

The rationale for this is that starting at the point learners have reached facilitates learning. However, the use of a learning portfolio is itself a valid means of assessment at higher levels. It can with value be combined with more traditional methods of assessment within both undergraduate and postgraduate programmes, as our own research via the DfE funded project The Competence-based Degrees Project [2] has shown.

More fundamentally, students accessing higher education via vocational qualifications will need effective systems of support to

enable them to make the transition to academic learning.

Many higher education institutions, on their own initiatives or through external funding such as the Enterprise in Higher Education Initiative, have established study skill/ 'learning to learn' courses. They may well have explored ways of using resources such as IT/multimedia to support learning. However, all these different strategies will need incorporating into mainstream course delivery throughout all their time in higher education.

The cost implications of the above are enormous and the staff development implications far-reaching. There is also little time available to us. The implications of failure are, in my view clear. If the challenge of a 'GNVQ time bomb' and an 'NVQ depth charge' is not met proactively, the current problems of how to increase student recruitment will rapidly become those of how to address problems of student wastage and how to promote retention.

Penny Wolff
University of Huddersfield

References:

[1] Reported in the Times Higher Education Supplement 8.8.97

[2] The Competence-based Degrees Project for which the author was a Project Manager, produced a Guidance Manual and 14 Units of Support Material to enable staff in higher Education to design and deliver competence-based programmes at undergraduate and post-graduate level. These can be accessed on the Internet and are freely downloadable using http://www.hud.ac.uk/CBD

Lying with Numbers?

This is the title of a university-wide Level 1 elective, worth 5 credits (equivalent to one-sixth of a full-time year), at the University of Central Lancashire.

The primary objective of the module is to empower students to look critically at data and the ways in which it is presented.

The most complicated formula is the calculation of percentages. Principles and concepts are emphasised, rather than techniques. Students are encouraged to examine data, and statements involving data, and to ask questions about the 'fairness' of such statements.

Assessment is by means of a log-book (40%) and a group-work exercise (60%). Groups normally consist of two ore three students.

There is now a strict syllabus; students are encouraged to 'set the agenda' by producing material or asking questions. There are, however, eight broad topics, addressed through a 2-hour weekly lecture for one semester (12 weeks) almost entirely via case studies.

Material such as graphs, articles, advertisements, datasets, questionnaires are collected by the tutor and students, and form the basis of highly interactive discussions and debates. Questions and arguments are actively encouraged; no genuine opinion is ever considered 'silly'.

We try not to move on to the next item until everyone has agreed or understood the point under consideration. This aspect, of taking students' opinions seriously, was much praised in our evaluation questionnaires.

Non-numerate students prove to be just as good as their peers at the critical work, and can grasp fairly sophisticated concepts relating to, for example, hypothesis testing and correlation.

Motivation among students has been good. Their interest is stimulated by highly topical material (this year including, for example, Richard Branson's balloon flight, and the lottery), and data collected directly from the class about themselves. They have a genuine curiosity about all of this.

Once started, they realise there's a wealth of relevant information easily available, and produce it without difficulty. The fact that students from any subject might take this module is a positive advantage in broadening the approach.

The tutor needs to stay alert to current news topics; be prepared to analyse data collected one week ready for the following week's class; and be positive about every idea, even the least promising, so that confidence is built.

The main problem is dealing with large quantities of marking. The module has been from the outset, and remains, oversubscribed (despite our target of 90 maximum); many are from non-numerate backgrounds, so we must be doing something right!

Gill Kerr
University of Central Lancashire

Numeracy – who needs it?

As a lecturer involved in the teaching of quantitative subjects to Business Studies students I am familiar with the appalling standard of numeracy among first year entrants.

We find ourselves confronted with students who cannot deal with fractions, decimals, percentages etc. What have students to show for the 10 years or so spent teaching them mathematics?

There has been much debate as to the cause of this drop in standards. I believe myself that it is largely due to the syllabus, not just the content of the syllabus but the sequencing of topics.

At one time students studied arithmetic, algebra and geometry as three separate subjects with a logical sequence within each where each step depended on the previous one.

Looking at current textbooks it is apparent what has happened. In a misguided attempt to make maths more interesting, topics are muddled; a little bit of fractions today, something about shapes tomorrow then something about algebra and in the meantime they have forgotten all about fractions.

This approach has failed in two ways: (1) students do not find maths any more interesting; (2) standards have dropped alarmingly. It seems to be possible for students to progress from stage to stage without knowing the previous stages.

We have students who cannot divide 3 by 2 without a calculator and for whom algebra might as well be a strange foreign language. Over reliance on calculators is in fact part of the problem as students as a result have no concept of orders of magnitude.

Our problem is what to do about the situation with which we are confronted. We could (to take two extremes) do either of two things:

1. Try to teach the material which they should have learned at school i.e. fractions, decimals, etc.

2. Accept that they do not know basic arithmetic and try to devise a syllabus which does not require any prerequisite knowledge. This of course implies that they will leave university with no knowledge of basic mathematics.

In trying to decide this question we need to decide on what they need to know when they graduate or on what a graduate is expected to know.

Businessmen may say that they expect graduates to be numerate but what does 'numerate' mean? Does it include basic arithmetic? I am constantly confronted by people saying with respect to a particular technique (e.g. adding two simple fractions), 'but will they ever need to do that?'.

This query always irritates me. It is indeed often difficult to say with respect to any technique when one would actually use it but all together the knowledge forms a foundation on which later work builds and provides one with a conceptual framework. After all if even businessmen do not need this knowledge why is it taught in schools?

The problem with teaching this type of material is that colleagues and others will argue with justification that it is not the responsibility of Universities to be teaching secondary and indeed primary school mathematics.

It could be covered as remedial work outside the actual syllabus but it is very difficult to get students to do unpopular material which is not directly assessed as part of their course.

The unfortunate consequence is that we are driven to the second of the two alternatives above and all that that implies! I suspect that many Business Schools now teach Quantitative Methods courses that do not require mathematics, even if that seems a contradiction in terms.

Sean O'Broin
University of South Bank

Can post-graduate mentors provide effective maths support?

People who have recently survived an experience are, arguably, the best people to help others in that same position. A health visitor who has had a baby can assist a pregnant woman much more effectively than one who has only read about it!

On the basis of this idea, a post-graduate student should be very well equipped to assist an undergraduate. They have recently walked the path. This forms the basis for the use of post-graduate mentors at the University of Surrey.

At the University of Surrey there is the usual type of scheme whereby each student is assigned a member of staff to act as a personal tutor and often a second person to act as an academic tutor, plus the availability of subject lecturers for extra explanations of their topic area. Hence, students' difficulties should be picked up quickly and effectively supported. However, the student's life is often not this straight forward!

What have been the most common sorts of problems assisted by post-graduate mentors? Maths and organising written work. The latter is usually associated with the special needs of dyslexic students. Some students with maths problems are dyslexic but some are not. Dyslexia is often associated with calculating difficulties but some dyslexic students are also able mathematicians.

At Surrey, the voluntary post-graduate mentors are thought of as special people: by self-selection they have shown they recognise the students' problems and want to help them achieve their full potential.

Often the mentors can recall their own difficulties and those of their friends. To provide maths assistance for a first or second year engineer, the mentor must have a good understanding of maths at that level. Hence, most of the mentors of physicists, engineers or scientists who are interested in maths.

The most experienced mentor, Andrew, is a biochemist. He is able to get the students to explain what they are finding difficult and trace this back to a rule or concept they either have never met or do not understand. Andrew has to be a good listener and detective as well as an able mathematician!

Why do students come to the Student Advice Service for maths mentoring, rather than sort out their problems with the maths lecturers? Many try this before coming to the Advice Service.

Some find lecturers who are so good at maths themselves that they cannot get down to the studentís level of difficulty and the student leaves feeling stupid. Pressures of funding mean academic staff have increased workloads and are often unavailable.

Economies forced by low funding cause more paper-exercise-type-of-teaching and, where there are lectures, very large groups often combine students from different courses. Tutorial groups are often quite large these days.

These experiences are in marked contrast to the mentoring situation. The mentor-mentee is a special one-to-one relationship where the mentee knows that their concerns will be listened to in confidence, and together a way forward will be explored. This non-threatening environment reveals a variety of difficulties, including study problems.

Students had come to Liz Thompson, Welfare Advice Officer, in the Surrey Students' Union, for advice and help with a very wide variety of difficulties, including study problems.

Their study problems are themselves the results of a wide variety of causes but many of them can be assisted if somebody has, or will make, the time to listen, to find out why they are not progressing as they had expected and assist the student to understand what they need to do to move forward.

Liz had read about the success of Ellen Morgan's post-graduate mentoring scheme for dyslexic students at the University of North London and decided that post-graduate mentoring was worth trying at the University of Surrey.

There are significant differences between the schemes at the University of North London and the University of Surrey; organising post-graduate mentoring could only be a small part of the Welfare Advice Officer's workload; post-graduate mentors at Surrey might be asked to assist anybody, not just dyslexic students.

What of the future? The University of Surrey has recognised the need for improved student support services and Ann Harvey has joined Liz Thompson, part-time, as Learning Support Tutor. Her role includes promoting the post-graduate mentoring scheme.

In the Spring 1997 issue of the *Mathematics Support* Newsletter, Ian Beveridge notes the effect of recent changes to the maths GCSE and to simply say somebody has grade A for 'A' level maths can give a misleading signal because of the variations in the syllabi.

In addition, there are various Access, BTEC National and GNVQ courses, so it is very difficult to know what students are able to do on entry to university. Very detailed diagnostic assessment, appropriate to their course, would be needed to reveal all the gaps in the students' backgrounds.

It is likely that all the students' numerical difficulties would not be revealed by such diagnostic assessment and it would not show how easily a student could 'pick up' new concepts.

There seems to be increasing numbers of mature students with non-standard backgrounds and it is believed that between 1% and 2% of undergraduates are dyslexic. Hence, it looks as if post-graduate mentoring is here to stay! Mentors are volunteers, so it is a very cost effective way to assist undergraduates. Ideally, any mentor with a dyslexic mentee would be trained in techniques for helping dyslexic students as well as having the necessary mathematical skills.

At this time, in the University of Surrey, the mentors will be aware of the special needs of dyslexic students but not specifically trained. None of the mentees currently receiving maths support, both dyslexic and non-dyslexic, can be regarded as novices or as being bad at maths, in the usual way, so the mentors' understanding of maths and their abilities to approach the maths from different angles is probably more important than their being specifically trained for dyslexic students.

The needs of these students is substantially different from those of the small proportion of dyslexic students who have extreme difficulty with calculations. For the latter, ability to teach special alternative strategies is most important.

Post-graduate students are very busy and are volunteers, so they may not have time to attend specialist training in addition to seeing students. Many post-graduate students need to do part-time paid employment so if funding was available to pay them for taking specialist courses they might be pleased to have that opportunity.

Ann Harvey
University of Surrey

First announcement: ALM5 1998

ALM (Adults Learning Maths) is an international forum bringing together researchers and practitioners in adult mathematics/ numeracy teaching and learning in order to promote the learning of mathematics by adults.

The ALM4 Conference was held in Limerick (Ireland) on 4-5-6 July 1997.

There were three plenary addresses: 'Mathematics is for living' (Dr. Con Power from Ireland), 'Technology Transfer — A Useful Metaphor for University Level Maths Courses for Engineers and Scientists' (Dr. Juergen Maass from Austria) and 'The Adult-Worker-Student and Mathematics Education — a reality in Brazilian Society' (Dr. Eliana Guedes and Regina Zandonadi from Brazil).

In addition to these there were a number of interesting presentations, among other things on topics about math activities in daily life, cooperative learning, independent learning, math for vocational training, math for nurses, assessment and Paulo Freire's legacy for adults learning math.

The whole program is to be seen on the ALM-website (see below). I advise everybody to purchase the proceedings which probably will be available at the end of November '97.

At ALM-AGM4 a new ALM-chair has been elected: Prof. John O'Donoghue from the University of Limerick in Ireland. Dr. Diana Coben has been a great chair for the first three years and will now continue as ALM-secretary.

From now we look forward to ALM5 in 1998 to be held near Utrecht in the Netherlands. The dates are: 1-2-3 July 1998.

Please write the dates down in your personal calendar. More detailed information will be posted in coming months. Information will also be available in the ALM Newsletter on the Goldsmiths College website:

http://www.gold.ac.uk/alm/welcome.html

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It's a Long Road to Success

Bradford and Ilkley Community College is one of the largest FE & HE colleges in the country with 36,000 students of which over 5,000 are full time.

The present college is the result of several mergers after the former Bradford Technical College became the University of Bradford in 1966, and today the college has over 1000 courses available for its students.

The late 1960's and early 70's were characterised by a halcyon period in which there was available, by today's standards, a veritable treasure trove of cash and the college expanded rapidly, the mathematics staff in particular growing very quickly.

This period also coincided with the reign of a Principal who was himself a mathematician, and a great believer in team teaching, so the idea of a Mathematics Workshop, when suggested, received favourable and active support.

After a short initial period in a classroom when a mathematics lecturer would attend for one evening a week and receive students who cared to drop in with any problems the Mathematics Workshop in its present form was set up in 1975, with the creation of a large floor area and tutors on hand and available for most of the hours the College itself was open.

The idea of a Workshop approach did not meet with universal approval from all members of the mathematics staff, but with over 30 full time lecturers and a considerable back-up of part time staff there was plenty of formal classroom teaching available for those whose preference lay in that direction.

For some years the scheme worked very well and benefited from a certain novelty appeal. As well as ` eing an open forum for any student in the College to attend and receive help with Mathematics problems or areas of difficulty, the brief was wider: various paper based materials were available for student's use and, what seems now to be extremely crude, mechanical teaching machines using filmstrips in addition to some primitive computing devices were also available.

The Workshop also acted as a consultancy base for any of the College's academic or technical staff who needed advice on any aspect of the teaching or application of mathematics.

Drop out rate

After a few years however the novelty began to wear off and the Workshop became less appealing to students and less positive in its approach. This was probably because very often large groups of students were sent there, with no clear direction from their course tutor and no clear purpose or motivation.

About this time too we became increasingly concerned about the drop out rate in the GCE 'O' level classes. Several of these ran each week, and the evening classes in particular suffered most. Initial numbers of 40/45 in each of the two or three groups running every evening in the week were decimated almost to single figures by Christmas.

Contributing to this were the size of the classes, the quantity of work that had to be taught in one year and the fact that so many of the students should not have been doing 'O' level in the first place. These students were there because there was no satisfactory lower level class available commensurate with their ability.

In 1981 a conscious decision was made to dispense with formal classroom teaching in the two mainstream areas of GCE 'O' level and 'A' level mathematics: it was decided to deliver these courses entirely within the Workshop using open learning, or resource-based learning techniques; we called the system the 'Tutorteach Scheme', as the role of the tutor in it was crucially important.

The decision was a bold one, and one which even now brings out the suspicion of a cold sweat. The students could not be given the choice of either classroom teaching or the Workshop approach: if they had been the scheme would never have got off the ground.

The success story of the Bradford Mathematics Workshop began at this point. The development was not easy, and looking back over the past 16 years we have made many mistakes and have at times been very naive.

During the summer prior to the scheme starting six of us got together to write the 'O' level course: we had all worked at the college for some time, got on well and could say just what we felt about the efforts produced by the others.

Conscious decision

Even so, predictably with hindsight, we came nowhere near completing the task in time, and for the first few years the 'O' level course was based on a textbook. Only later was a free standing 'O' level , now GCSE, course completed; we still use textbooks for the 'A' level course but this is a conscious decision and they are backed up by full and comprehensive study guides.

The Mathematics Workshop is open 0900–2030 Mondays to Thursdays and 0900–1630 on Fridays. During these opening hours the Workshop is staffed at all times — at peak times with as many as five or six tutors: approximately 180 staff hours are needed each week for Workshop supervision.

Holiday opening hours are usually confined to 18 hours per week over three days. The Workshop is closed during the Christmas holidays and during the month of August.

Extra hours

Our guiding principle in setting up and developing the Mathematics Workshop has always been to remove as many constraints and barriers as possible — constraints particularly of time, access and enrolment — and to enable those who want to learn to be given the means to study at a time, place, and pace appropriate to their needs.

Having said that we do like students on set courses to attend at times which conform to the general college GCSE and 'A' level subject timetables: the advantage of this is that they can study as a group, make friends and hopefully talk mathematics. If there is a timetable clash students can do their mathematics at any other time suitable to them.

'A' level students would be timetabled for 6 hour per week during the day or 4 hours over two evenings and for GCSE students attendance would be 3 hours during the day or 2 in the evening.

In addition to these formally arranged hours students can spend as many extra hours in the Workshop as they choose, at no extra cost. Tutors are available whenever the Workshop is open, including lunchtimes and teatime.

A three hour session need not necessarily extend from 0900 to 1200, but may be from 1000 to 1300 if required, and for mature students in particular this can be convenient with young children to take to and collect from school. Also bus fares are cheaper in Bradford after 9.30 am and before 3.30 pm!

Mature students and part-time students are very important to us. I feel very strongly the significance of the word Community in the College's title and believe that one of the College's roles is to provide a second chance for students.

We have always encouraged the post 19 students, who in many cases have had a bad deal at school and are anxious to make a come-back into education.

The list is almost endless of mature students who have started in the Workshop with virtually nothing, struggled initially, but because they themselves have been able to control the pace at which they learn and have had the benefit of one to one tuition have progressed to further and higher education courses. Such students would undoubtedly have gone under in the classroom situation.

Confidence building

Also for some mature students it requires will power and steely determination to open a door with mathematics on it when the initial approach is being made.

Our oldest student to date was a charming 80 year old gentleman who did both his GCSE Mathematics and English at the College.

The more time I spend in the Workshop the more I realise that in the first instance particularly the need is for sympathetic confidence building and there is no doubt that this can be implemented much more easily by an understanding tutor in a one-to-one session than in the more open group atmosphere of the classroom.

One of the disadvantages of the Workshop system is that a student can feel isolated and alone outside the cosy confines of the classroom. We counteract this by allocating each student to a particular mathematics counsellor, whose duty it is to take more than a passing interest in students allocated to him or her.

The counsellor would mark the student's assignments, which are required regularly, would monitor progress and give advice on exam entry, University application, etc.

The student's counsellor would be on duty in the Workshop during some if not all the student's attendance periods.

Diagnostic course

For students on GCSE or 'A' level courses information supplied during the initial induction, guidance and registration enables computer printed registers to be produced for each session (morning, afternoon or evening) and it is the students' responsibility to sign against their names to signify attendance. Records of attendance can then be produced at intervals for the counsellors to take action in cases of extended absence.

All students wanting to do GCSE maths are first put on what is effectively a diagnostic course which we call 'Improve your Maths'. After a few weeks they can be allowed to progress to GCSE, or, if they are not capable there are numeracy courses available from either the AEB or City & Guilds Boards which students can take.

In this way more students achieve the satisfaction of actually passing something and coming away with a certificate - in many cases for the first time in their lives. The 'A' level scheme has a similar Access to 'A' level course which allows a settling in period and the diagnostic test which is administered to all students starting the course inevitably throws up areas of

weakness which the bridging course that we have devised seeks to address.

Over the years we have developed a system of regular tutorial sessions at busy periods: these can be used for teaching topics of common difficulty or for general information dissemination. For those students who are not able to attend these tutorial sessions there is a selection of 'A' level teaching videos available, and for GCSE students wide use is made of the video 'The Approach to GCSE Coursework', which was produced in house and which is used both for groups and individually.

Support from tutors

As well as catering for over 1000 students a year on numeracy, GCSE and 'A' level courses the Workshop fulfils a variety of other roles. Students on any of the college courses are entitled to use the mathematics provision whenever the Workshop is open — just as they would use the libraries or computer centres.

Business Studies, GNVQ, Foundation courses or CMS (Certificate for Mature Students), as well as Higher Education degree courses, are able to receive support from tutors. Many tutors actually teach on these students' courses as all staffing of mathematics throughout the college is under the control of the mathematics department.

The Workshop also receives casual 'drop in' customers from the general public who want to study a particular area of maths, need help with statistics, the decimal system or whatever, or who want to help their children with homework.

Mature students, students in Employment Training, Training Credit schemes, or any of the government's current training initiatives, as well as schoolchildren use the Workshop. However, we are careful in the latter case that the headteacher's permission is first obtained before the pupil, who must be 16 or over, is registered.

Finally, help is available for University students — either from Bradford University, of which we are the Associate College, or for former students of the college who are now on degree courses at other Universities. Some of these students so enjoyed the atmosphere of the Mathematics Workshop that they return and pick our brains for help with their present courses! These students may be on Science, Engineering or Maths courses.

An increasing problem we are finding is that students are being admitted to maths based courses with non-maths backgrounds, and the college is being called upon to provide bridging courses and tutorial support.

It is also an unfortunate fact that several Universities are having to phase out their mathematics degree courses, Bradford University being the latest victim of this malaise. Because of this the role of resource based learning workshops will become even more significant in providing the support for those University degree course for which maths is so important a component.

Unforeseen advantages

Advantages of the workshop system have emerged over time that were not foreseen at its inception: the flexible nature of the operation and the open access policy.

This has meant that enrolment could take place at any time of the year and ensured that students could work comfortable at their own pace spending as much time in the Workshop as they chose.

The fact that work missed could easily be made up helped students who were called away to work for a month, experienced changed work shifts, or had problems at home.

We did not appreciate at the start just how valuable it was to the students to have the choice of different tutors, nor did we realise fully how useful and convenient the system would turn out to be for absorbing classes with small numbers — classes which would have folded with conventional teaching.

We were also pleasantly surprised how versatile the system turned out to be with regard to the number of maths courses and syllabuses that could be made available. Additionally, syllabus changes could be accommodated with relative ease. From the students' point of view, it is easier to take responsibility for their own learning; the system is time effective so high fliers can graduate rapidly to more advanced topics, while less able students are not seen as remedial by themselves or others.

The scheme at Bradford is not perfect, and the examination pass rate has not climbed exponentially through the ceiling, but I am convinced that we now give a far better deal to students than we did in the old days. Recruitment and retention — so beloved of Funding Councils — have improved and the Mathematics Section received the seal of approval from the inspectors following their visitation two years ago.

Success in any Resource Based Learning Scheme cannot be achieved without the unstinting commitment of a friendly, caring, sensitive and knowledgeable staff working closely as a team, and I am so grateful for the goodwill that has always existed in abundance.

Anyone who has spent time in the Workshop will tell you that they receive a real fillip when they hear the comment, and we hear it often, "I could never do maths at school but I'm making real progress here"; and then the real boost comes when it's followed by "and I'm really enjoying it!".

John G Brook
Bradford & Ilkley Community College

Is there a Santa Claus?

1) No known species of reindeer can fly. However, there are 300,000 species of living organisms yet to be classified, and while most of these are insects and germs, this does not COMPLETELY rule out flying reindeer which only Santa has ever seen.

2) There are 2 billion children (persons under 18) in the world. BUT since Santa doesn't (appear) to handle the Muslim, Hindu, Jewish and Buddhist children, that reduces the workload to 15% of the total — 378 million according to Population Reference Bureau. At an average (census) rate of 3.5 children per household, that's 91.8 million homes. One presumes there's at least one good child in each.

3) Santa has 31 hours of Christmas to work with, thanks to the different time zones and the rotation of the earth, assuming he travels east to west (which seems logical). This works out to 822.6 visits per second.

This is to say that for each Christian household with good children, Santa has 1/1000th of a second to park, hop out of the sleigh, jump down the chimney, fill the stockings, distribute the remaining presents under the tree, eat whatever snacks have been left, get back up the chimney, get back into the sleigh and move on to the next house.

Assuming that each of these 91.8 million stops are evenly distributed around the earth (which, of course, we know to be false but for the purposes of our calculations we will accept), we are now talking about 1.26 km per household, a total trip of 121.5 million km, not counting stops to do what most of us must do at least once every 31 hours, plus feeding and etc.

This means that Santa's sleigh is moving at 1,046 km per second, 3,000 times the speed of sound. For purposes of comparison, the fastest man-made vehicle on earth, the Ulysses space probe, moves at a poky 44.1 km per second — a conventional reindeer can run, tops, 24 km per hour.

4) The payload on the sleigh adds another interesting element. Assuming that each child gets nothing more than a medium-sized lego set (1kg), the sleigh is carrying 326 million kg, not counting Santa, who is invariably described as overweight. On land, conventional reindeer can pull no more than 150 kg.

Even granting that "flying reindeer" (see point 1) could pull TEN TIMES the normal amount, we cannot do the job with eight, or even nine. We need 214,200 reindeer. This increases the payload — not even counting the weight of the sleigh — to 360 million kg. Again, for comparison - this is four times the weight of the Queen Elizabeth.

5) 360 million kg travelling at 1046 km per second creates enormous air resistance — this will heat the reindeer up in the same fashion as spacecraft re-entering the earth's atmosphere. The lead pair of reindeer will absorb 14.3 QUINTILLION joules of energy. Per second. Each. In short, they will burst into flame almost instantaneously, exposing the reindeer behind them, and create deafening sonic booms in their wake.

The entire reindeer team will be vaporised within 4.26 thousandths of a second. Santa, meanwhile, will be subjected to centrifugal forces 17,500.06 times greater than gravity. A 120 kg Santa (which seems ludicrously slim) would be pinned to the back of his sleigh by 2,071,207 kg of force.

but...well it's magic!!!!!!

(Lifted off the Web)

The Mathematics Learning Support Centre at Loughborough University.

Introduction

The Mathematics Learning Support Centre at Loughborough University, which is based in the Department of Mathematical Sciences, became operational from the beginning of October 1996.

It provides a friendly and welcoming environment for any undergraduate student in the university wanting help with learning mathematics.

It now contains an excellent range of resources, uses a balance of traditional and modern technologies and teaching methods, and can call upon experienced teaching staff who offer one-to-one help with students. Its facilities are completely free to students.

The large number of students who have used the Centre throughout the year have found it to be an invaluable source of support at a time when widening access, and a national problem with mathematics in schools, in turn have led to difficulties with mathematics in higher education.

1. Background

The Department of Mathematical Sciences at Loughborough University is committed to improving support for mathematics learning for all students, not only those on single and combined honours mathematics programmes but also for those receiving service teaching from the Department, for example in the faculties of Science and Engineering.

To this end, the Department identified a need for a Mathematics Learning Support Centre. Funding was secured through what was known as a 'Faculty Initiative Funding bid' in 1996, sufficient to develop a Centre and appoint a Manager for a period of two years from October 1996. This article will describe the developments which have taken place since then and the facilities now available to undergraduate students.

2. The Physical Environment

Prior to the start of the academic year the Department had taken steps to ensure that an adequate environment was available for the Centre. Substantial alterations to an area of the department had been carried out in order that space was available in which students could work independently, or in small groups, and tutorial staff could be close at hand.

Walls were replaced with windows in one staff room so that limited watch could be kept over the Centre and its resources. New furnishing was supplied to make an attractive environment which students would want to visit.

3. Learning Resources

Throughout 1996/7 a wide range of resources have been either developed in-house or purchased. These are summarised here.

Study Areas: The study area is open all day every day during term time and students have access to the computers, comfortable study space and freely available leaflets. A neighbouring room is designated an Undergraduate Study Room, and is available for private study, workshops etc.

Textbooks: An excellent library of undergraduate mathematics textbooks is available for students to consult in the Centre. These cover the majority of areas of mathematics which cause concern to foundation and first year students, including those of engineering and science, business studies, computer science and mathematics. Foundation mathematics is well covered too.

In addition to the books purchased by the Centre, a major publishing company has made a substantial donation consisting of textbooks to the value of several hundreds of pounds, together with a lockable, glass-fronted bookcase.

Open learning materials for physicists, engineering students, and also for students needing basic numeracy support are available for students to consult.

Handouts/Leaflets: A wide range of leaflets has been prepared covering areas which have been found to cause the greatest concern to students, and have been written in a user-friendly and readable style in order to help students overcome their difficulties and enable them to then move back to their lecture notes and textbooks.

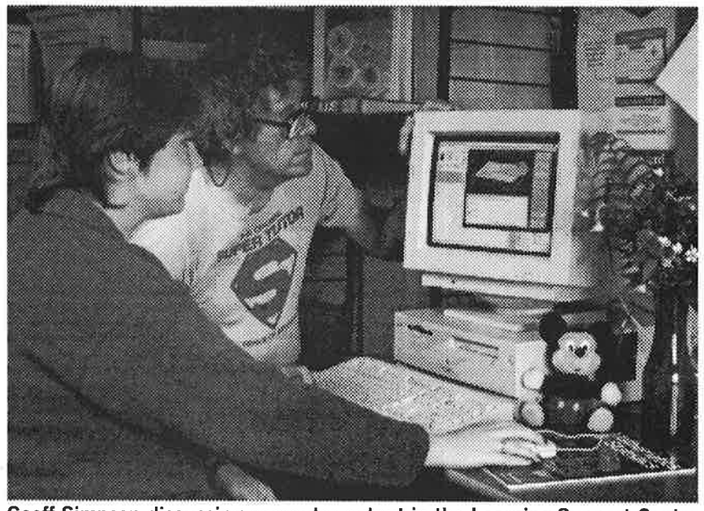
With widening access, some texts are found by some students to move rather too quickly, and fail to provide sufficient detail and explanation. The leaflets described here are intended to fill this gap.

They are written at three levels, 'Foundation' (including Access, Bridging Maths), 'Common First Year Topics', and finally, 'More Advanced Topics'. They have proved extremely popular, and are in great demand.

In addition to being available in the Centre some of them can also be obtained from a carousel in the University Library, and another in the Careers Service. All this material has been prepared using the computer typesetting package Latex, and source code is available for academic staff in order that they can customise any of this material for their own use if they so wish.

It can be accessed electronically through the departmental computer network.

The handouts can also be accessed electronically from various



Geoff Simpson discussing computer output in the Learning Support Centre

student laboratories around the campus.

A further range of Mathematics Advice Sheets prepared before the Centre opened, are also available covering key areas around the level of GCSE mathematics.

A comprehensive 'Facts and Formulas' leaflet has been produced [1] which contains a mine of useful mathematical information for first year and foundation students. This will be available to all first year engineering students in 1997/8. The leaflet is now being marketed externally through the University Flexible Learning Initiative.

Computing Facilities and Software: To date, four computers have been bought for use by students in the Centre. Two Pentium PC's and two Apple Macintosh computers contain a wide range of software for the Computer Assisted Learning (CAL) of Mathematics together with a selection of computer tools, such as Derive, Matlab, Excel, Maple and others.

The Centre Manager has worked closely with the faculty CAL Officer and started to produce study guides for students wishing to use the CAL package Transmath. It is hoped to incorporate some of this activity into mainstream teaching next academic year (1997/8).

The two PC's in the Centre are able to access the WWW through Netscape. An older PC already in the Centre is able to access the CAL Launcher — this is a campus wide source of CAL material including a great deal on mathematics.

Videos: The Centre has two video cassette recorders and televisions, and a set of videos covering the core of A level mathematics. These are suitable for those students wishing to revise forgotten techniques or study areas they have not met before.

One-to-one help: One of the most important facilities is the drop-in surgery. Any undergraduate student has been able to take advantage of this service during the year and simply 'drop-in' for help, between 2pm and 5pm Monday to Thursday and also between 6.30 and 8.30pm on Thursday evenings.

There is no need to make an appointment and students know that a member of staff will be available to help them between these times. Student feedback tells us that this service is particularly appreciated.

Workshops: Throughout semester 2 in 1996/7, workshops were run twice weekly on important topics in first year engineering mathematics such as calculus, algebra, vectors and matrices, and complex numbers. These were advertised to all first year engineering students and several made use of them.

4. Other Activities

The Centre has been the focus of several other activities during the year. There have been several Open Days for prospective students. Students have been shown the Centre and its activities have been explained. Many have said that they regard features like this as particularly attractive when they are applying for university.

On many visits parents have accompanied the students, and they too have been pleased to see that the university takes its student support role seriously. Careers and sixth form and science teachers have also visited the Centre during various conferences.

The Centre has been called upon to discuss its work at a recent TQA visit. The Quality Assessment Unit is able to draw the attention of HEFCE assessors to the work of the Centre to highlight the importance of student support in the university.

5. Promoting the Centre.

The Centre can only be successful if students are well aware of its existence and its facilities. To this end a very vigorous promotion exercise was undertaken.

This included the design and

production of posters and leaflets, advertising in the Student Newsletter, and the staff newsletter News@Loughborough, the setting-up of a web-page, informing the Student Welfare and Counselling Services, the Hall Wardens, and the Chaplaincy.

Lecturers were supplied with OHP transparencies with information that they could show to students at the beginning of a lecture. Information packs have been provided for Admissions Tutors, and Programme Directors etc.

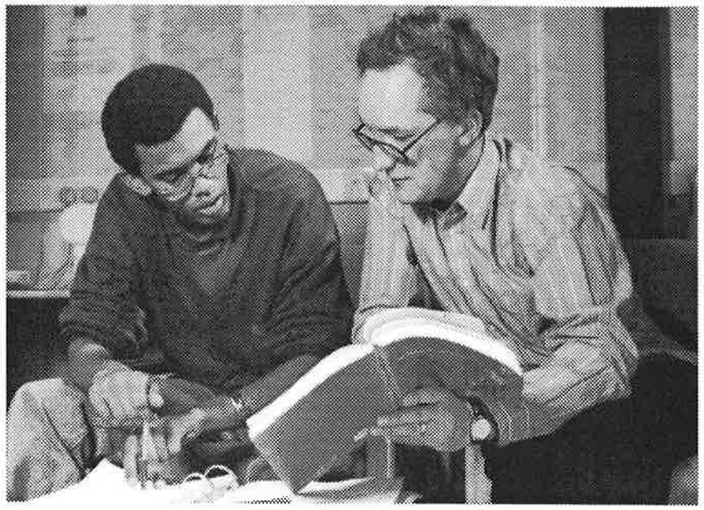
It is now possible to e-mail groups of students on particular modules. Students studying engineering have been frequently targetted for e-mail advertisements throughout the year. Individual letters were sent to certain students following the first semester examinations encouraging them to visit and make use of the Centre.

6. Student Numbers and Departments.

Monitoring usage of the facilities is not easy. However students using the Centre are encouraged to sign in a log book, and record the nature of their difficulty and the facilities used. Over 400 student visits were recorded during the year, but an unknown number of students have taken leaflets from the Centre and the Library and Careers Service. On a small number of occasions students prefer not to sign in.

Students visiting the Centre have come mainly from the Engineering faculty and this is where most of the advertising has been targetted. In addition we have also been visited by students from the Business School, Chemistry and Physics Departments, and Computer Science.

On several occasions final year students studying humanities or the social sciences have visited for help in preparing for numeracy tests for employment. This trend is likely to continue and the Careers Service are advertising the Centre when necessary.



Tony Croft giving advice during a drop-in surgery

There is no way of knowing which groups have taken the freely available literature. There is considerable demand from students on many programmes for help with problems of a statistical nature, often arising through final year project work or postgraduate study.

7. Conclusions.

The year 1996/7 has seen the Mathematics Learning Support Centre develop into a popular and well-resourced facility for undergraduate students.

The nature of the mathematical difficulties experienced by students visiting the Centre, has meant that the most valuable feature has been the tutorial support offered by experienced teaching staff. Texts and handouts/leaflets have also been found to be particularly useful. Less attention has been given by students to computer software. The main reason for this is that software for learning mathematics is not yet regarded as part of the mainstream learning experience, and many of the CAL packages are designed as complete programmes of study rather than as a support mechanism for students with very specific problems.

Work going on elsewhere in the university may mean that this shortcoming can be overcome in the future. As access to higher education continues to widen, and programmes accept students who are less well-equipped mathematically for the demands of their chosen course, the need and demand for help from a support centre like this is likely to increase.

Readers interested in obtaining further information about the work of the Centre are invited to contact the author.

References:

[1] 'Facts and formulas' by A. Croft & G. Simpson, Flexible Learning Initiative, Loughborough University.

Tony Croft
Loughborough University

Diagnostic Testing of Mathematics Students

Background

In a previous article in *Mathematics Support*, Peter Edwards asked "Diagnostic Testing - Who's doing What?" [1] This article gives further information on this very important question. The need to assess the current ability of students on entry to any course is self-evident; to be able to do so with the minimum resource implications is a new criterion.

The variety of different examinations, assorted mathematical backgrounds, (including access and mature students), will reinforce these demands in order to help students achieve a common base line.

Furthermore, the existence of strategic diagnostic testing will help demonstrate the "value added component" of existing and future courses.

Finally, such testing will provide data on the long term trend of a typical student's actual capabilities and the associated course management and resource implications.

Students – Numbers and Distribution

There are many factors which influence the skills which students entering HE possess, and indeed the total number of such students. Government statistics appear to indicate that there appears to be a decline in the numbers taking A level but the number of students passing is increasing.

This may be due to a different approach to the subject matter or there may be other factors at play. This has been analysed by Kitchen [2] who concluded that most worrying feature is the decline in double A Level candidates.

One possible means of investigating the level of skills possessed by students entering mathematics courses is to look at the way that A level papers are changing. A recent report, Standards in Public Examinations 1975-1995 [3] drew the following conclusions regarding the change in A-Levels over the last twenty years.

- In pure mathematics, standards set at the grade E boundary have fallen in two of the three syllabuses reviewed;
- at the grade A boundary in pure mathematics, whilst many aspects of performance were comparable with 1985, candidates in 1995 were not required to demonstrate as much competence in the important areas of problem solving, reasoning and algebraic manipulations;

The report recommends that in any revisions, or attempts to monitor, GCSE A levels, SCAA should work with the examination boards to:

- ensure that sufficient emphasis is given to algebraic manipulation;
- reintroduce appropriate topics from the pure mathematics section of the 1983 Common Core;
- introduce strict limits on the use of calculators in certain papers;
- limit the degree of structuring in examinations questions, ensuring sufficient discrimination between higher grades;
- ensure that more emphasis is placed in examinations on reasoning and problem solving;
- establish agreement on a set of formulae which students should be expected to know.

Suitable diagnostic testing will be able to monitor whether these recommendations are being implemented and may be able to advise on which skills, algebraic or basic knowledge of formulae need to be reinforced.

Motivation

There has been considerable change in the 'traditional student' and their qualifications. In addition we have to take into account the increasing number of students who arrive with non standard access or foreign qualifications, and the number of mature students.

In order to establish the capabilities of each student it is necessary to identify which skills they are competent in and those for which additional attention is required. Plenary teaching can be complemented by providing supplementary assistance through tutorials, supplementary classes or CAL courseware but this is more effective if each student has received precise and detailed information on their possible deficiencies.

Furthermore, the large numbers of students means that this is can be time consuming and labour intensive — we need a simple diagnostic test or tests.

Although the primary aim is to help students to achieve their potential, the gathering of national information regarding the mathematical abilities of students in HE will also be useful. Such information will help long term planning in HE and also provide positive feedback to SCAA and secondary education in general.

In the short term, it is crucial that information regarding existing diagnostic testing be made more widely available. This information should include case studies, resource requirements and possible utilisation. To facilitate this it is necessary to encourage extensive discussion between existing diagnostic test developers.

Existing Diagnostic Tests

At present there are a number of different diagnostic testing methodologies ranging from paper based testing where results are entered by OMR and computer

generated multiple choice questions through to intelligent diagnostic systems.

These tests are being used at a number of sites in a variety of different formats and produce results in numerous different formats. We envisage that a community wide approach based on these existing diagnostic tests and the development of the next generation of test will be of both educational and strategic importance.

BP Mathematics Centre, Coventry University

This is a paper based test which is marked by OMR. It is given to all students entering Engineering subjects to assess the mathematical skills and to help evaluate their individual needs. As the scores are recorded it is possible to analyse both individual students and long term trends. The results have been published by Lawson 1996 [4] .

CALM, Heriot Watt University.

This diagnostic test was originally designed on paper by Professor John Hunter of Glasgow University in the late 1970s. It is taken by all students taking Mathematics in their degrees in 1980.

In 1990, the test was brought up-to-date making allowances for changes in the syllabus and translated the questions onto the computer using Authorware. The diagnostic test still consists of 25 multiple choice questions based at the level of Scottish Higher Mathematics and was designed to take 45 minutes.

At the end of the test session the students are given an analysis of their performance which is also available to the course teacher. A sample set of questions can also be viewed at:

http://www.marble.ac.uk/marble/maths/public/assessment.htm

Mathlectics, Brunel University

Mathlectics was developed by Martin Greenhow using Question Mark Designer. It draws an interesting analogy between simple mathematical skills and single track events, grouped skills (such as problem solving) and the pentathalon, general skill and the decathalon and so on.

It is aimed at non-principal mathematicians but could easily be developed. Its great advantage is its flexibility in designing more general questions which include problems which require hot spots

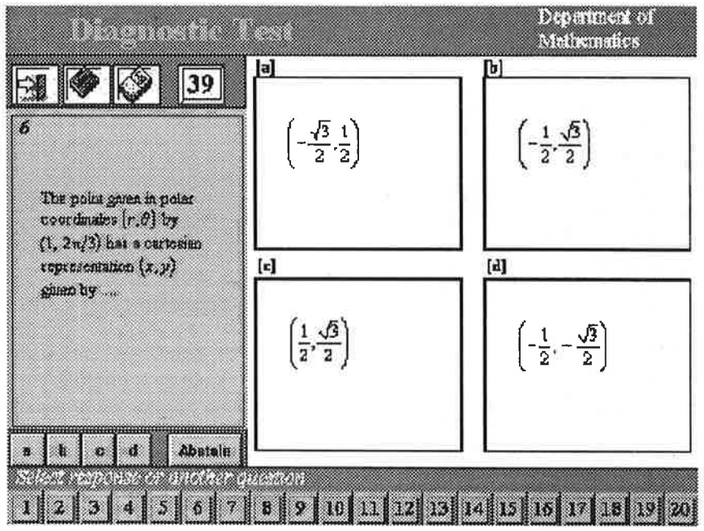


Figure 1: Testing polar co-ordinates

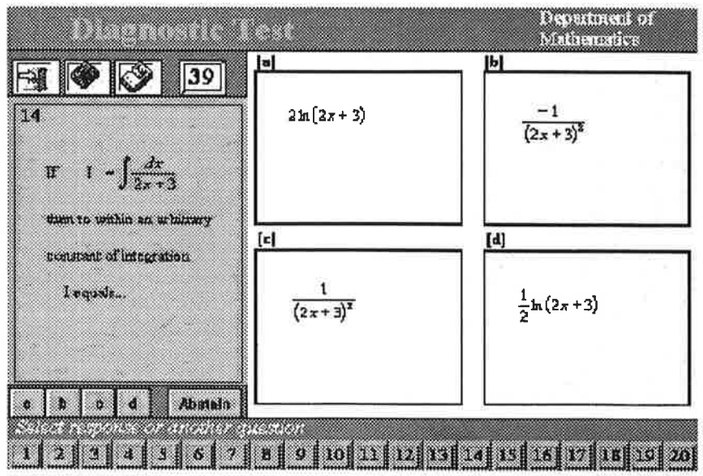


Figure 2: Testing integration.

but it is less flexible in its random capabilities. It comes with software to collect and analyse individual and group results.

Shell Test, Nottingham University

Mathematics is a core subject for over 500 students entering courses within the Faculty of Engineering and with such large number of students involved, it is inevitable that an initial level of attainment and competence in a range of mathematical skills and knowledge is assumed of the class.

As part of a CAL initiative, support has been given to the development of computer-based self-assessment diagnostic tests. to investigate the knowledge for students entering a first year module in engineering mathematics [5].

The diagnostic test was written in Authorware to run under WINDOWS and follows a format adopted in previous years in paper-based tests with Multiple-Choice questions (MCQs). Of primary importance was simplicity of operation for students but it is also flexible enough for its 'shell' to be readily used for other diagnostic tests, self-assessment tests or as a possible grading method. Customised versions of the test has been implemented by a number of UK and Australian institutions.

The test comprises twenty questions selected from a pool of 48 questions to be answered in 40 minutes; selected pseudo-randomly to ensure an adequate range of topic coverage. Further, students can usefully repeat the test at future times to gauge any improvements.

Each question is assessed for the skills needed to answer it and then weighted so that selecting random answers is not beneficial for the student. In addition to providing diagnostic material for the student, it is

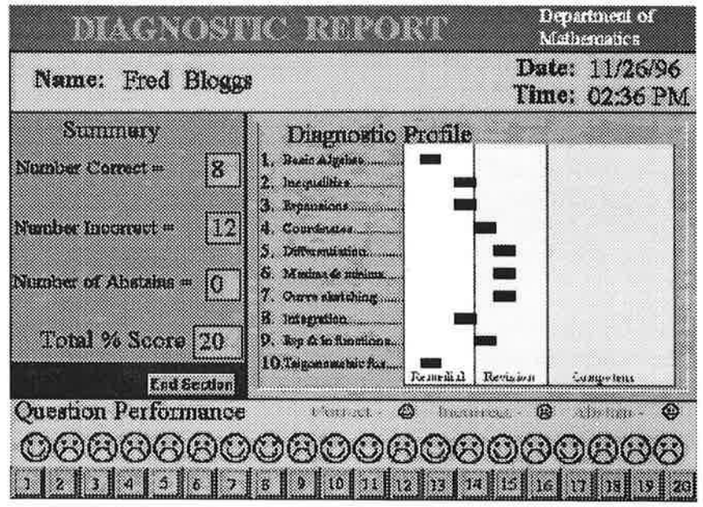


Figure 3: Student Diagnostic Report

also possible to extract global information on each question, including the most common incorrect answers.

Examination of the raw data files provide very detailed information on global student performance that can be readily used as a reference for module revisions or for directing supplementary resources.

Diagnosys, University of Newcastle upon Tyne

DIAGNOSYS is the product of TLTP in collaboration with four North-East universities. The aim of the project is to produce a computer based diagnostic testing system for mathematics and other technical subjects. Previously, the Engineering Maths Department had used a paper based diagnostic test to identify those students at risk.

DIAGNOSYS is an 'expert system' designed around a network of skills which have four levels of difficulty ranging from pre- GCSE (level 1) to approximately AS level (level 4). The main features of the basic mathematics test is that the questions asked are dynamic and based on over 90 'skills' organised into a network. The initial questions are based on prior qualification and following questions are selected using inference rules ("expert system") so that typically only about 50% of questions need to be asked. It takes about an hour and produces both tutor and student feedback.

Further information on all these tests and associated case studies can be found on:

http://www.keele.ac.uk/depts/ma/diagnostic/

Resources

In order to answer the resource implications which diagnostic testing is likely to bring forward, it is essential that suitable "remedial" material be written. While this needs minimal staff resources, it provides an effective way of ensuring all students have a common core of mathematical skills.

In the medium term we would like to encourage all diagnostic test developers to provide "student profiles" which can be linked to mate-

rial developed under TLTP, for example, Mathwise, CALMAT and TransMath.

Example of a Diagnostic Test

At Keele University a decision was made to introduce a simple diagnostic test for all students entering principal Mathematics. The test was not designed to provide summative assessment but to accomplish some of the following:

Encourage students to be self-critical

Allow students to obtain immediate and individual feedback

Give students their own learning profile

Allow students to direct their own additional studies

It involves the selection of 20 multiple choice questions from a bank of 40, the order of the choices being randomised. In addition, to a student selecting a correct option they can also abstain, the effect of which is to avoid the penalty of selecting an incorrect answer.

Typical questions are shown in figures 1 and 2.

At the end of the test each student is presented with a diagnostic report, see figure 3 and a suggested program which they might follow.

In addition to identifying individual students strengths and weaknesses, information is gathered on the cohort of students and it is possible to analyse students by skill. We are currently, investigating this. We intend to use this information to follow the trends over the next few years.

Diagnostic Consortium

The need for diagnostic testing is self evident. It is also obvious that if each institution were to develop its own test/tests then this is both wasteful and inefficient. There is a clear need for a coordinated development of diagnostic test.

To this end HoDoMS, (Heads of Departments of Mathematical Sciences) have funded a WWW site to provide information on existing diagnostic test. This is now established at the following web page

http://www.keele.ac.uk/depts/ma/diagnostic/

The format is to provide not only information where possible diagnostic tests can be obtained but also provide cases studies and contacts. A longer term aim is to coordinate the data formats of existing tests so that information interchange is possible.

References:

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[2] Kitchen. A. A-Level Mathematics isn't What it Used to be; or is it? *Mathematics Today*, June 1996, pages 87-90.

[3] Standards in Public Examinations 1975-1995. OFSTED & SCAA publication KS4/96/639

[4] Lawson D, 1996. The Mathematical Assessment of Students Entering University Engineering Courses. *Studies in Educational Evaluation*, Vol. 22, 375-384

[5] Brydges S & Hibberd S, 1994. Construction and Implementation of a Computer-Based Diagnostic Test. *Maths and Stats. Quarterly* Newsletter of the CTI Centre for Mathematics and Statistics, 9-13.

Douglas Quinney
University of Keele

Bookmarks

Conferences

Adults Learning Maths (July 1998 in Amsterdam)
http://www.gold.ac.uk/alm/welcome.html
Authoring on the WWW conference (26.11.97 at Newcastle)
http://www.netskills.ac.uk/events/
Encouraging maths students to talk (10.12.97 at Oxford)
http://www.brookes.ac.uk/services/ocsd/
NISS — Lists all major conferences
http://www.niss.ac.uk/

Diagnostic Tests

CALM, Heriot Watt University Diagnostic test:
http://www.marble.ac.uk/marble/maths/public/assessment.htm
Diagnostic tests and associated case studies
http://www.keele.ac.uk/depts/ma/diagnostic/

Archives

The CAIN Educational Archive at
http://www.can.nl/Education/education.html
The Mathematics Archive at the University of Tennessee (mirror) ttp://micros.hensa.ac.uk/subject/Mathematics/index.html

Educational Change

Centre for the Popularisation of Mathematics
http://www.bangor.ac.uk/ma/CPM/welcome.htm
Computer Aided Assessment
http://www.cms.livjm.ac.uk/www/homepage/cmsp-stri/treefrog.htm
Project Minus-Plus (to encourage use of IT in maths)
http://www.connect.org.uk/merseyworld/minus-plus/

Educational Web sites

Mathcad http://www.mathsoft.com/eduindex.html
Mathematica http://www.wolfram.com/education
Mathview http://www.maplesoft.com/CyberMath
Matlab http://www.mathworks.com/education

Networks

Adults Learning Maths
http://www.gold.ac.uk/alm/welcome.html
CTI Mathematics at the University of Birmingham (TLTP)
http://www.bham.ac.uk/ctimath
Mathematics Education International Directory
http://acorn.educ.nottingham.ac.uk/SchEd/pages/gates/names.html
Maths Support List — now LEARNING-MATHS.
You can use it to have discussions, collect information, or announce events.
To send a message to the list, just address it to:
IN%"LEARNING-MATHS@MAILBASE.AC.UK"
MEANS: Matching Ed. Assessment & Needs in Statistics
http://www.maths.nott.ac.uk/rsscse/means/means.html
Teachers Teaching with Technology (T3)
http://www.tech.plym.ac.uk/maths/ctmhome/t3.html
SI student peer support homepage:
http://www.umkc.edu/cad/

Newsletters, Interactive Magazines

Adults Learning Maths newsletters:
http://www.gold.ac.uk/alm/alm1.html
http://www.gold.ac.uk/alm/alm2.html
DeLiberations - magazine about teaching and learning in HE
http://www.lgu.ac.uk./deliberations/
Mathskills Newsletter:
http://www.hull.ac.uk/mathskills/
Philosophy of Maths Education Newsletter
http://www.ex.ac.uk/~PErnest/pome/pompart9.htm

Reports

Manual for HE to design and deliver competence-based programmes.
http://www.hud.ac.uk/CBD
Tackling the Mathematics Problem (at entry to FHE)
http://www.qmw.ac.uk/~lms/tackling/report.html

Software

Ceefax page 615
Review of GCSE Maths Cds.
Maths Software for Secondary Schools
http://ncet.csv.warwick.ac.uk/WWW/projects/cits/maths/software.html

Teaching Material

Centre for the Popularisation of Mathematics
http://www.bangor.ac.uk/~mas007
Online Classroom lessons in maths & logic
http://www.cam.org/~aselby/lesson.html

Mathematical Modelling and Communication Skills

INTRODUCTION

In the 1990's undergraduate mathematics programmes must equip students with a wide range of technical and professional skills. Among the most important of these is the ability to communicate clearly, verbally and in writing.

A recent survey conducted by the Department of Mathematics at the University of Hertfordshire indicated that many employers of mathematics graduates now regard communication skills as being more important than technical skills in mathematics.

Despite the importance of communication skills traditional courses in this subject are often unpopular with students as they appear to be unrelated to other parts of the degree programme. At the University of Hertfordshire this problem has been overcome by embedding communication skills within a first course in mathematical modelling.

THE COURSE

The course, entitled Mathematical Modelling and Communication Skills, runs for one semester in the first year of the Mathematics Degree.

Students receive up to 3 hours of tuition each week. The classes are run in a 'workshop' style and involve a variety of activities including lecture style presentations, discussion sessions and problem solving exercises. The mathematical modelling and communication skills components are taught separately but are integrated throughout the course.

The modelling component introduces the students to the art of mathematical modelling. No new mathematical techniques are taught. The models considered and the coursework exercises rely only upon the mathematical skills covered at 'A' level.

The modelling component begins with a discussion of the 'modelling model' i.e. the mathematical modelling process as described by the seven-box diagram [1]. The course continues by classifying mathematical models as being either empirical or theoretical and then looks at a number of standard models in each category.

Examples which have been used for this purpose include the Handicapping Weightlifters problem [2], the EOQ Inventory model [3], the Pace of Life model [4], the Dartford Tunnel problem [5] and the Toilet Roll model [6].

The communication skills component covers library skills i.e. locating, selecting and structuring information, report writing e.g. writing mathematical modelling reports, oral presentation, visual aids, communicating technical information and working in groups.

The course is assessed entirely by coursework. In the communication skills component there are three coursework exercises i.e. a logbook in which the students record the development of their communication skills, a group skills exercise in which the students describe the operation of a group with which they are involved and a short oral presentation on a mathematical topic. In the modelling component there are three coursework exercises i.e. two modelling exercises and a final oral presentation.

The modelling exercises require the students to work through the entire modelling process, from conducting library searches through to

presenting a solution in a formal report. The first exercise usually involves an empirical model and is undertaken individually. The second exercise usually involves a theoretical model and is undertaken in small groups.

Each exercise is marked for both mathematical content and the content of the modelling report, including the use of English, spelling, punctuation and grammar.

In the final oral presentation the students assume the role of consultants who have been called in by a company to solve one of the problems posed in the modelling exercises. The course presenters act as representatives from the company.

The students are divided into small groups and each group is required to give a 20-minute presentation to non-specialists which describes the problem, their solution and their recommendations to the company. Each presentation is marked for technical content, audibility, the quality of the visual aids, group cohesion, clear and concise recommendations and appropriateness for a non-specialist audience.

Embedding communication skills within a mathematical modelling course has produced a number of significant benefits. Student motivation in the communication skills component has improved and there has been a notable improvement in the student performance, particularly in the presentation of coursework exercises and final year dissertations.

Positive feedback has also been received from sandwich students, graduates and employers about the career preparation provided by this course. However, perhaps the most important benefit is that communication skills is now seen by students to be an integral part of the problem solving process and hence to be an essential tool for a professional mathematician.

CONCLUSION

The designers of this course, Professor Alan Davies and Rosalind Crouch, were awarded a British Nuclear Fuels prize for innovative communication skills teaching.

Since being introduced in the early 1990's the course has continued to develop. Each year new modelling applications have been introduced and increased use has been made of computer technology e.g. the Internet for locating and retrieving information and IT aids such as spreadsheets and computer algebra packages for solving mathematical modelling problems [7], [8].

In view of the increasing importance placed upon communication skills by employers and the other benefits mentioned above, it is certain that this course will continue to play a major role in the Mathematics Degree at the University of Hertfordshire for the foreseeable future.

References:

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[5] Fitzharris, A, M., 1994. Traffic, Populations and Barber Shops : A Royal Institution Mathematics Masterclass. University of Hertfordshire Department of Mathematics Technical Report No.2.

[6] Thatcher, D., 1990. The Length of a Roll of Toilet Paper. In : Huntley, I, D. and James, D, J, G. [Eds.]. Mathematical Modelling : A Source Book of Case Studies. Oxford University Press, 51-58.

[7] Davies, A, J., 1994. The Spreadsheet as a Medium for Teaching and Learning Undergraduate Mathematics. ICTCM-7, Orlando, Florida, USA.

[8] Davies, A, J. and Fitzharris, A, M., 1995. DERIVE in Undergraduate Courses for Mathematicians and Engineers. 1st International DERIVE Conference. University of Plymouth, UK.

Andrew Fitzharris
University of Hertfordshire

Biographical Notes

Andrew Fitzharris is a Principal Lecturer in mathematics at the University of Hertfordshire. He is Scheme Tutor on the BSc in Mathematics and is responsible for the day-to-day running of the mathematics courses on the engineering and science programmes. His academic interests include mathematical modelling, numerical analysis and computer simulation. He has used IT aids such as spreadsheets, computer algebra and modelling packages in his teaching for many years.

Consolidating Concepts with the TI-92

Introduction

I recall reading the results of a survey a couple of years ago, where foundation-year science students told what they found most frustrating in their maths classes. Top of the list were unhelpful comments from the lecturer when the students admitted not understanding something. Comments such as:

"You should know that from your GCSE work";

"It just is";

"The rest of the class seem to understand. Just accept it for now";

"If you can't manage that, you shouldn't be on the course".

Naturally, we all hope that we have never uttered remarks like those ourselves. But the pressure is on when having to cope with larger classes of ever more mixed backgrounds.

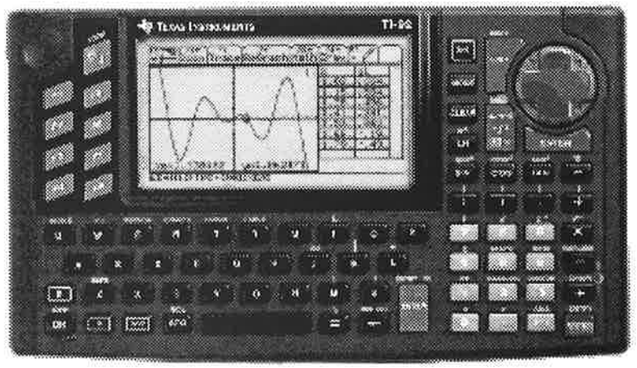
Providing support for students with conceptual difficulties - for example through additional tutorials, appointments in the maths workshop, or simply staying behind after the lesson - can be time-consuming, and not always easy to arrange.

Furthermore, students may lack the confidence to seek such "face-to-face" support. However hard we try to be approachable, my experience shows that some students still feel ill at ease and quickly claim that the "understand it all now", even when this is far from the case.

I claim that new technology can be exploited to provide structured conceptual support for students in a way which is flexible, non-threatening and credible. Examples are given below with reference to the TI-92.

The Texas Instruments TI-92

The TI-92 represents the latest generation of "supercalculators". This hand-held machine is unique in that it combines high-precision arithmetic and powerful graph plotting with a computer algebra system (a modified version of DERIVE), dynamic geometry (based on CABRI), a simple spreadsheet-style data/matrix editor, programming and text-editing functionality. It is advertised, with some justification, as combining



"the power of a computer with the independence of a calculator".

It is this independence, and portability, that can free the student to "do" maths in a computer algebra environment without being tied to attending a computer lab that runs such software. (We will concentrate in this article on the algebra facilities of the TI-92.)

Although the TI-92 currently retails for around £149, it is to be anticipated that prices will fall with time and that we may soon expect students to have such a machine just as they currently have graphics calculators.

TI-92-supported worksheets

The question is therefore: how can we exploit the unique algebra features of the TI-92 to support student understanding of essential topics? We propose a series of structured worksheets which the student works through using the TI-92. The worksheets can either be issued to the student directly, or the student can pick one up voluntarily, depending on how the need for remedial work has been identified.

The idea is that the worksheet asks the questions and the TI-92 provides the answers, in such a way that the student is able to identify what is going on and get a greater "feeling" (not to say "understanding") for that topic.

As an example, take the common case of the student being unaware of the rules of logarithms, perhaps just after a lecture where expressions containing logs were routinely simplified with no explanation. The corresponding TI-92 worksheet, in the form of a "gapped handout", would have the following structure:

(I) The student is asked to use the TI-92 to simplify expressions containing the sum of logarithms such as $\ln(3) + \ln(7)$, and write down the result. (With the TI-92, as soon as an expression is entered, it

appears on the right hand side of the screen in simplified form, as shown in Fig. 1. Note how the TI-92 works in exact arithmetic, something previously not available on a hand-held calculator.)

(II) The student is encouraged to suggest the simplified form of some similar expressions without the TI-92, by observing the patterns ini the results obtained previously.

(III) The student checks her answers with the TI-92, and is in a position to verify the result that $\ln(a) + \ln(b) = \ln(ab)$.

(IV) The procedure is repeated for the other rules of logarithms.

I believe that the provision of TI-92 -supported worksheets such as these can have a number of advantages. Firstly, students nowadays tend to believe a machine with which they are already familiar.

It would be easy for me as a lecturer to pronounce "The sum of logs equals the log of the product - learn it!" and set the student a few examples which I could summarily tick or cross, but this might appear somewhat arbitrary and temporary.

Using a TI-92, the student can try out a variety of examples until convinced. The machine is patient and always available. The student is in control.

Secondly, the TI-92 makes the pedagogical benefits of computer algebra portable and personal, and the worksheets can add to this independence. If the worksheets are readily accessible, the student can pick one up and start on it immediately rather than waiting for the next tutorial or workshop session. If the worksheets are successful, the student is spared the embarrassment of admitting to having problems. The sheets can be re-used for revision or refresher purposes.

Thirdly (this may be a disadvantage rather than an advantage unless the worksheets are carefully prepared), the computer algebra facility of the TI-92 is quite sophisticated and can reinforce some important concepts.

In the case of the rules of logarithms used as an example above, $\ln(7) + \ln(3)$ will return $\ln(21)$ as expected, but the general case of $\ln(a) + \ln(b)$ will not simplify unless the domain is appropriately defined. (The TI-92 uses a vertical line symbol to append the given conditions — see Fig. 2.)

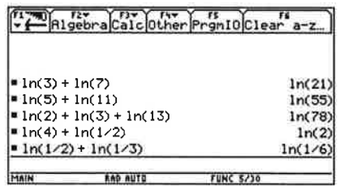


Figure 1

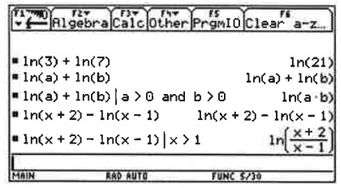


Figure 2

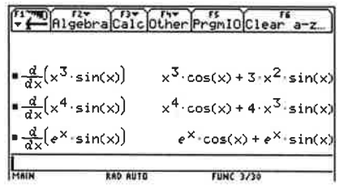


Figure 3

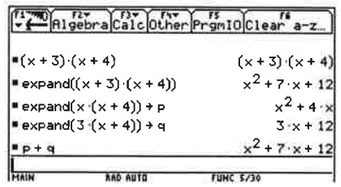


Figure 4

Furthermore, the machine is sometimes "too" clever, for example by simplifying $\ln(2) + \ln(18)$ as $2.\ln(6)$. This can lead to fruitful discussion, but should perhaps be avoided initially.

Other examples

There are many areas in mathematics where students do not understand what is going on because they are not fully familiar with some essential concepts or rules. TI-92 -supported worksheets are one way of allowing students to see the corresponding results "in action" at their own pace, and gaining the required familiarity.

Many students will find this less threatening and more convenient than seeking extra help from the tutor in the first instance.

Figs. 3 and 4 show examples of the TI-92's output when used to illustrate differentiating a product and multiplying out brackets. Readers are invited to consider how a properly structured worksheet on these topics might look, and think of further examples based on the needs of their own students.

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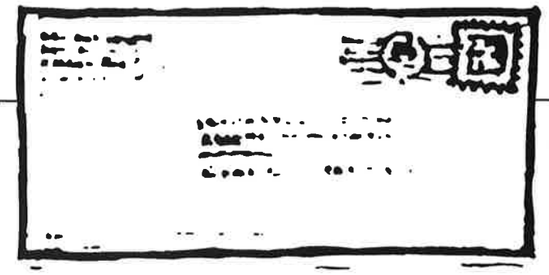
The author can arrange in-house short courses on the TI-92 for groups of interested teachers and lecturers.

The Texas TI-92, and books dealing with computer algebra and mathematics education, can be supplied by Chartwell-Bratt Ltd (tel: 0181 467 1956).

Letters



Help?!

John Wakefield (tel: 0161 745 5414)

I am setting up a Mathematics Learning Resource Centre in the University (of Salford) and am seeking help and best practice.

Numeracy in the Third World

Seigo Mabuchi
(mewxfsm4@fs1.ed.man.ac.uk)

I am taking a course in Adult Education and Development at the University of Manchester. Working as a volunteer maths teacher in Zimbabwe in the past got me interested in numeracy education in the 'Third World'. Is there anyone interested in this topic(eg. adult numeracy, indigenous mathematics, street maths, mathematical ideas and concepts of different cultural groups, emancipatory mathematics...), or with information about reasearch and literature in this field? I haven't found much on numeracy in the Third World, so any piece of information is welcome.

Literacy & Numeracy Skills in Journal of Access

Lisa Crivello <l.crivello@mdx.ac.uk>

I have been involved in fairly small scale research here at Middlesex concerning staff perceptions of literacy/numeracy skills amongst students, if anyone's interested, we published in the Journal of Access Studies, Summer '95.

Numeracy Support Systems in HE

dot lambert (d.lambert@liv.ac.uk)

I am currently undertaking research into numeracy support systems/facilities for students in HE. Does your Institution have such facilities ?

I am particularly concerned with either cross-campus provision and/or provision for those Arts or Social Science students who are taking courses which include modules e.g. stats/analytical methods/ research methods and who are experiencing difficulties with the maths content. Any information you do have would be gratefully received. If your HEI does not make any provision but you know of somewhere that does could you send me the contact details.

Project Minus Plus at Liverpool John Moores

Roger Marsh (R.E.Marsh@livjm.ac.uk)

This is a project set up in Liverpool to encourage use of IT in Maths teaching. A particular focus is under-achieving pupils (mainly KS3/4). We are working with maths teachers and SENCOs in secondary schools, and local special schools, raising awareness of new IT developments and their application to teaching and learning. We also offer technical advice and training. The project started by assessing current use of IT in maths and provision of resources (hardware and software). Schools can borrow software from the project, to try out and evaluate. I would be interested to receive names of any Maths / Numeracy programs or software packages, that members have found useful (with any comments ?), or that pupils find particularly interesting. There is a description of the project aims etc. at:

http://www.connect.org.uk/merseyworld/minusplus/

Learning Innovation Network

Caroline Adams (cadams@humber.ac.uk)

The aim of the new network will be:to act as a forum for research, discussion and dissemination in the area of managing innovation in learning in higher education, encouraging collaboration and sharing of best practice:

- sharing innovation through academic partnerships and liaison
- utilising non-university providers in learning innovation
- implementing professional development in managing transition
- assessing the future pattern of teaching and learning provision
-using new technology in promoting and managing innovation in learning

Losing Staff

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I am sorry to have to tell you that I will be unable to write an article for the Newsletter - we are losing staff hand over fist right now with corresponding increase in workload for those who are left! Sorry again.

Statistics for the Terrified, version 3

Introduction.

This program provides an intuitive approach to descriptive and inferential statistics for undergraduates who are not maths specialists. The examples are mainly taken from biological and medical topics that are of general interest and should work equally well with Business, Social Science, and Science students.

The third edition is reviewed and it involves the student in activities as well as sharpening up the graphics. It makes much of the potential of the computer to establish relationships by moving objects around on the screen. The key feature of this software is its activity approach which is intuitive, rigorous, highly visual, and with immediate feedback.

Content.

Descriptive statistics and basic distributional ideas are covered in the first of eight 'modules'. The second module explains how to choose between six basic tests that the authors claim are 90% of statistical tests in research papers.

A test of 12 questions really makes one think about the quality of data. I found the third module extremely useful and timely. It explains the meaning of '$p<0.05$', type 1, power, and type 2 error.

The modules covering difference tests and regression allowed students to move data points and observe the effects on their changes to immediately calculated statistics.

One activity has students move data until a given correlation coefficient and gradient are achieved, which I found challenging. Moving data points also makes clear how much outliers affect parametric statistics.

Concepts are treated rigorously although in the one instance where the authors are tempted to explain some mathematics, as with chi square calculations, the quality of explanation deteriorates to average.

The final module seeks to look at approaches that uncover hidden influences. It makes use of an educational experiment and examines ANCOVA and two-way ANOVA. Its visual approach works well right to the end and shows how a well designed experiment can avoid the need to control for 'noise' by advanced statistical techniques.

Strengths and Weaknesses.

The quality of graphics, plethora of examples, and student involvement by making examples interactive, are the features that make this program stand above the mass of 'ordinary' statistics software.

It has a logical approach and a modular structure that allow students to use it as a reference manual by examining one topic separately from the rest of the programme.

However, in the last two modules on regression and Ancova, all topics within the modules were linked and I found this worked better. Constantly going back to the main menu was tiresome and the forwards and backwards chevrons moved you one whole topic rather than one page.

When the Windows 95 versions of SPSS and SAS are used, the integration of this package to the procedures of these statistical software will be a marvellous feature. Currently the older versions of this software is supported. More links might be usefully made in the next verstion (please!). The ability to switch between supported software at the press of a button is an excellent idea which works well.

Summary and Conclusions.

The authors have attempted to find a way to reach students terrified of statistics and they really do have something to offer that is beyond the trivial. They achieve this by focussing on a visual though rigorous treatment of concepts.

Moreover, I found the equal treatment of the parametric and non-parametric tests made the visual analysis of data answer more useful questions than the usual textbook focus on parametric tests.

Details of Statistics for the Terrified (v.3) are available from Gregory Moxon at Radcliffe Medical Press. Tel: 01235 528820 (fax: 01235 528830).

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Support for Self-Paced Teaching Method

Background

For over 20 years most of the first year Engineering students at the University of Southampton have been taught their Mathematics by the Self-Paced (SP) method, which is based on the Keller Plan [1], [2].

Our SP method splits the material to be taught into units of approximately one week's work. A textbook, which must be purchased by the students, is chosen and material which is suitable for self-study and is written around the textbook is produced for each unit.

On their timetables students have two hours of Mathematics per week and when they feel confident about the material in a unit they take a short test during one of the two periods.

The test is marked by a tutor in an adjoining room and discussed with him on a one-to-one basis. If the student passes the test the next unit is given out, but in situations of failure the student must take a parallel test on the same unit at a later testing session.

Support

Units are written with the aims of producing a structured work programme for studying a topic, providing fuller and/or better explanations of difficult sections in the textbook, presenting complete notes on material not included in the book and, if necessary, correcting errors in the text.

Most students find the explanations satisfactorily provided, of course, they spend the necessary time on study. Not surprisingly, some have problems and it is important that appropriate tutorial support is available for those who need it.

The marking tutors are almost always free for the first 20 minutes of a testing session, whilst many students are taking their tests, to discuss with particular students any problems that they have encountered.

Students are strongly encouraged to bring along any minor queries to these sessions, but time is limited and the marking tutors are not able to provide lengthy assistance.

As a result a very important additional help scheme, called the Mathematics Workshop, runs throughout the academic year. The Workshop is open for 2 three-hour sessions each week and has two resident tutors, very experienced at the School-University interface.

Students in difficulty can drop in at any time during opening hours with quick queries, or can stay for longer periods and obtain extensive assistance and support. Some library facilities are also available in the Workshop.

About 15% of Engineering students use the Workshop at least once during their first year. Some use it infrequently, whilst others attend regularly. Students with problems can also now access some of the CAL packages increasingly available.

Conclusions

Southampton is fortunate in that most of its Engineering students enter with good A-level grades, but there is still considerable variation in the mathematical backgrounds and abilities of the first year students within any given Engineering department.

For these heterogeneous groups, student questionnaires and examination results suggest that the SP method is an effective, efficient and, in general, popular way of teaching Mathematics, but the success of the scheme does depend crucially on having in place appropriate support mechanisms for students experiencing difficulty.

References:

[1] Keller, F.S. Goodbye Teacher. Journal of Applied Behaviour Analysis 1 (1968), 79-89.

[2] Keller, F.S. and Sherman, J.G. The Keller Plan Handbook. Benjamin, 1974.

Bob Craine
University of Southampton

In this issue