MATHEMATICS SUPPORT NEWSLETTER

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editorial

The Yin and the Yang of Maths Support

In this issue, John Searl reviews some of the lessons of the (superior) way that Scottish Universities develop students' mathematical skills.

He challenges the assumption of constructivists that learners will attempt to make sense of mathematical problems.

In place of it, he wonders if we don't first select the important problems (i.e. those we can do something about) and devalue all other problems as not worth an effort, and for many that would include mathematics.

Supporting students who have failed in the traditional routes necessarily requires attention to the affective aspect of their experience. The primary task is to provide positive motivation to learn maths.

Larger class sizes are upon us. Service teaching can often be delivered to classes in the hundreds. Survival, if nothing else, forces consideration of objective tests marked electronically.

I've noticed students tend to do worse in electronic tests as compared to traditional pen and paper exams. The distracters seem more correct than the genuine answers. The examples of typical naive beliefs from forty years ago, when used as distracters in objective tests of algebra, still work today.

A small group examinination of multiple-choice questions and exploring the logic of each possible answer might be a way to learn how to handle electronic tests. Liza Brown from Coleg Harlech practices small group discussions of typical errors in order to reinforce recent learning. It is an alternative to routine exercises and requires students to think about why one answer might be better than another and what exactly makes it better.

Do these contributions from Wales and Scotland represent complementary or alternative views? Might the recognition of a need for frequent practice come from working in small groups that demand competence from its members? Groupwork makes use of the social situation of education whereas routine work can be done, as the author says, independently and at the speed and intensity of the individual learner.

There is an analogy with the Yin of psychotherapy which develop understanding as a basis for problem-solving and the Yang of drugs to create a stable environment. Working with small groups to articulate the logic of maths is the Yin that creates independence from understanding.

The Yang is regular practice of known routines developing automaticity with basic maths skills, which is the stability treatment for the very large numbers of students with low maths self-esteem.

A problem-solving environment with peer support and small group work throws the responsibility of learning back onto students. That would seem to be the environment that is both created and needed in successful maths workshops *a.k.a.* maths support centres.

Special pullout section

maths on the internet

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Therapy More Effective Than Remediation

A number of commentators on the undergraduate mathematics scene have claimed that students now come to university less well prepared mathematically than they did ten, twenty... years ago.

It is difficult to prove or disprove such assertions, when we are not comparing like with like. There have been changes in the mathematical demands made of students in the last twenty years due to the impact of computer technology on all our lives.

Surprise

I can still remember my surprise at finding first year students who thought that $1/(a+b) = 1/a + 1/b$.

That surprise, of course, occurred 40 years ago when entry to university was very restricted and only the best students were accepted. (There are other old friends: $\sqrt{(a+b)} = \sqrt{(a)} + \sqrt{(b)}$. Surprisingly, one rarely sees $\sqrt{(a2 + b2)} = a + b$. Perhaps repeated exposure to Pythagoras' theorem prevents that blunder.)

The real issue is: how do we respond to such ignorance in our teaching approaches?

One response is to subject all incoming students to a mathematical test which attempts to identify areas of weakness in individual student's knowledge, to make the student aware of these inadequacies and to supply the student with some resources for remedying them.

An alternative response is to attempt to identify areas of weakness common to many of the incoming students and to ensure that the teaching materials take those weaknesses into account.

This second approach was that adopted by the Scottish Universities in a series of annual tests that were organised in the later 1970's.

The purpose of the test was to identify those areas of the school curriculum which were poorly understood or consolidated. The main aim of the study was to assess how well first year students would be able to follow working on a blackboard or television screen.

The main weaknesses identified were: index laws, algebraic manipulation, geometric series, logarithms, inequalities, and trigonometry.

Since 1980 some universities have continued to use the test as a 'diagnostic' test, a purpose for which it was not designed. It is neither broad enough in content nor subtle enough in questioning to fulfill that role.

Distribution of errors

A recent study (Jackson, 1997) of undergraduates at the University of Edinburgh found that on their examination scripts the distribution of basic errors (i.e. errors due to misunderstanding school learnt mathematics) was the same among both those who passed and those who failed the examination.

The difference between those who passed and those who failed was in the distribution of non-basic errors (i.e. errors due to misunderstanding university learnt mathematics). It seems that, as in other areas of life, students with a mathematical disability learn to live with it and find ways of coping.

Among the reasons for this may be:

1. these blunders, because they concern elementary mathematics, are described as trivial mistakes and are mentally discounted as of no importance.

2. undergraduates have many more pressing demands being made of their time and energies.

3. most students have implicitly rejected mathematics many years before.

Thus the experimental evidence is that the mathematical progress of first year students is impaired by misunderstandings and mis-skills arising from poorly consolidated school mathematics. These inadequacies lead to further disenchantment with mathematics.

Confident and competent

In the face of these inadequacies, the detail of the mathematics presented to students in lectures and elsewhere has changed. The 'missing' steps between the lines of an argument are more often explicitly put in place.

The mathematical demand made of students in some subject areas has changed. Exercises are more clearly structured, more 'help' is given.

These changes partially address the problem, but not wholly. The aim is to produce mathematically confident and competent students and to achieve that it is necessary to elicit some complementary action from the students themselves.

A remedy for their unease with 'basic' mathematics may lie in a teaching approach used in many primary schools in Scotland (and elsewhere). There, use is made of a series of small books called, "Six-a-day..., Ten-a-day" (Griffiths, 1983) which rehearse skills and concepts learned in previous years of the pupil's experience.

A study of the effectiveness of these as a study aid in a very difficult learning environment was made several years ago (Sheikh, 1984). He showed how this learning resource could be used in primary school classes in Sudan.

Remarkable improvement

There, the class size was about 100 pupils and there were few teaching materials available. The books were translated into Arabic and given to the pupils. They were told to work by themselves on the books, one set of exercises per day. There was no opportunity for any teacher input.

The improvement in performance of pupils in the State Examination was remarkable in two ways: (1) the size of the effect and (2) the uniformity of it.

All pupils benefited from this learning resource, not just the less-able pupils. The mark distributions show this quite clearly. Passing the examination was critical for many of these pupils. It gave them access to secondary education and the possibility of a less harsh life.

Greater exposure to mathematics

Following the success of this experiment, a similar learning resource was produced for students at university. A set of forty 10-a-day refresher exercises were produced on school mathematics.

The school syllabus was covered systematically. Each set of questions focused on a single topic and a target time was given.

An analysis of the examination scores showed that the students' performance improved by a factor of about 25% and that an improvement was observed across all levels of attainment.

Of course, it is difficult to persuade students to use this type of unglamourous learning resource. It is simple to produce. It has been demonstrated to be effective when it is used, but students' lives are busy with many more obviously relevant tasks to address.

Logically, part of the success of the materials can be attributed to the greater exposure to mathematics of those students who use them, in the same way as the blunder $\sqrt{(a2 + b2)} = a + b$ is seen more rarely than $\sqrt{(a+b)} = \sqrt{(a)} + \sqrt{(b)}$.

And perhaps if our students spent an extra 10 minutes a day doing elementary mathematical tasks associated directly with their courses, they would perform better anyway.

References

Griffiths, A.L. *Basic Ten-a-Day*, Oliver and Boyd, 1983.

Jackson, S.M. *The Use of Investigative Tasks in Developing Students' Ability to Apply their Mathematical Skills*. MPhil thesis, Napier University, 1997.

Sheikh, AS el D. *School of Mathematics in Sudan*. PhD thesis. University of Edinburgh, 1984.

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MATHEMATICS SUPPORT

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The next issue will be:
Autumn 1998

The deadline for contributions for inclusion in the next issue is October 31st, 1998

Letters

Is Anyone Researching Internet-based Maths Tutoring and Assessment Systems?

The Maths Department of Ngee Ann polytechnic (in Singapore) is currently developing an internet-based maths tutoring and assessment system and the pilot system will be implemented in May 98.

This system is intended to be adaptive, *i.e.* to tutor the students according to their ability, whether weak, average or good. The objective is to cater for the wide-ranging maths abilities of our students and improve overall student learning, supplementing the traditional lectures/tutorials.

As such, my department is interested to know whether there are similar projects / research interests in the area of internet-based discovery mathematics, adaptive and intelligent teaching and assessment systems at universities/tertiary institutions in the UK.

Lim Khia Kiam
(lkk2@np.ac.sg)

Lim Khia Kiam will be at Warwick U from 19 to 26 Sep 98 for a seminar, and would like to explore the possibility of making a visit to persons in the UK involved in using/developing such systems after the seminar at Warwick U.

Best wishes,
Pam Bishop (CTI maths)

Are there Numeracy Diagnostic Tests out there?

I am a lecturer in Mathematics at Liverpool Hope University College, and the college is considering requiring that a large number of our first year degree students (several hundred) diagnose the existing level of their numeracy skills.

We are looking for a flexible computer software package that can diagnose/assess skill levels in numeracy, and separately provide opportunity for practise.

If you are aware of any software package (suitable for use on networked PC's) that might meet our needs, I would be very grateful if you could let me know.

Dr Peter Kahn, Fax 0151 291 3163

Hello,

Does anyone have a maths or numeracy diagnostic test for adults that could be used by a teacher in the classroom? Or any ideas concerning the area of diagnosis of an adult's problems with basic operations?

Help gratefully appreciated,
Send reply to:
alexa.con@zetnet.co.uk
(Alexandra Connolly)

The Phantom Maths Workshop

Have anyone else experienced anything like the following?

De Montfort University had a visit from a large number of sixth-formers from several schools expecting to attend a mathematics workshop at the university.

Each of the schools had received an official-looking 'invitation' to an event, hosted by an organisation called the National Institute of Mathematics, during which HRH The Duke of Edinburgh was scheduled to attend a reception and present prizes.

Eminent mathematicians, said the invite, were to speak at the event and run master classes, quizzes and other activities.

Fortunately, an improvised programme of events was laid on by DMU so the sixth-formers didn't go home too disappointed. We are, however, trying to get to the bottom of the mystery.

Any help would be appreciated.
Reply-to:
admin-cvcpr@mailbase.ac.uk

Study Skills in Mathematics – the Book

I am pleased to tell you that some progress has been made at last. Pam (Bishop) has discussed the booklet with Mathskills who have suggested that the booklet (on Study Skills in Maths originally published by the Shell Centre for Maths Education) should be scanned in to a computer and put on their web site (http://www.hull.ac.uk/mathskills/

Michelle Ashworth
CTI Mathematics

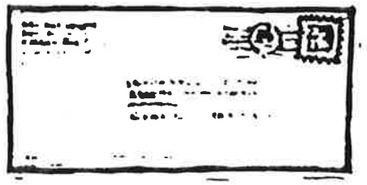
Anyone teach Maths Entirely on the Web?

DeLiberations is working with James L. Morrison, who is part of the Microsoft Corporations initiative Helping to Fulfil the Promise of Technology, in a call for manuscripts that provide examples, success stories, rationale, and tactics of how faculty members have incorporated technology in their instruction. The objective is to provide guidance to faculty members who wish to begin using such tools in their own classrooms. The manuscripts will be developed from thesis paragraphs through to completion on the web.

http://www.lgu.ac.uk/deliberations/

Have You Researched Adult's Ideas About Mental Arithmetic?

My name is Kathy and I work as a part time numeracy tutor. I am currently undertaking some research to try to identify the various mental methods adults use to calculate basic arithmetic.



I am making comparisons between methods used by adults who feel 'confident' with everyday maths and those who do not.

I am particularly interested in how adults who have limited mental computational skills can be helped to develop them.

I am having great difficulty finding any literature relating to the subject of mental arithmetic and adults.

Send reply to:
Kathy Bocutt
100754.2157@compuserve.com

Does Your Maths Workshop have a Remedial Tag?

There has been steady trickle of new members joining the (Learning-Maths Discussion) list, but not much else has happened for a while. Perhaps it would help if we all introduced ourselves to the list, to see if there are any common discussions or arguments we could be having!

I ran a drop in maths workshop for a whole university, and much of the institution liked to think of me as the "remedial numeracy" teacher. This label makes it easier for issues of learning and teaching in maths not to be addressed. Does anyone else suffer from this?

What percentage of your students take maths as part of their course? Either implicitly (such as in geography) or explicitly as numerical skills and statistics/QM units. At the University of North London I estimate it to be around 85%. This means the debate about maths in FE and HE really should not be confined to those concerned with maths specialists.

Sybil Cock

Talk about Maths Support Centres –Please!

My name is Biddy Casselden and I recently started work as WAND (Writing & Numeracy Development) Centre Manager within the Student Services Dept. at the University of Northumbria (UNN).

WAND is an open access learning resource centre for all UNN students, to either drop-in, or be referred to. We offer a confidential service as well as resources in different aspects of literacy and numeracy. For example, we have materials in; report writing, statistics, essay-writing, dissertations, CVOs, algebra etc. (We hope to greatly expand to include other key skills). Our materials include study guides, books, videos, and CAL packages. We also arrange 1:1 tutorials with numeracy/ literacy specialists, which take place in the centre and are booked by students. In addition, we offer group sessions on particular topics.

My remit is to develop the resources of the centre (I am a qualified librarian and ex-teacher) and raise the profile of the centre within the University.

I would be interested to hear from other individuals who work in a similar set-up, in order to develop a network, and perhaps swap ideas as to the best way to develop such a facility.

Biddy Casselden
(email: biddy.casselden@unn.ac.uk or tel: 0191 2273526).

CONFERENCES

MSC3: Maths Support Conference in FHE, 7 September 1998, University of Loughborough. www2.unl.ac.uk/~11pickardp/msc3
This one-day conference is an opportunity for those involved in helping students learn maths to compare notes. Broader issues are examined in the keynote addresses; areas of specialised support are discussed in seminar groups; and our own in-house resources can be shared with a wider audience. Cost £65 or £85.

Improving Student Learning Symposium, 7-9 September 1998, University of Brighton. /www.brookes.ac.uk/services/ocsd/ISLtop.html
Cost and board £255

Mathematics Education and Society, 7-10 Sept. '98, Nottingham University. Cost in the region of £400. e-mail: peter.gates@nottingham.ac.uk

Undergraduate Mathematics Teaching Conference, 7-10 September, Sheffield Hallam University www.hull.ac.uk/mathskills/umtc/ A working conference of HE lecturers. Cost is £250. Last day is a separate one-day conference on computer algebra with the TI92 (cost £30).

Do You Want to Improve Your Maths or Statistics Teaching?

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http://www.maths.napier.ac.uk/courses/postgrad/pgmed.htm

Encouraging Discussion in the Numeracy Class

Inspectors identify that a narrow range of teaching and learning activities is often a significant shortcoming in the teaching of maths. In particular, students are not encouraged or do not have opportunity for discussion in the subject.

I teach Basic Maths to adult returners, mostly previously unemployed men, who are embarking on Arts or Social Science courses. Typically they are frightened of the subject and greatly lacking in confidence.

It can be difficult as a tutor to devise ways to introduce fruitful communication between students when teaching basic routine procedures. This can especially be the case when time to cover a great deal of material is limited.

One idea, which I have recently found has stimulated some lively argument, is to present students with sheets which I call "Bertie Brainbox's Wrong Answers". (See examples below).

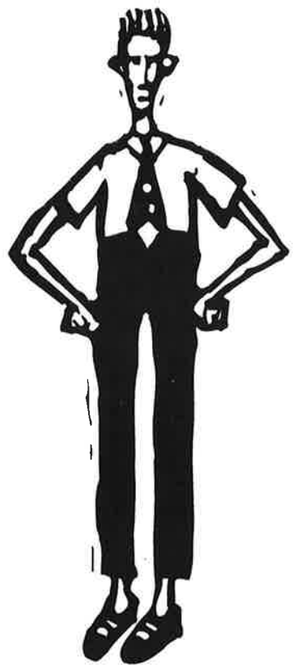
These are presented after covering the topics in more conventional classes. Most of these simple sums are given wrong answers which are based on the most common errors students tend to make. (I also throw in the occasional correct answer!)

In small groups of three or four, students are asked to identify:

(a) if the answers are incorrect
(b) what mistake Bertie made?
(c) what should the right answer be?

Emphasis is made that this is a group exercise so that no-one should dominate if they see the answer immediately, but everyone should have the chance to give a point of view.

As a tutor, I wander around eavesdropping and just occasionally put a suggestion to look again if a whole group thinks a wrong answer is correct.



Groups also occasionally call me over to help settle disputes, in which case I would ask a few leading questions to set them on a more fruitful path.

The students themselves have responded positively and would like to do this activity more often. Among their responses have been:

It's very useful. I used to be ashamed if I couldn't do something but this is O.K.

It's good to bounce ideas around.

It's very useful as revision – you can check how much you know without looking at notes. I picked up a few things I need to revise.

Everyone seemed to enjoy it. Different people remembered different things – it was good revision for us all.

It breaks down barriers if you're afraid of asking for help.

I hadn't done the practice work and it showed me that I need to.

It wasn't so much getting the answer, it was spotting what he had done wrong that was enjoyable.

It's a boost to yourself to see how much you've learnt.

Maybe we could do a few every week – you know – the previous week's work. That would encourage us all to revise and practice in between.

When you work cooperatively in a group, you don't feel like you're cheating: not like in school when you sit in lines.

Funnily enough I enjoyed it. I didn't think I would but when you enjoy it you learn and we all got on well.

I often went wrong but there was a lot of feedback. Interaction stimulates you – you think, "Oh yeah, I could do that!"

I have noticed that having done this work there is more peer support in the more traditional (talk - do - talk) classes that have followed.

The only potential drawback I see is that the occasional very weak student could feel an increased sense of inadequacy if they do not follow what the others in the group are saying. However, in my experience so far, the more able students have been very patient and painstaking in their attempts to help weaker students and indeed it is not unusual for a weak student to gain much confidence when they have helped someone else.

- All in all, I recommend this as a useful activity that is easy to organise and that has several positive features including:
- increased communication
- peer support
- useful revision developing awareness of a variety of pitfalls
- increased student self-confidence
- an enjoyable learning environment.

Liza Brown
Coleg Harlech.

Bertie Brainbox's Wrong Answers

What did Bertie do wrong to get these answers? What should he have done?

1. Write in figures the number two thousand and six... 2,000 6
2. 652 – 316 = 344
3. 43 × 5 = 2015
4. 912 ÷ 31 = 34
5. 3 + 4 < 8 × 0... True
6. 5 ≥ 5... False
7. 8 – (4 – 3) = 1
8. 4(7 – 2) = 9
9. 2 + 6 × 3 = 24
10. 5 × 4 – 6 ÷ 2 = 7
11. 3/5 = ?/15 *ANS.* = 3/15
12. *CANCEL* 6/24 *ANS.* = 4/6
13. 3/4 + 1/3 = 4/7
14. 4 1/4 – 1 1/2 = 3 1/4
15. Which is bigger? 3/5 *or* 3/4? Answer: 3/5
16. 2 3/4 × 3 1/5 = 6 3/20
17. 3/5 × 4/15 = 12/15
18. 4/15 ÷ 2/3 = 2/3
19. 6 2/3 ÷ 2 3/4 = 3 8/9
20. What is 2/3 *of* 5/6? Answer = 4/5

Maths and Non-violent Communication

Dr Marshall Rosenberg created the Non-violent Communication (NVC) model some 30 years ago in the USA in response to the physical, emotional and spiritual violence which he witnessed around him as he grew up in Detroit.

He studied the behaviour of people who were able to deal with others constructively and in a non-violent way. He works with business people, parents, teachers, doctors, politicians, police, students, prisoners and urban gangs across the continents.

There are now over 60 authorised trainers of NVC in over 20 countries. In the UK, there is a co-ordinating team who are presently working with schools, University students and staff, drug addicts, health workers and therapists.

The NVC process helps me to:

- express my observations, feelings, needs and requests and hear others without judgement, blame, guilt or shame
- resolve differences constructively
- influence people without engendering resentment or impaired morale
- enable students to act out of choice
- respect diversity and difference

Training in Non-violent Communication has changed the way I interact with my students. I find modelling it myself enables them to communicate using NVC too. It has changed the atmosphere in my seminars from competition to co-operation, from me/them to one of mutual education and trust.

Marshall himself was training Primary teachers and children in Italy recently. He said to one boy in a maths class: "I don't agree with your answer."

The boy's face dropped. Marshall asked him: "What did you hear me say?"

The boy replied: "You told me I got it wrong".

Marshall repeated: "I said, I don't agree with your answer."

The boy's face lifted. Marshall said: "Could you show me how you got your answer, and I'll show you how I got mine."

By the end of the day, the children could 'hear' "I don't agree with your answer" even when a teacher said to them: "You got it wrong!"

I value autonomy and interdependence; NVC skills help me work in harmony with these values in my classrooms.

Pat Dannahy
Senior Lecturer in maths
& maths education,
Westminster College, Oxford

Initial and Diagnostic Assessment of Maths Skills

By initial assessment, I mean assessment of all new students, the purpose of which is to identify students who may have support needs and to check that students are being placed on the correct programmes.

By diagnostic assessment, I mean further assessment of those students identified in the initial assessment process to ascertain the nature of support needs and design a support plan.

INITIAL ASSESSMENT

At Croydon College we have been using initial assessment material which consists of quite a long selection of questions which arguably range from Entry Level to Level 2 Application of Number in content. We are working on a new approach which is described here.

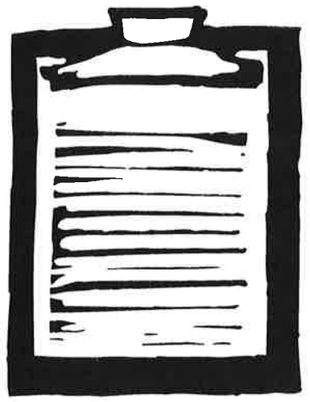
We have taken into account several key requirements of an initial assessment scheme for maths:

- It must be short
- New/prospective students do not want to spend hours being assessed.
- It must be easy to administer
- Large numbers of students need to be assessed and sufficient specialist staff are not available.
- It must be quick to mark and interpret
- Admissions/course tutors need to mark and give quick, sometimes instant feedback. The process must be easy to follow.
- It must accessible to students whose first language is not English
- We are assessing maths skills; English skills will be assessed elsewhere.
- It should be focused at the level required from the student
- A new student will be demoralised if the assessment is too difficult.
- It should test maths skills and not their application
- Application of Number/Key Skills can be taught in context on the course if the basic skills are in place.
- It should look inviting but not childish
- Students must take the test seriously.
- Students should be reassured that the outcome will be to their benefit
- Nervous students will not produce their best work.

Time is the important factor. Hard pressed admissions/course tutors do not have the time or expertise to conduct a full diagnostic assessment; this is so whether initial assessment is at interview, enrollment or induction (and there is some debate over this issue).

We are moving towards initial assessment at interview so that students are placed on the right course and support is planned and put in place from the outset. Consequently we will be assessing even larger numbers of students, some of whom may subsequently decide to go elsewhere.

On the other hand a short test may not always be very reliable.



Care must be taken in interpreting and feeding back results — some students may be wrongly identified as needing support (this is rare) but others may slip through the net and even feel unduly complacent about their ability as a result. Students can always self-refer for support, so the anxious but capable student will still be supported.

It is not feasible for us to use a computer-based system at this stage for reasons mainly of logistics but also cost. In FE, many adult students would not be comfortable with a computer test and the tutor can learn more from written answers.

FUNDAMENTAL SKILLS

What we are developing at Croydon College is a series of short, level specific tests. Each consists of approximately 10 questions based on fundamental skills within the appropriate Key Skills definitions.

At the moment we are making the assumption that, at the start of a course, students would need to perform adequately at the level below that of the intended course. The scores suggested are:

above 60% = pass

40–60% = needs additional learning support

below 40% = query choice of course/needs additional learning support.

Course tutors could choose the relevant level of test for in-coming students. In some cases e.g. academic maths and engineering students could sit a higher level test and others e.g. non maths based HE students could sit a lower test although the courses may be designated the same level.

Other colleges are taking the view that students must achieve a 50% score on the test at the level of the programme of study. This decision depends on the calibre of incoming students and their expected achievements.

There is always the option that more than one test could be used. This could establish whether a student should consider a higher level course. High or low scorers in relation to the chosen course could benefit from further diagnostic assessment before making a decision.

At present the tests we have developed are not vocationally specific. In the longer term, we may use the original tests as templates for vocationally based tests, if required. A further option is that programme teams could add vocationally specific questions of their own.

The tests we have devised satisfy the requirements stated above for initial assessment.

A possible deployment of the tests could be:

Test	Level	For Admission to Programme at Level	For Admission to maths-based programme at level:
A	Entry Level	Foundation GNVQ or equivalent	
B	Foundation Level (Key Skills Level 1)	Intermediate GNVQ or equivalent	Foundation Engineering programmes
C	Intermediate Level (Key Skills Level 2)	Advanced GNVQ or equivalent	GCSE maths
		HE (low maths requirement)	Intermediate Engineering programmes (GNVQ, BTEC)
D	Advanced Level* (Key Skills Level 3)	HE (some maths requirement)	A Level maths
			Advanced Engineering programmes
E	Higher Level**		HE maths based programmes

** = GCSE level approx; ** = A Level approx*

DIAGNOSTIC ASSESSMENT

Diagnostic assessment is a much more detailed investigation into specific skills or the lack thereof. It is needed to verify the results of initial assessment, to establish support needs and to set up a support learning plan.

We have found much of the published material, whether paper-based or on computer, is very expensive and I cannot claim first hand experience of most.

We have tried Diagnosys in the past and found it too advanced for the majority of our students as our assessment levels D and E (see table above) are where the Diagnosys package starts — perhaps it could be extended downwards?

Our priority is identifying students whose support will be funded through additional support units which by definition means their needs will lie in the pre-GCSE domain.

We use a generic assessment of some 40 carefully chosen questions. The test delves into the fundamental skills starting with low level questions and increasing in difficulty. We explain carefully to students that it is not a pass or fail test but is designed to identify what they can and cannot do.

As with initial assessment we are more concerned with skills than application but at this stage we also investigate language skills — can the student turn a wordy question into a sum? Further material (for example for students on engineering courses) is used as necessary.

The skills requiring attention are recorded on a checklist and this forms the basis of the on-going support programme.

We report back to course tutors on the planned support and at regular intervals on progress. We also discuss resources and the course syllabus so that support is tailored as far as possible to the requirements of the course.

Of course, support is not just about the skills but also their application; however during assessment, we focus on skills.

We are always looking at new approaches to assessment — all suggestions will be gratefully received!

Nicola Fleet
Croydon College

ROBERT GORDON UNIVERSITY'S MATHEMATICS LEARNING SUPPORT CENTRE

An Analysis of the First Year

The primary objective of the Mathematics Learning Support Centre (MLSC) is to raise the level of student proficiency in the use of basic mathematical skills. Success in achieving this objective will help reduce student wastage rates and enable students to achieve better grades on their undergraduate programme.

At the beginning of the academic session all first year students entering the Faculty undertook a diagnostic test before embarking on their undergraduate studies.

This was done via DIAGNOSYS v2.3, a computer-based quiz (CBQ), with the option of a paper-based version (PBV) for the benefit of those students who did not feel completely at home with computers. The results were used to help Course Leaders and Mathematics Tutors identify students at risk.

This procedure enabled the MLSC to focus on the specific areas of weakness of each student at risk, thus saving valuable time.

Over 200 students were tested by the Centre; details of the mean score for each course are given in the table. It is interesting to observe that the students who sat the PBV scored higher than their counterparts.

Diagnostic Test Results – Summary

Course	CBQ	Mean Score	PBV	Mean Score	Gender M/F
Electronic and Electrical Engineering HND/BSc	47	47	0	–	43/4
Mechanical Engineering HND/BSc	36	46	2	48	37/1
Electronic and Electrical Engineering BEng	23	56	1	49	22/2
Mechanical Engineering BEng	12	51	0	–	9/3
Mechanical and Offshore Engineering BEng	31	52	0	–	29/2
Applied Sciences BSc	31	47	42	65	37/36
Technology and Business BSc	4	70	0	–	0/4

SUPPORT PROVIDED

Student Learning Programme – Student test profiles have been useful in setting up Individual Learning Programmes (ILP) for some students coming to the Centre, however this task has required greater input than initially estimated.

One-to-one Tuition – Although this is a costly procedure it is evident from the figures below that it is the most popular support.

Workshops – To avoid repetition, students with a common problem area are provided with group tuition in a workshop. We expect this mode to be more useful as we gain experience in identifying topics which many students find difficult.

USE OF RESOURCES

Computer-based learning packages are available for self-study purposes, in order to free valuable academic staff time for one-to-one, or group tuition as required. So far the problems encountered are finding good packages and getting students to use them independently.

Despite today's technological advances most students are still used to learning using paper and pencil; of course it may be true that learning is indeed enhanced by writing on paper. However, the interactive packages do provide visualisation of a problem, and require pro-active strategies to be utilised successfully.

Video tapes are also available for self-study; however the Centre's environment currently does not provide ideal conditions for this mode of study. We intend to improve this situation and also increase our library of tapes which is far from comprehensive.

Text books are available for reference.

Study area is provided at the Centre. The availability of a tutor in the study area, if/when required has made this a useful and popular facility for our students. Unfortunately our records for study area usage are not as accurate as we would wish.

Generous opening hours, with tutor support between 10am and 6pm, are offered during the week along with a couple of evenings. The Centre was open Saturday mornings but it has only attracted a handful of dedicated students. These opening hours allow students to attend the Centre outside of teaching times.

Feedback — is obtained on skills commonly causing problems is given to teaching staff so that they can address these early in the Semester.

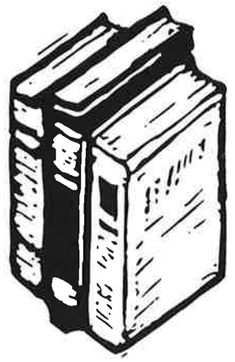
Hours of usage for the MLSC are given below:

Tutor	917
Computer	83
Video	4
Study	52
Total hours	1056

Of course, the role of the Centre is not to act as an additional tutorial facility but to deal with deficiencies in basic mathematical skills that are hindering their undergraduate studies. So far we have not had a problem with turning away students who intentionally

Continued on page 21

Special pullout section



maths on the internet

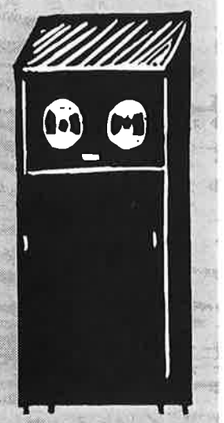
Acquiring Internet Skills

Education & the Internet and Authoring Web Sites
http://www.netskills.ac.uk/events/
This is a practical workshop for users of the World Wide Web who have had some experience of creating basic Web pages. The workshop focuses on the issues and practical aspects of designing and creating multimedia Web pages and will explore on-line tutorials. A free on-line tutorial for Education users is available at: http://www.net-skills.ac.uk/TONIC/

Archives of Maths Resources

CAIN (Computer Algebra Information Network)
http://www.can.nl/Education/education.html Lessons, Tutorials, Lecture notes, Maths & stats. software. Links to worldwide web sites and inter-active material in maths education. A huge collection of resources, much of which is immediately available.

The Mathematics Archive at the University of Tennessee (mirror)
http://micros.hensa.ac.uk/subject/Mathematics/index.html
The 'mirror' adjective is important as it means this site is local and so downloads very fast at most times of the day. Owning a MacIntosh, I'm particularly keen on this page http://micros.hensa.ac.uk/cgi-bin/browser/get:/mirrors/info-mac/_Science_%26_Math/ with a huge collection of maths programs. There are free scientific calculators for every taste and that's just one of thousands of bundles of useful resources. I recommend free statistics programs to my students since they are easier to use and often as powerful as student editions of popular software.



The Treefrog Project
http://www.cms.livjm.ac.uk/www/homepage/cmspstri/treefrog.htm
A computer based self assessment of maths skills combined with tutorial. TREEFROG checks each step of the student's argument for consistency, and recognizes if the correct finishing point has been reached. The on-line prototype in polynomial algebra gives rudimentary feedback using malrules if a mistake is made in a step. Contact: P.M.STRICKLAND@LIVJM.AC.UK

Statistics Education through Problem-Solving (STEPS)
http://www.stats.gla.ac.uk/steps/ The STEPS consortium consists of several institutions who developed problem-based modules to support the teaching of Statistics in Biology, Business, Geography and Psychology. The software is free to educational institutions, and can be downloaded from this Web site. The aim of the materials is that students

Diagnostic Tests in Maths

discover statistical issues arising from specific problems in the individual course subjects. The role of the computer is to assist in the exploration of the problem and to provide support materials. Graphical illustration plays a major role. The STEPS modules are intended to support existing coursework. Each module is supplied with appropriate documentation, as Word files which can be edited.

CTI Mathematics at the University of Birmingham (TLTP)
http://www.bham.ac.uk/ctimath Listings of forthcoming maths and stats conferences when you click on the 'Diary of Events' link.

FE and HE education site (NISS)
http://www.niss.ac.uk/ A general site for UK and foreign news with links to BBC and major UK newspapers. Good listing of most academic conferences with special section on maths and education. Good for jobs too.

Diagnostic Tests in Maths
http://www.keele.ac.uk/depts/ma/diagnostic /
The need to assess the current mathematical ability of students on entry to any course is self-evident. In addition, 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 core of mathematical skills. The aim of these pages is to make information on existing diagnostic tests more widely available. There are links to 5 well documented sites for main diagnostic tests on offer.

Statistics Diagnostic Tests for Engineering Students
http://www.cs.auc.dk/Svess
You need to capitalise the S in Svess to get through. Additionally you need a password. This on-line test of level 1, level 2, and level 3 statistics skills is an attempt to create common standards in this subject across Europe. It is a joint initiative of European Universities (CRE), European Engineers (SEFI) and European Distance Learning (EADTU). The tests are multiple choice and focus on probability and probability distributions and their applications to engineering. The accompanying paperwork is thorough and useful and a paper-based version of a test can be printed directly.

Educational Change

Centre for the Popularisation of Mathematics
http://www.bangor.ac.uk/ma/CPM/welcome.htm
An interesting site quite different in content from the usual. A good collection of material on knots. This site is linked to other interesting web sites. The aim is to show mathematics as a study of form, pattern, and structure. The hope is to bring certain areas of mathematical thought to the attention of anyone who enjoys thinking and puzzling over patterns and structures. The goal is to introduce people to the idea that mathematics is something which they can do.

On-line Classroom lessons in maths & logic
http://www.cam.org/~aselby/lesson.html
Dr. Alan Selby's lessons in 15 areas of popular maths. The Electronic 'Sawyer'. Begins with adding and subtracting whole numbers.

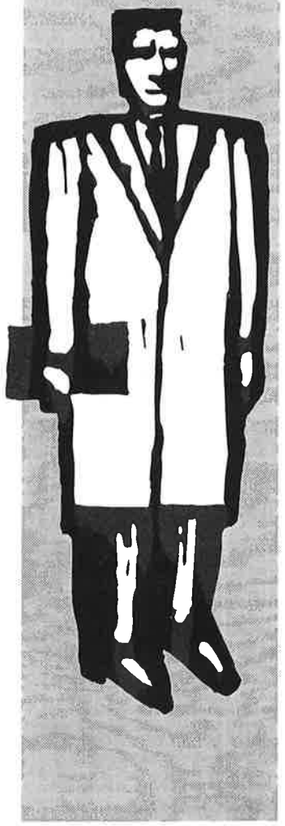
Project Minus-Plus (to encourage use of IT in maths)
http://www.merseyworld.com/ minusplus/
An inspirational site suggesting a way to combat unemployment through improved numeracy skills. A pilot project aiming to help in the regeneration of Liverpool by

addressing the low attainment levels in numeracy of school-leavers and other disadvantaged groups. The aim is to produce an interesting learning / revising environment, such that the target group would be motivated to use. A COMPUTER GAME with Maths content was seen as a solution to this. The use of multi-media technology should also increase confidence and skills in IT. Secondary maths software reviews are also found on this site.

Teachers Teaching with Technology (T3)
http://www.tech.plym.ac.uk/maths/ctmhome/t3.html
This is a genuine European initiative to promote the use of computer algebra, Derive, & TI92's in schools, FE colleges, and elsewhere in HE. Provides inservice courses for teachers of mathematics and science. The courses are designed to:

- increase teacher confidence in using hand-held technology,
- raise teacher awareness of its potential,
- identify examples of good practice in use,
- provide a framework to raise standards in teaching,
- enable teachers to enhance student understanding

Networks



Adults Learning Maths
http://www.gold.ac.uk/alm/welcome.html
Do you teach adults maths, stats or numeracy? This is a friendly network that meets once a year and publishes everything that has been presented at that conference. Since all participants are encouraged to bring some material, a lot of useful resources are accumulated.

The Centre for the Study of Mathematics Education (CSME)
http://www.nottingham.ac.uk/csme/ is a new centre for research, development and teaching in mathematics education established in the University of Nottingham. It incorporates the Mathematics Education Social Research Group and the Shell Centre for Mathematical Education, which closed on 31 December 1997.

CTI Mathematics at the University of Birmingham (TLTP)
http://www.bham.ac.uk/ctimath
A government sponsored organisation to develop and disseminate useful computer based material in HE and with many resources for FE. (See article on page 16).

Mathematics Education International Directory
http://acorn.educ.nottingham.ac.uk/SchEd/pages/gates/names.html
Here is a list of research oriented maths educators in the UK.

MATHSKILLS: a Discipline Network in Mathematics
http://www.hull.ac.uk/mathskills/
The aim is to disseminate information on innovations in teaching and learning. Mathskills provides regular newsletters, survey data, discussion groups, conferences, as well as gradually establishing reference material such as expert lists, exemplars of good practice, case studies and other support material. Contact Dr.Ekkehard Kopp. Tel. 01482-465876, Fax: 466218 email: p.e.kopp@maths.hull.ac.uk

MEANS: A Discipline Network in Statistics
http://www.maths.nott.ac.uk/rsscse/means/means.html
Matching Education, Assessment and Employment Needs in Statistics (MEANS)
Its main aim is to create a closer match between the statistical training received in

Discussion Groups

Newsletters & Interactive Magazines

higher education, and graduates' subsequent employment needs. Web pages are designed to help people find suitable teaching and training materials. Contact is Peter Holmes Tel: 0115 951 4911; email: ph@pmn1.maths.nott.ac.uk

SI student peer support homepage:
http://www.umkc.edu/cad/
Click on the overview button to finally get a clear idea of what peer support means and takes to make successful. It makes clear the focus is on difficult modules and trained students who don't teach but facilitate the acquisition of the study skills needed to pass.

Maths Support List — now LEARNING-MATHS.
http://www. mailbase.ac.uk/
This is the home page so click on the bullet against, 'Discussion Lists', choose the letter 'L', and then click on 'Learning Maths'. We are an esoteric gathering of 135 maths educators. Curiously, only 6 of us are included in the list above. What does this mean? The framework for a lively list (such as the Innovations in Student Learning list below) is right here.

Improving Student Learning Symposium
http://www. mailbase.ac.uk/
This is the home page so click on the bullet against, 'Discussion Lists', choose the letter 'I', and then click on 'ISL'. This really is a lively discussion group with many contributions to each debate, such as 'graduateness' and does it include numeracy? Its 370 members average 45 contributions per month!!!

Adults Learning Maths newsletters:
http://www.gold.ac.uk/alm/welcome.html
ALM newsletters and conference reports form a rich resource on learning maths all over again as a mature student.

DeLiberations — electronic magazine about teaching and learning in HE
http://www.lgu.ac.uk./deliberations/
Content includes: evaluated case studies of teaching and learning in subject discipline areas; contact lists of staff interested in similar work; extracts of related published articles; commentary on case studies and articles contributed by readers; book reviews; annotated bibliographies; links to related resources and relevant publishers.

London Mathematical Society (LMS Journal of Computation & Mathematics)
http://www.lms.ac.uk/tackling/report.html
Fully developed site with Jobs, Journals, Lists of sub-committees, Meetings & Conferences, & Reports. 475 maths journals listed in its library. In addition, reports such as "Tackling the Mathematics Problem" (http://www.lms.ac.uk/policy/tackling/report.html) and also "Mathematics Still Counts" (http://www.lms.ac.uk/policy/tackling/node5.html).

MathSkills, issue 4 of its newsletter.
http://www.hull.ac.uk/mathskills
This issue includes updates on a number of the MathSkills themes, as well as some more general articles, including 'A levels: A higher Education Perspective' by Mario Micallef of Warwick University, and a guest editorial by Alan Norcliffe of Sheffield Hallam University, looking at performance tables.

Computer-assisted Learning (CAL) and Basic Mathematics

CTI Mathematics [1] was set up to provide an authoritative source of information on ways that computers can help in the teaching and learning of mathematics in higher education.

To that end we have amassed a great deal of information about packages that can be used by mathematics lecturers either in their own departments or when providing service teaching for science and engineering courses. Full details are available in our publication Maths&Stats: Guide to Software for Teaching [2].

Many CAL packages listed in the Guide focus on the core topics of a first year undergraduate course. For lecturers based outside mathematics departments this focus may be too advanced.

The National Council of Educational Technology publishes a booklet listing major applications[3] but these are mainly relevant to the schools sector. There is also a project developing materials for use with graphics calculators[4] rather than computers.

Summary

I have attempted in this article to identify basic CAL packages which will be relevant to post-16 students and their teachers. Unless stated otherwise they will run on IBM compatible personal computers under Windows 3.1.

The following summary selects software that addressing numeracy skills, and then basic mathematical skills as foundation for HE work. Reference is made to more detailed accounts or reviews of the software, user departments and an indication where possible of the support provided to student users — our quarterly newsletter Maths&Stats is referred to below as M&S.

Usage information is based on a recent survey of mathematics departments, and so does not reflect the situation in the wider institution, or in the further education sector.

This is followed by a section listing resources which can be obtained at little or no cost, or for the cost of materials, at least in the higher education sector. The final section gives contact details for further information about CTI Mathematics.

1. Numeracy Skills

Many packages have been written for school pupils at this level, but they tend to be aimed at the requirements of the National Curriculum and so were not considered relevant for inclusion in the Guide. The following have been developed for use in further and higher education.

Core CALMAT is a suite of programs covering numeracy, basic algebra and geometry, some coordinate geometry and basic trigonometry. It is a new development from the CALMAT team at Glasgow Caledonian University, and we hope to carry a review in our November newsletter.

T102, the Open University Technology Foundation Course, has an introductory unit with number test, followed by Block 1 covering units, number, simple algebra and graphs, Block 2 binary number and functions, Block 3 manipulation, sines and circles, Block 4 exponential growth and log-linear graphs and Block 6 statistics relating to health. This CAL material is only part of the course, but can be purchased separately.

The Numbers Disc provides interactive multimedia support for adult numeracy through a flexible learning programme suited to a wide range of abilities. It can be customised to meet the needs of different learners and organisations, and features case studies, a hidden spreadsheet, skill-building exercises and numbers games.

The Complete Mathematics Workshop covers the GCSE syllabus, including 231 modules variously at Foundation, Intermediate and Higher level. There is primary teaching material in modular format, each module complete with student workpacks/sheets and random selection of questions. Results are stored on disk, and there is a courseware monitoring and reporting system.

Two packages have been developed in Australia. Queensland University of Technology produces a wide range of interactive computer-based tutorials including 20 maths modules and 12 each on business statistics and accounting. Fundamentals of Mathematics from the University of Wollongong consists of Macintosh CAL modules in numbers, logarithms, function notation, indices, factorisation, trigonometry, vectors and limits.

2. Foundation Mathematics Skills

The following packages provide tutorial material in algebra, calculus, trigonometry and geometry. Most are organised in modular form, so that a selection can be made to suit a particular student or course.

Only titles addressing more than one topic are included here - there are also single-topic packages listed in the Guide, and recently there have been several releases of multimedia calculus packages, requiring the use of a CD-ROM reader and sound card, which is expensive to provide in a teaching laboratory.

CALMAT courseware is aimed at students at the interface between

school and university. It was developed at Glasgow Caledonian University, where it is the backbone of a summer foundation course for new entrants. Each lesson contains prerequisites, learning outcomes, instructional material and randomly generated questions with complete solutions on demand. There is a review of its use at Coventry University in M&S Feb 93.

Mathwise provides an interactive environment for self-study. There are some 50 modules, each the equivalent of some 5 hours of lectures, aimed principally at students on science and engineering courses. One of these covers the basic rules of arithmetic applied to the manipulation of real numbers and algebraic expressions.

The user can also browse through leaflets on specific topics, and use resources and tools within the environment to investigate problems set as part of the teaching material. There are accounts of its use at Keele and Glasgow in M&S May 96.

Transmath also consists of self-study modules which cover the maths topics required by students entering science and engineering courses. Many examples and exercises are provided; a number of runtime generated exercises incorporate sophisticated help facilities.

There is a revision section in the elementary algebra module covering number, fractions, indices etc. The original version required a link to Mathematica for full functionality in the exercise sections, but later versions are free-standing in this respect. There are accounts of its use at Leeds in M&S Aug 94 and ALT-J v1 n2, and at Strathclyde in M&S May 96.

METRIC is a third approach to the mathematics that students need for science and engineering courses. Its modules encourage active learning in which the students use Mathematica to explore ideas and solve problems. Each module takes about one hour to complete and consists of a Mathematica NoteBook and a Study Guide booklet.

Some of the worksheets are published in print and electronic format as Experiments in Undergraduate Mathematics, and this was reviewed in M&S May 97. The integration into courses at Imperial College is described in M&S May 96.

Mathematical MacTutor is a computerised tutorial system which provides a large number of examples for practice, help facilities, relevant theory and worked examples.

It covers most mathematics topics covered in first year courses at a Scottish university, using the graphics and animation features of

MATHS SUPPORT ASSOCIATION MEMBERSHIP APPLICATION

NAME _____

JOB TITLE _____

INSTITUTION ADDRESS _____

_____

_____

TEL/FAX: _____

E-MAIL _____

Are you willing to join the editorial board for the next newsletter?

YES/NO

Are you willing to help plan the next conference?

YES/NO

I enclose a cheque for £15.00, made payable to "The University of Luton."
In return, my institution will receive the next two copies of this newsletter and discounts for all delegates to the next conference.

RESEARCH INTERESTS:

_____

_____

Send to: **Ian Beveridge**
Department of Electronics & Mathematics
Faculty of Science, Technology & Design
University of Luton
Park Square, Luton
Bedfordshire, LU1 3JU
e-mail: Ian.beveridge@luton.ac.uk

Macintosh computers to enhance the understanding of concepts and ideas. There is a review of the package in M&S Feb 92, and accounts of its extension to more advanced courses at St Andrews in M&S Feb 96 and May 97.

CALM (1) is a set of 25 computer-based tutorials, each based on a lecture topic as given in the first year of an engineering course. The student is given a review of the theory covered in the lecture, taken through worked examples based on this, and finally tested using randomly selected questions.

A management package is included which stores the student's results for monitoring purposes. *CALM (2)* extends these ideas for basic algebra. Heriot-Watt has extensive experience with developing and implementing this material, as can be seen from early issues of M&S, for example in Feb 90 and Nov 91.

Maths (I) CD runs on Macintosh computers, and contains modules on basic algebra, functions, coordinate geometry, calculus and mathematical modelling. It uses animation, a library of functions and other features to reinforce specific topics. *Maths (II)* CD contains these modules as well as a course in Numerical Analysis; it was reviewed in M&S May 94.

MST121 *Using mathematics* is a first level course from the Open University. It shows how mathematics can be employed to investigate and answer questions from science, technology and everyday life, using a range of powerful techniques, in particular discrete mathematics (including matrices), calculus and statistics.

The use of computer software (Mathcad) is an integral part of the course. Communication of results and the ability to define problems are important and these skills are also developed and can be related to the skills defined by the Scottish/National Vocational Qualification, Level 4.

The Advanced Maths Workshop covers the complete A Level syllabus, including Pure Maths, Applied Maths and Statistics, in 100 modules on a single CD-ROM.

This is primary teaching material, each module complete with student worksheets and random selection of questions. Results are stored on disk, and there is a courseware monitoring and reporting system. A review of this package was published in Computers in Higher Education Economic Review 12, Feb 91.

Mega Maths is a 24-program step-by-step A-level course for mature beginners. It covers topics common to Pure and Applied Maths and all examining boards, from permutations and straight line geometry to advanced calculus topics.

Mathematics Toolkits, developed at the University of Arizona, consists of many useful interactive demos and teaching aids, and has the advantage of being available free of charge from the Mathematics Archive (see cost of resources, below).

The cost of resources

For all the packages listed here, prices and suppliers details are either included in the Guide or can be obtained by request from CTI Mathematics. Some are available for little or no cost, as follows:

The original versions of materials developed under the Teaching and Learning Technology Programme (TLTP) are available to staff in higher education either free (via the Internet) or for the cost of materials (disks or CD). This covers Mathwise, Metric and Transmath; instructions for downloading are available from CTI Mathematics. Fees will be charged outside higher education or when there has been post-TLTP development, quality assurance or upgrading.

The Mathematics Archive at the University of Tennessee contains large quantities of freeware and shareware. Much of this is listed in the Guide under the heading Public Domain Mathematics Software, and the archive itself is mirrored at http://micros.hensa.ac.uk/subject/Mathematics/index.html

If your institution has a network licence for one of the commercially produced mathematics packages, it is worth looking at their educational Web site. This may include worksheets based on the package which are suitable for beginning maths students.

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

The CAIN Educational Archive at http://www.can.nl/Education/education.html also points to educational material for courses that use computer algebra packages, including Maple and MuPAD as well as those listed above.

Where to get more information

Further information on any specific package can be obtained from CTI Mathematics at the University of Birmingham, Birmingham B15 2TT, phone 0121 414 7095, fax 0121 414 3389, email ctimath@bham.ac.uk

There is a Web page at

www.bham.ac.uk/ctimath giving further details of services provided by the Centre and pointers to other sites of interest including those listed above.

Staff in higher education are entitled to receive our quarterly newsletter M&S free of charge. This contains reviews of software and articles about its implementation in departments.

Anyone with access to email is invited to join a discussion list by sending the following one-line message to mailbase@mailbase.ac.uk /join cti-maths Your Name

Members of this list receive advance information of Centre activities, including our regular workshops.

Pam Bishop, August 1997
CTI, University of Birmingham

References

[1] Formerly known as the Computers in Teaching Initiative Centre for Mathematics

[2] Maths&Stats: Guide to Software for Teaching is available from CTI Mathematics, price £5

[3] Software for Mathematics, available free of charge — send a self-addressed A4 envelope to Ronnie Goldstein at NCET, Milburn Hill Road, Science Park, Coventry CV4 7JJ

[4] Teachers Teaching with Technology (T3) c/o John Berry, Centre for Teaching Mathematics, University of Plymouth, email jberry@plymouth.ac.uk, Web page http://www.tech.plym.ac.uk/maths/ctmhome/t3.html

Are Maths Standards Falling in Secondary Schools?

In 1996, the London Mathematical Society (LMS) sponsored research into the question whether a pass in GCSE maths (i.e. grades A to C) is comparable to GCE O-level or a grade 1 at CSE. This article summarises two reports (1) (8) that can be read in the original version from the library of the LMS (see last item of the centre-page pull-out of Internet resources).

The LMS champions what it claims to be the overwhelming view of maths lecturers that standards in mathematics have fallen among those entering higher education.

Despite recently rising percentages of students achieving good maths GCSE grades, the weight of evidence suggests falling rather than rising standards.

Moreover, changes in GCSE, such as the introduction of project work and structured questions, have made the transition to A-level maths even harder.

Since 1994 students can acquire a B Grade when taking only intermediate tier GCSE syllabus that assesses students on a syllabus with little algebra (1) (2).

Putting more students through this route can raise the league table position of counties and schools (because it is easier to teach and to learn) but puts students in a mathematical cul-de-sac where progression is difficult.

What happens elsewhere?

The experience of teaching 'new maths' in America during the 1960's, with a more general syllabus, was regarded by many educators there as too abstract, and lead to a 'back to basics' reaction (3). Subsequently, trends in teaching mathematics have been more utilitarian, *a la* Cockcroft, applying maths to consumer problems, and using computers to develop ideas through visual aids.

Critics in America once again claim better results can be obtained using pencil-and-paper drills based on rote memorisation of tables and commonly used results (4).

However, there are few programmes that develop the thinking skills required for a deep understanding of, for example, 'Algebra Word Problems'. The reviews on current software in the second half of this newsletter point to the difficulties in attempting to write intelligent tutorial software.

Perhaps the problem in the US and UK is more to do with dependence upon calculators rather than computers. Calculators are forbidden to under 13s in Germany, Austria, & Switzerland (5). The conservative mathematics curricula of Germany, France, and Japan, i.e. those countries with the strongest commitment to modern technology, is cited to support this claim (1).

Fluency in traditional paper calculations are better foundations for the important ideas of numeracy and algebra than electronically aided computation, at least in schools. Estimation skills have simply not materialised such that students are aware when calculators produce unreasonable answers.

In addition, new naive beliefs deriving from widespread use of this technology are emerging. For example, many students have difficulty understanding how to scale graphs and commonly extend lines through a break in a graph's x-scale to find a y-intercept (6).

Another example is the notion that an increased value of the constant in a linear equation moves a graph horizontally rather than vertically. This is the visual appearance when one explores changes in the constant value within a restricted domain, as is necessary with graphing calculators (7)

What if we spent more money on Secondary Maths?

• *Enhanced choices in Higher Education:* a poor maths background is a principal deterrent in following courses in science and engineering. Mathematics is now important in many areas where it has not previously played much of a role (both in HE and at work).

• *Enhancing student's self-esteem:* esteem that derives from experiencing the feelings of solving whole classes of problems (i.e. at a general level).

• *A greater intellectual training:* the notion that mathematics is of interest in its own right. A greater appreciation of logic and of philosophical argument, if developed, might wean the British public away from sensationalist discussion of public issues.

• *Better Communication Skills.* In science, technology, management and commerce, mathematics is the only effective language for the analysis of problems.

• *Needed problem-solving skills:* Modelling decision processes and industrial processes require an understanding of the principles underlying these models, or the conditions limiting their validity. For example, the 'millennium bug' is a nasty problem in that it is not clear even where to look for it.

• *More adaptable workforce for this 'information age':* retraining Europe's unemployed to demanded skills presumes a significant element of basic mathematics. "Some things have to be learned when young, and basic mathematics would appear to be one example. The attempt to confront these shortcomings during retraining in later life is wasteful, painful, and usually only partly successful." (8)

Conclusions & Recommendations

Grade C GCSE does not guarantee student success in science and engineering in Higher Education. A consensus has emerged that numeracy skills are falling in areas important to the vitality of science and technology in this country (1)(8).

In particular, in arithmetic, fractions, ratios, algebraic technique, and the basic geometry of triangles, lines and circles. One major cause is the uninformed use of calculators in English schools.

The London Mathematical Society advocates a definitive report, that includes grass-roots involvement of maths teachers and lecturers, to decide appropriate levels of numerical and algebraic fluency., and to consider reliable means to achieve this (1).

Ian Beveridge
University of Luton

Bibliography

(1) *Tackling the Mathematics Problem* (1996), published by LMS.

(2) *The Changing Mathematical Background of Undergraduate Engineers* by R. Sutherland & S.Pozzi (1995), published by The Engineering Council.

(3) Morris, R., ed., *Studies in Mathematics Education* (1987); NCTM, *A History of Mathematics Education in the United States and Canada* (1970)

(4) Paulos, J., *Innumeracy* (1989).

(5) *Schooling as Preparation for Life and Work in Switzerland & Britain* (1995). Discussion Paper No. 75, published by NIESR.

(6) *Tutoring in the Maths Workshop* (1995). Issue 3 of MSA Newsletter.

(7) *Straight Line Graph – Computer Aided Learning* (1996) by P. Pickard in ALM Conference Proceedings, No. 3.

(8) *Mathematics Still Counts* (1996), published by LMS.

Interactive Past Papers

Mathematics — A Level & Scottish Higher (for Windows). Author(s): C E Beevers, D E R Clark, M G Foster, B Cherry, G McGuire, J H Renshaw, G Stirling, D G Wild.

Interactive Past Papers is an interactive computer package intended to prepare students to sit for the A Level and/or Scottish Higher examination. It can be used by teachers to set revision exam papers and to monitor students progress.

The package is based on the educational research carried out by the Computer Aided Learning in Mathematics (CALM) team at the Heriot-Watt University.

Hardware requirements: Windows 3.x, Windows 95, Windows NT 3.5; 486DX-66 (75MHz Pentium recommended); 8Mb RAM 16Mb recommended, 32Mb for Windows NT); SVGA Graphics, 10Mb Free Hard Disk Space; Windows supported sound card and speakers (for on-disk tutorials).

RRP £39.99; available from Lander Software or leading stores i.e. W H Smith and PC World.

TECHNICAL PERFORMANCE

Once the programme is installed and despite some error messages it does run without any problems. However, the sound facility was not as straight forward to operate as it could have been. The package was run on a Pentium 100, operating on Windows 3.1, with a sound card and speakers.

The package provides student and teacher options with facilities for disabling student options when necessary. The teacher is able to configure the set-up so that appropriate tests can be made up for pupils. The questions can be selected from a pool on various topics, either randomly or specifically. *Interacive Past Papers* can be used as a practice tool and an appropriate feedback level can be provided for students to use to overcome problem areas.

Sample Progress report

Progress Report for "Pupil one"

Test: Pupil one **Date:** 10/12/97 **Time:** 15:28 **Score:** 48%

Question	Parts	Score	Reveals	Time Taken
Q1 [T4Q1]	2	[0][2]	N/A	00:00:44
Q2 [T9Q6]	1	[2][2]	N/A	00:01:12
Q3 [T8Q7]	1	[2][4]	N/A	00:00:31
Q4 [T5Q2]	2	[4][4]	N/A	00:09:20
Q5 [T7Q1]	2	[0][4]	N/A	00:01:46
Q6 [T3Q2]	3	[2][3]	N/A	00:01:34
Q7 [T2Q4]	1	[0][2]	N/A	00:03:06
Q8 [T10Q1]	2	[2][4]	N/A	00:02:31

Advice

Q1: You need to look at simple trigonometric relationships. In particular, look at the relationship between sin (A), cos (A) and tan(A)
Q5: You need to revise on composite functions.
Q7: You need to revise how to find the equation of a tangent to a curve (application of differentiation)

The package provides a profile of the individual test result and advice on which mathematical topics should be revised. The profile (see below) also gives the time taken for each question. There is a password facility which enables the maintenance of pupil confidentiality.

PACKAGE

The layout and presentation of the material are user friendly and attractive, while the uniformity makes it easy and fast to use. *Interactive Past Papers* has easy-to-use facilities for selecting questions and making up tests for various groups. For teaching staff this can be a useful and although it does not carry the feel of a full A Level exam, the shortness of the tests allow students and teachers to run short exam sessions. The instant assessment report for each test can then be followed by directed revision. *Interactive Past Papers* has a facility that offers step-by-step assistance and if this is used on the re-run of the test it is helpful in the revision process.

CONTENT

The questions are broken down into smaller steps, enabling the students to be assessed thoroughly and provides a means of identifying problem areas very specifically.

A-Level section of the package covers the core mathematics required for most Pure Mathematics syllabus, the questions cover the following categories:

Core Areas

Solving Equations; Quadratics; Solving Simultaneous Equations; Inequalities; Polynomials; Indices and Logarithms; Exponential Growth and Decay; Co-ordinates and graphs; Functions; Trigonometrical Functions; Planes Triangles; Trigonometrical Identities; Sequences; Series; Binomial Theorem; Differentiation; Further Differentiation; Special Points; Integration; Methods of Integration

Non-Core

Polynomial and Fraction; The Straight Line; The Circle; More Trigonometry; Vectors; Vectors and Geometry; Matrices; Methods of Differentiation; Applications of Differentiation

In a typical modular mathematics syllabus students are required to attempt at least 2 modules. The modules can comprise of Pure mathematics, Statistics, Mechanics, Discrete mathematics and/or even the optional coursework topics. Using *Interactive Past Papers* the teacher does not have enough of a selection to set a suitable test paper.

For the Scottish Higher syllabus there are similar questions. It was difficult to note any major difference between the A-Level and Scottish Higher questions, except that some questions are not available for the Higher revision. The level appears the same and this makes one question the applicability for both A Level and Higher revision.

DOCUMENTATION

The manual provided is well presented and of durable quality. It gives instructions for loading and operating the package. Included is a list to help input mathematical terms correctly. The conventional input keys have been used which helps one to move along fairly quickly.

APPLICATIONS

The limitation in the number of questions i.e. 8 questions per exam paper makes it difficult to treat as a past paper, 'past exam questions' may be a more descriptive and appropriate. Even an indication of the expected time to be taken per questions may make it a better gauge of performance.

The promised unlimited questions also fall short. In a traditional mathematics A Level revision book it would be normal to expect around 15 questions per topic to practise. Unfortunately the package averages 3 questions per topic. In addition, the questions within the same topic are very different and do not allow for practise on the same question type. Perhaps that is not the intention of *Interactive Past Papers*.

OVERALL PERFORMANCE

There is access back to unanswered or incorrect questions and this is a useful facility as in a normal exam conditions the students would be able to return to previous sections if necessary. The test does not carry the feel of a real crisp exam paper. Perhaps this is overcome in a real classroom situation where the teacher can set the test for the pupils for whom it would be new and demanding.

The sound facility within the package did very little to add to the teaching material and would not have been missed. Saving completed exam papers takes a long time, but it is difficult to say whether this is due to the PC's capability.

The overall performance of the package as a Computer Assisted Learning (CAL) is sufficient, and if used in conjunction with other related material would enhance revision at this level.

Ms Chetna Patel, Co-ordinator of the Mathematics Learning Support Centre

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miss their lectures and wish to make this up at the Centre. It is the more motivated students who are using the Centre's facilities.

There are three possible student routes to the Centre:

- Students can be referred to the Centre for help in specific areas by their mathematics tutor or course leader. (Referral slips are made available at a suitable central point i.e. School office).
- Students can use the Centre as a Drop-in facility, with the use the study area and access to various resources. The students themselves can book sessions with tutors if they are aware of particular difficulties.

CONCLUSION

To date the majority of the students using the Centre are studying on engineering courses, thus reflecting the pivotal role played by mathematics in these courses.

The main purpose of the diagnostic test was to identify students at risk and to encourage them to use the resources available at the Centre. This purpose has been accomplished to a significant extent in light of the number of students using the Centre, particularly early on in their undergraduate studies; approximately 150 students have attended and used the Centre, which is 26.8% of the total number of full-time first year students in the Faculty of Science and Technology.

In the future, diagnostic testing will be carried out as part of the formal Induction Programme in the host Schools with appropriate invigilation to prevent ant student collaboration.

We are also developing a fully integrated computerised monitoring system for students progression.

Chetna Patel
Robert Gordon University

The Numbers Disc

THE NUMBERS DISC, published by Cambridge Training and Development Ltd., is a collection of multi-media resources on CD to help people develop and build basic numerical skills.

The software runs under Windows 3.1, 3.11 or Windows 95 and the recommended platform is a Pentium 75 with 16Mb RAM, 500Mb hard disc, CD ROM drive, VGA/SVGA screen, 16 bit sound card, microphone, speakers and printer.

The software is easy to install with clear instructions. Once installed the main menu is bright and attractive, and as the cursor is moved over the screen, the various sections of the software are displayed.

There are three sections: *Talking about numbers, Working with numbers,* and *Playing with numbers*. Each section is divided into several subsections. A separate disc contains a users guide.

Those running adult numeracy courses and support centres will find the software very useful and interesting and it will go a long way to present basic skills in a relaxed, often informal and personal way.

The experiences of other adults who have needed number skills in their daily lives, but have found difficulties and ways of overcoming them, are shared with the user, making good use of colour, graphics, video, and sound.

The main pedagogic content lies in the section *Working with numbers,* and particularly in the subsection *Maths File*. This contains hypertext links making it simple to navigate through the File.

There are sections on number including long division and long multiplication, fractions, decimals, percentages, graphs (line, bar and pie charts) and using a calculator.

Alongside the main screen is a smaller window containing an index with hypertext links to a wide range of topics. All examples are very applications-orientated with immediate and obvious relevance to everyday life and working situations. They are interesting and this undoubtedly aids motivation.

There are also other gadgets and "special calculators" such as that for finding areas and volumes of common shapes. The user simply enters dimensions on a figure, the figure is then redrawn automatically and the area or volume calculated.

The *Skill-builder* subsection allows the user to select a topic and then provides a set of exercises. These include multiple choice questions, and those where the user is required to enter an answer. There are different levels of difficulty which the user can choose.

At the end of the exercises feedback is given on the number of correct answers.

The *Projects* subsection contains a range of assignments within which students can work with spreadsheets and graphs. Parts of existing spreadsheets, graphs and charts can be modified and students can therefore carry out their own investigations.

There are tools with which tutors can create new assignments. There is a section on Standards mapping, where project work can be linked to the national Key and Core skills standards or to City and Guilds Numberpower – the Basic Skills Agency standards. Project work can be saved and used as evidence of achievement.

Unfortunately, there are other parts of the software which I found difficult to follow, and other parts which were incorrect or meaningless.

For example, in the section *Talking about Mathematics, Having your say,* one of the examples to illustrate the use of a pie chart is

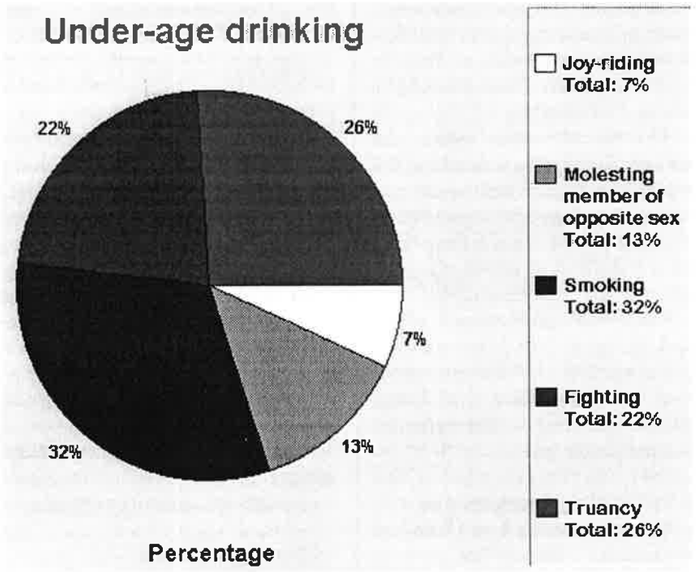

Figure 1

Say Not the Struggle Naught Availeth

Say not the struggle naught availeth.
The labour and the wounds are vain.
The enemy faints not, nor faileth,
And as things have been, they remain.

If hopes were dupes, fears may be liars;
It may be, in yon smoke concealed,
Your comrades chase e'en now the fliers,
And, but for you, possess the field.

For while the tired waves, vainly breaking,
Seem here no painful inch to gain,
Far back, through creeks and inlets making,
Comes silent, flooding in, the main.

And not by eastern windows only,
When daylight comes, comes in the light;
In front, the sun climbs slow, how slowly!
But westward, look, the land is bright.

Arthur Hugh Clough (1819-1861)

A H Clough was a well-known academic (Fellow and tutor of Oriel College, Oxford; later President of University Hall, London). He was important in the development of the pastoral style of poetry in the nineteenth century, being particularly influential with American poets.

He was disgusted with the Oxford movement (as it tended to reinforce the Establishment and restricted academic freedom) to the extent that he became a leading sceptical writer. Personally, he was a both pleasant and good man; his early death caused a great outpouring of grief among the intelligentsia.

June Pitcher, Lecturer in Maths
at the University of Luton,
who retired last year.

concerned with under-age drinking habits. We are presented with the screen in Figure 1.

It purports to show what anti-social behaviour under-age drinkers get up to. Surely the different pieces of the pie cannot be mutually exclusive ?

An audio comment on divorce statistics says 1 in 9 marriages will last until the silver wedding anniversary but the graph on the screen shows 48% lasting 25 years.

The section *Back of the Envelope* gives some tips and rules of thumb, but I found some of these very confusing. As part of an example to subtract 797 from 1741, we are advised to "make 797 up to the nearest big number, 1000." The concept of nearest big number is not well-defined.

The section *Playing with numbers* contains several number games which will help develop skills in mental arithmetic. My ten year old son found these very enjoyable and addictive!

One of the indicators of a good piece of computer-assisted learning material is its ability to grab the user and encourage him or her to want to learn more. This software does just that. It is bright and colourful, easy to navigate and lots of sources of help are available.

An adult lacking confidence, who worked through all the material on the disc should find that their skills are enhanced immeasurably. The product reviewed here is the first release and the documentation provided by the developers states that this is a product they intend to improve and develop.

If the deficiencies and errors such as those described above are rectified in future releases, the Numbers Disc will be invaluable in adult numeracy centre, and mathematics learning support centres.

Tony Croft
University of Loughborough

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MSC3

Maths Support Conference in FHE

7 September 1998, University of Loughborough

http://www2.unl.ac.uk/~11pickardp/msc3

This one-day conference is an opportunity to compare notes for those helping students learn maths. The diversification of routes of entry into HE has provoked a variety of responses and it is time for us to get together. The conference will examine the broader issues in the keynote addresses; discuss areas of specialised support in seminar groups; and share our own in-house resources with a wider audience. Cost only £65 or £85.