MATHEMATICS SUPPORT *Newsletter*

NATIONAL NEWSLETTER FOR ACADEMIC MATHS SUPPORT ISSUE 2 XMAS '94

A National Conference in the Summer of 1995

Welcome to the Christmas edition of the Mathematics Support Association's newsletter. Once again, national attention is being brought to the problem of foundation maths for engineering and science students (Sunday Times, Section 6, 20.11.94). All the usual things were said - ill prepared students and despairing lecturers - more resources needed and less being provided..

If it hasn't been written yet, someone needs to write an article entitled, 'Games Maths Lecturers Play' in their (usually successful) attempts to deny responsibility for students' difficulties. The 'Stupid Student Syndrome' is one such game. Another is 'Why Bother?' (when students and management combine against you), and there is also, 'Students Don't Really Need All This Maths Do They!'

The end result is to do nothing and to complain a lot. The more we complain, the less we feel like making an effort. We go to conferences to find fresh ideas and spend much of the time moaning how hard it is at the chalkface. We need to let off steam but not at the expense of draining our energy to make change. We need readers to organise seminars for this year's conference.

The themes are (i) research, (ii) successful practice and (iii) working together. Call me!

Introduction

This second issue introduces a series of case studies on maths workshops. David Bowers of Suffolk College is organising this section and begins with an account of the services his workshop provides for the 30,000 students there. Hilary Rimmer describes Stafford College's three workshops and informs us that their open learning material is now in use in over 200 FE and HE institutions.

Ian Beveridge (University of Luton) reports the results of a study of his own workshop as part of wider research comparing the quality of academic support in workshops with student peer support. A plea for pooling research in the use of peer support in numeracy modules is made in the article, "SI in Developmental Maths", by Jay Stephens of Tarleton U. in Texas.

Language issues are increasingly recognised as problems in learning maths. Professor Alan Davies (U of Herts) reports on the first year module in mathematical modelling which he has developed over the last seven years with Ros Crouch, a communications expert, with whom he team teaches. Ann Evans and Tom Scott at Napier University challenge us by their use of the medium of videos to broaden the learning of maths.

Peter Samuels (Brunel University) writes an authoritative statement on research into Psychometric Assessment. Sean O'Broin chairs an investigation of mathematical competency for Business students. Marion Canham and Vivien Ferguson continue their report into diagnostic testing as a part of their programme to develop numeracy skills at Cheltenham and Gloucester College of HE.

Steve Martin, HoD of Maths at Luton VI th Form College, writes an article about flexible approaches to learning Access Numeracy, arising out of his experience with Access students in FE in Birmingham. Ann Dickens documents insights she has gained teaching adults in Bucks. and Berks..

When you find mistakes or errors of fact, I shall be delighted to hear from you and please note that;

the only way to avoid mistakes... is to gain experience,
and the only way to gain experience... is to make mistakes.

I know many of you award high marks for the flawed work of students who thereby demonstrate they are gaining experience.

I hope for similar treatment. - ed.

Drop-in

The Mathematics Workshop at Suffolk College

Under this rubric we intend to publish regular case studies of successful Maths Workshops run by colleges and universities across the country. It is hoped that this will be of value to those institutions who are currently thinking about establishing a Workshop, and offer new ideas to those who already have a Workshop of their own.

Background

Suffolk College is a large mixed-economy institution of further and higher education with an annual enrolment of over 30,000 full and part-time students. Courses range from vocational training (NVQ and GNVQ) through GCSE and A levels to professional, degree and post-graduate courses in a number of subject areas. Skills in numeracy, mathematics and statistics are required at all levels. A core team of eight specialist mathematicians within the School of Information Systems Engineering are responsible for all GCSE and A level teaching, as well as a wide range of servicing on vocational, professional and degree courses. Mathematics and quantitative methods are also taught by non-mathematicians in some vocational areas.

The Initial Phase

The initial impetus for setting up a Maths Workshop came from college management in 1989, anticipating what we now all recognise as the trend towards flexible learning opportunities on the one hand and the rapid expansion of student numbers on the other. The mathematics staff were expected to respond to the challenge. Initially, 10 hours a week were made available to staff a Maths Help Service. This took place in a small classroom at specified lunchtimes and evenings; the room was used for tutorial activities in other subject at other times.

With hindsight, the teething problems we experienced were only to be expected. The making available of the ten staff hours a week to provide a cross-college Maths Help Service was a positive gesture - some colleges expect staff to run similar schemes voluntarily in general duty time - but coming over and above normal teaching requirements meant that part-time staff often had to be used who did not know the students' background. We now realise it is essential to deploy full-time staff on any 'support' scheme who have a full understanding of the college's courses, and preferably know the students themselves.

Furthermore, without significant 'pump-priming' there was a limit to the amount of resources that could be available for students to use. Reference copies of standard textbook and sets of past exam papers were purchased, but the original idea that staff could all contribute copies of their 'tried and tested' handouts and revision sheets did not get off the ground. (It is contended here that such a resource bank is indeed viable, but only if staff know in advance that anything they produce is to be included in the bank, and structure the layout and style accordingly. The author would be interested to hear from colleges who implement a communal standard for supplementary material production).

Nevertheless, whatever its initial faults, the availability of extra individual help with maths problems was greatly appreciated by those students who used it, and the positive feedback (ensure students have a channel to express this!) helped to consolidate the Help Service as a precursor of the college's Mathematics Workshop.

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MathematicsWorkshops

Justifying Expansion

In 1990, a senior lecturer was appointed to nurture the Maths Workshop to 'maturity'. This, together with the continued provision of the Help Service staff hours, confirmed the commitment of the college. However, the maths staff themselves were expected to formulate and justify a strategy for Workshop expansion. The arguments went roughly as follows:

- using a Maths Workshop to provide 'more for less' is neither feasible nor acceptable; however, 'better for no more' is certainly achievable, the radical replacement of 'traditional' classes by Workshop attendance as the sole means of delivering maths is not considered appropriate, and would place too high demands on staff and resourcing, however, supplementing t raditional classes with Workshop attendance would allow the best of both worlds;
- a large 'dedicated' room is necessary. A lecture-tutorial mode for all maths classes, with the tutorial timetabled in the Workshop, can allow full pro grammed utilisation of the Workshop and place no extra burden on rooming;
- locating the Workshop alongside a computer network room (run by the central computer unit) and knocking down the wall between them will provide one multi-usage resource-based area with increased flexibility of use;
- enrolling Open Learning students through the Workshop and providing them with their tutorial entitlement during the Help Service hours generates FTEs which can go towards the cost of materials. Open Learning materials are ideal for general Workshop use;
- the Maths Workshop should be made available at a fee to external subscrib ers, generating extra funds for resources. Local press and radio are happy to provide free publicity.

These and similar arguments, backed up by relevant data, were deployed to show that the advantages of a Mathematics Workshop could be provided with no additional demands on rooming, staffing and running costs. Furthermore, TVEI-X funding was won for the furnishing of the designated Workshop.

Current Provision

The Mathematics Workshop at Suffolk College is housed in an L-shaped open-plan area of approximately 180 square metres, made by knocking two rooms into one. It is zoned into three regions: a PC network of 24 stations (run by the Computer Unit), a large tutorial area (seating up to 24) and a smaller tutorial area (seating up to 12). In the tutorial areas, tables are in islands. There is no whiteboard, 'it is college policy that any mathematics class timetabled for more than three hours a week has at least one of these hours in the Workshop, and the Workshop Coordinator books these sessions in. The Workshop periods are tutorial in nature, with students working by themselves on assignments set by their lecturer, who supervises them in the Workshop. Thus during the day, the Workshop is timetabled essentially as a 3-in-1 classroom, with classes and lecturers working in resource-based tutorial mode rather than chalk-and-talk mode. However, any student or staff member can use the room for private work at any time, provided there is space, and any lecturer in there with his/her own class is expected to offer appropriate assistance to such 'foreign bodies'. The atmosphere in the Maths Workshop can best be described as 'purposeful flexibility'.

There are around 300 different self-study units filed on open-access shelves in the Workshop, covering basic numeracy, GCSE, GNVQ Intermediate & Advanced, and A Level work. These units were purchased with full photo-copying rights from a variety of sources. It is common for lecturers to refer students to these units during the Workshop periods to consolidate the previous classroom-based lessons. There are also class sets of standard text-books and individual reference copies of many more books. The PC network runs the college-standard suite or application programs, as well as the symbolic manipulator DERIVE, and we are currently developing computer-based courseware and studyware units.

From 12:30 - 1:30 lunchtimes and 5:00 - 7:00 evening, the Maths Workshop is booked out for the daily drop-in Help Service. Since many students will have already had a timetabled tutorial in the Workshop at some other time of the week, there is no 'threshold anxiety' in coming to the Help Service, and no stigma attached to its use. All students know when 'their' lecturer is on Help Service duty. All Help Service duty staff have a caseload of Open Learning tutees, who are advised to meet their tutor there when possible. External subscribers pay a termly fee for access to the Help Service and reference use of the study resources. Students attending the Help Service sign in at the door and, on leaving, they ask the duty staff to countersign a record card on which they have summarised what they did that session. These record cards can be submitted as 'evidence of

Continued on *page 4*

achievement' in portfolios.
The Workshop area can also be rearranged to provide an appropriate venue for short courses and meetings, which can generate additional profits.

Future Developments

The lecture-tutorial mode of delivery is now well established, and many staff members are asking to increase the proportion of time they spend in the Workshop rather than in a traditional classroom. The key to this lies in having adequate supplies of good quality study material available for use in the Workshop, and in keeping the Workshop a clean and attractive place to be (spare cloths and furniture polish are always at hand!). The availability of a network of PCs within the Workshop will make a transition to computer-based learning easy to implement as and when it becomes appropriate.

Attendance at the daily (lunchtimes and evenings) Help Service is increasing steadily, and with the recent growth in the portfolio of College course, the requests for help are ever more diverse. We may need to focus the provision more specifically, for example certain topics on certain days.

Although apparently some institutions across the country are threatening to cut back their Mathematics Workshop provision, we do not anticipate this at Suffolk College. By timetabling in specific groups for tutorials at specific times, we can show that the room is in fact more highly utilised than most spaces in the College. Continual public relations exercises by the Workshop Coordinator have ensured that the availability of the Maths Workshop has been written into most college documentation and incorporated into the teaching and learning strategy of all relevant courses. Records show that students form all parts of the college have made use of the facility.

By incorporating the tutoring of Open Learning students as part of the duty of Help Service staff, the daily drop-in Help Services becomes in part self-funding with its own FTEs. And by running just two or three fully-costed short course pieces of consultancy through the Workshop each year, enough profit is generated to pay for most of the new books, materials and consumables required.

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MEMBERSHIP APPLICATION

NAME_____

JOB TITLE_____

INSITUTION ADDRESS_____

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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:

_____

_____

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The Mathematics Workshop at Stafford College

Flexible learning materials for GCSE, BTEC, GNVQ and many other Mathematics and Numeracy programmes have formed the basis for the successful development of a series of Mathematics workshops at Stafford College. The materials developed at the college are now being used at over two hundred other colleges and universities throughout the UK.

In 1988 a Maths Resource Centre was opened at Stafford, to cater for a wide range of GCSE students. Teaching was based on photocopyable flexible learning materials using individual programmes on a booklet system. Approximately three hundred students used the centre, which was timetabled from 9:00 am until 5:00 pm for the full time day students and then 7:00 pm until 9:00 pm on four evenings a week. Students worked at their own pace but were given guidance by the staff and a programme of study specifying completion dates for assignments.

This proved to be successful, so at this time production of our own flexible learning materials for A level support commenced. In particular a series called Maths Plus was produced, which was designed to help A level science students who were not studying A level Mathematics. These were eventually marketed and sold to many colleges both in the FE and the HE sectors.

In 1991 the college opened a Central Learning Services area. This involved closing the traditional library and opening a series of interlinked workshops, which housed the library books together with IT facilities and flexible learning materials. Staff are timetabled into these workshops; in the case of the Mathematics and Communications workshops this is for approximately 20 hours a week, although the facilities are open to the students to use as a study centre for much longer than this. This facility is in addition to the Maths Resource Centre, which we continue to use for group work.

In the Maths Workshop we have tried to cover all aspects of Mathematics from Numeracy to A level, including materials for Year Zero students from Staffordshire University. Further material of our own has been developed including a set of Modular Mathematics GCSE units, designed for the SEG; these are now used in the Maths Resource Centre, where all students take GCSE Modular Mathematics.

Other flexible learning materials developed at Stafford include a series called Maths Xtra, which the BTEC, GNVQ and year zero Engineering, Science and Computing students use. Some of our Mathematics A level students use selected units from this series for extra support.

A further recent development has been the creation of a GNVQ package for Application of Number and GNVQ Workshops, which opened in September 1994. These are designed to support the three core skills.

This means that there are now three workshops for Mathematics; (1) a flexible Maths Workshop in the Central Learning Services, (2) a Mathematics Resource Centre for the delivery of GCSE Modular Mathematics using flexible learning units and (3) a GNVQ Workshop for group delivery of Application of Number.

The flexible learning materials are used extensively by our own students and have been sold to other colleges and universities. They include examples, exercises and complete answers so that the majority of students are able to use them unassisted. The students borrow them from the workshops or use them in there. Files of past papers and solutions from every course are open for student and staff use around the Maths Workshop shelves. The Maths staff are involved in the purchasing of textbooks, which are used as both reference books and those on general loan.

Students are encouraged to come to the Workshop for extra help. There is a staff timetable on the wall so that students can see a particular member of staff if they wish. A few of the students take courses in the Workshop if they are unable to fit the course they need into their timetable.

I was interested to note that some colleges report that certain students appear to be reluctant to come to a workshop for remedial help. Our workshop presents itself as a study centre, where help is made available. We have therefore not experienced this problem. On the contrary we have experienced few problems other than there not being enough hours in the day to produce all the materials we, and the students, would like. Putting the materials together has been a very rewarding experience. The students enjoy working in the Workshop, and the staff appreciate the challenge offered by the flexible teaching arrangements.

Hilary Rimmer, Stafford College.

Alll of the materials used in the Mathematics Workshops at Stafford College are available for purchase with photocopying licence.

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Cartoons are taken from the booklet, "Getting to Grips with Maths", by Sybil Cock and available from the University of North London.

Special thanks to Patricia Murchie, Alan Page, and Stephaie Crawshaw for unpaid help in production & editing.

The deadline for contributions for the next issue is April 30 .

Assessing the Value: Maths Workshop

This study attempts to measure some of the benefits of the workshop for Access Numeracy Students. Level 0 numeracy is a module where students are heavy users of the workshop. Students attending the maths workshop made up 53.4% of the 266 full time Access students but 62.5% of the students who complete all the assignments (see the table below).

Table 1: Attendance at the Workshop and % of Students completing all Tasks

Workshop Attendance	No's of Students	% of students who turned in all tasks
Never Went	125 (46.6%)	53%
At least 1 visit	141 (53.4%)	78%
At least 5 visits	33 (13.2%)	100%

The workshop was clearly successful in enabling students to complete their assignments. This 9% improvement in the proportion of students who stay to complete the course module amounts to 13 students (.09 X 141). Sheffield Hallam University calculates a retained student is worth between 2 and 3 new recruits, so the workshop saves the University an amount equivalent to the value of 26 to 39 new students, just from the Access programme alone.

Table 2. Student Performance in terms of modular points (higher is better).

Workshop Attendance	Task 1	Task 2	Task 3	Task 4	Result
5+ visits	6.5	9.8	9.3	5.3	7.7
1 to 5 visits	7.8	9.1	9.7	7.4	8.9
Never Went	8.3	9.5	9.0	9.0	10.0

While the workshop helps students to complete their assignments, it may not be teaching them to be independent learners of maths. There were 4 assignments in the Access numeracy module. Students attending the workshop did better in assignments 2 and 3, which were take-home projects. They did significantly worse in the in-class traditional exam, assignment 4, than students who worked independently or who got help elsewhere. The worry is that the workshop creates and feeds a dependent population of Access students who are not well served to be successful in more traditionally run modules.

The 120 students who never went to the workshop appear to have a final grade which is higher than any of the component assignments. However, students doing badly dropped out, especially from this group, and the remainder were the cream of this crop. High drop-out rates will always produce better final averages. 50 Access students dropped out after their first task and 70 dropped after the second task. No students dropped out after tasks 3 or 4.

The success of the workshop in retaining students is reflected in significantly lower drop-out rates. The consequence of this is that it kept enrolled a group of students whose final assignment performance was much lower than that of the unsupported students. Nevertheless, it seems clear that the workshop is a remedial support that targets students who are initially weak (see assignment 1 grades). The workshop's remedial image discourages many students from seeking help in the drop-in workshop. Those coming to the workshop regularly did not improve their test taking abilities, despite much individual assistance.

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A Framework for Discussing the Location of the Maths Drop-In Workshop

Location	Advantages	Disadvantages
Central Support	It provides first hand information for staff development programmes.	Staff development is external to the maths school.
	Staff is more likely to emphasise problem-solving techniques.	Staff trained in maths are often part-time.
	It clearly serves all faculties - non mathematics specialists may feel safer.	A strong remedial image quickly develops.
	It is more likely to buy in effective open learning materials which maths school staff might naively want to do themselves.	This open learning material never gets effectively used by maths lecturers and can be seen as "competition".
	Maths support can be linked to other forms of support.	Less likely to have maths CAL programs available which may not be supported if they were.
Maths School	Staffing is potentially easier and does not have to involve so many part-timers.	Staff less easy to train in effective tutorial techniques; some staff fear questions out of their field.
	Students' actual lecturers become available for student-centred help, thereby releasing time currently used for individual explanations before and after lectures.	Students may want a different explanation in a workshop other than the one they currently don't understand.
	The marketing of workshop services is made easier since lecturers can simply advise students where to go for help.	Workshop seen by staff as a remedial activity and follow-up work not undertaken.
	The workshop is a location for research on new worksheets as well as a place to try out new teaching methods.	Current staff may be weak in mathematics education research.
	Worksheets used by maths lecturers become available.	Internally generated worksheets may be of poor quality.
	Discovery learning using DERIVE etc. can be built into all regular modules to vary the teaching.	The maths school may be less likely to have resources to support CAL than a central service.
	Students get help with the particular methods they need to know to do well in their assignments	Stronger students may be denied exposure to a variety of approaches.

Enhancing Maths Modules

Mathematical Modelling as a Vehicle for the Teaching of Interpersonal Skills

For the past seven years the first year intake to our Mathematics Degree has followed a course entitled "Mathematical Modelling and Communication Skills". This course is presented in the first semester and requires about six hours student effort over the 14 week period. The course was first conceived when our mathematics degree scheme had a major redevelopment and we wished to bring the existing communications skills course into the mainstream mathematics area. We try very hard to ensure that the course does not appear to be two separate courses, one on Communication Skills and one in Mathematical Modelling. We use a team teaching approach to the presentation of the material in which a mathematician and a communications skills specialist work very closely together (Crouch and Davies 1991, Davies and Crouch 1993). Without a doubt the success of the course is due in no small measure to the flexibility adopted by the members of staff involved.

The course content has been designed in such a way to provide introduction to mathematical modelling, a theme which runs through all three years of the degree scheme, and to integrate it with the teaching and learning of transferable skills including group work, oral and written communication and peer and self-assessment (Crouch and Davies 1993).

In the mathematical modelling element of the course we make use of the simple models which are well-documented elsewhere. We ensure that the mathematics is at a level which enables students to be able to concentrate on the modelling process without the worry of mathematical difficulties. There is now available a wide variety of sources of such material, as the books by Edwards and Hamson (1989) and Giordano and Weir (1985), and the interested teacher has plenty of problems from which to choose.

In the Communications element of the course the students are introduced to the skills of group work and written and oral presentations in the context of problems that they perceive as being mathematical. For the past four years or so we have also introduced students to peer and self-assessment (Crouch and Davies 1993).

It is interesting to note that in general the course is well-received by students and it has led us to develop a subsequent course in the second year entitled "Mathematical and Professional Skills" which ran for the first time last year.

An important aspect of both these courses is that in principle they could be used with students by different mathematical backgrounds by using models whose mathematics is accessible, as the transferable skills element remains the same. Indeed, since mathematical modelling has its basis in the scientific method, the approach could be used in the context of other subject areas such as science and engineering.

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Giordano F R and Weir M O (1985) *A First Course in Mathematical Modelling*, Brooks/Cole.

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The Personal Technology Project in Mathematics

Introduction

The aim of the Personal Technology Group (1) is to provide students with a range of courseware which will help them to overcome deficiencies in their background knowledge of Foundation Mathematics. The video tape recorder is one item of personal technology which is currently available to most students. This article describes the authors' experience in the production of a videotaped exposition of foundation Mathematics.

The Problem

Mathematics is a core subject in many undergraduate programmes of study at Napier University. This, together with the increased participation rate in Higher Education, has led to major difficulties in the Mathematics education of some first year undergraduates. In particular, there is a large variation in the mathematical backgrounds and abilities of students on courses in Science and Engineering. A growing proportion of students underachieve in these courses simply because they are lacking basic mathematical skills. The first priority of this project was to provide such students with a resource which would help them to overcome these difficulties.

The Solution

Building on the success of the Telemaths project at Edinburgh University (2), we decided to produce a video which covered certain topics in the area of foundation mathematics. Our target audience was first year students of Science and Engineering and our aim was to provide them with an alternative method of reinforcing their pre-calculus mathematics through independent study. As a learning experience, it was not intended that the video should replace conventional teaching. Rather, it should provide an opportunity for students to reinforce their understanding of certain topics.

Resources

The project was funded by the Educational Development Unit at Napier University. Technical and technician support were made available within the Video Production Unit. Throughout the academic year, one day per week was set aside for our use of the studio and its equipment. On this particular day, the filming and the sound recording were done, involving cameramen, light and sound technicians. The graphical work and animation on the computer, together with all the editing, were carried out at different times. In short, a tremendous amount of time and expertise was put into this project by the Unit's technicians.

Content

At the outset, we included as many basic mathematical topics as possible. Theinitial list included indices, logarithms, transposition of formulae, graphs, equations and trigonometry. We soon recognised that this was an unrealistic target and eventually it was decided to omit trigonometry and concentrate of the other topics. For each topic an introductory explanation and worked examples are given, followed by a set of questions for the student to try. Each question is followed by a worked solution which the student may check before continuing with the next example. We believe it is essential to adopt such a simple format and to vary the presentation. To keep the students interested, we decided that the video should be cheerful, captivating and friendly. With this in mind, the technicians were encouraged to use cartoons and animations. In the first two topics, the rules of indices and logarithms are illustrated using animations. Of course we have mentioned Napier's Bones and filmed the Tower at Merchiston where John Napier lived! The worked examples and solutions to exercises are simply produced on a drawing board. A similar approach was used for the section on transposition of formulae. For the final two topics, we decided to use an alternative approach. Graphs and equations are computer generated, as are the solutions, and further explanations are contained in a "voice-over" for each of the topics. Typed solutions to equations appear on the screen. Students are required to use a graphical calculator or a graph plotting computer package when attempting the examples in the section of graphs.

Support

Flexible learning is increasingly being used within mainstream provision at Napier. This activity is supported by the University's Flexible and Open Learning Development Programme. The Flexible Learning Group in the Department of Mathematics is concentrating on the development of materials at levels 1 and 2. These materials include self-instruction units and study guides, covering a wide range of topics from the Mathematical Sciences, ranging from Foundation Mathematics to Multi-criteria Decision Analysis. It was to the Flexible Learning Group that we turned for comments and advice on each section of the video as it developed. Useful suggestions obtained from the Group have been invaluable during the production of the video.

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Ann Evans and Tom Scott, Napier University

References
(1)For further information on the Technology Project, contact Tom Scott in the Dept of Mathematics, at Napier University.
(2)For further information of the Telemaths Project, contact John Searl in the Dept of Mathematics, at the University of Edinburgh.

(CAL)Diagnostic Testing

Psychometric Assessment in Mathematics and Computer Science Education: Position Statement.

The purpose of this article is to explain my motivation in organising a workshop on this subject (June 1993 and September 1994). The following are my principal areas of interest:

- Psychometric (especially Personality) Assessment
- Learning Methods and Theories
- Online Computer Assessment of Skills
- Computer-Aided Student Profiling (User modelling and the like)
- The Design of Technology Based Teaching Materials
- Process Models of Student Answers (especially errors)
- Alternative Assessment/ Elicitation Techniques (both psychological and subject area orientate

I would identify four different types of psychometric profiles:
Context Dependent Skills - for example, the CALM[9] and CALMAT systems measure student ability in areas of mathematics such as differentiation.
Transferable Skills - skills which are not dependent on a particular context (e.g. the ability to follow procedures). These are measured, for example, by the EUREKA skills card sort [8].
Learning Styles/ Approaches to Studying - Hambleton has investigated the use of the Approaches to Studying Questionnaires in Mathematics Education [4].
Personality Style - this is measured, for example, by the Myers-Briggs Type Indicator [2].
I feel there is a need to generate discussion between these different areas, especially in terms of their use in Mathematics and Computer Science Education. I am also interested in the role of the computer and technology within those areas.

Related Work

Here are a few references to work relating these different areas together:
1.Jensen has written about the use of the Myers-Briggs Type Indicator in assessing learning style [5].
2.Matz has investigated the use of process models for analysing errors in Algebra [7].
3.Ford and Ford have recently written about learning strategies within a computer-based learning environment [3].
4.There is a large amount of literature about cognitive modelling, intelligent tutoring systems and computer-aided instruction, e.g. [1], [6], and [12].

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Teachers as Researchers

Undergraduate Mathematics Teachers Conference (UMTC)

At the recent UMTC meeting in Nottingham, one of the working groups had to come up with a proposal for teaching research to be carried out in the current academic year.

The group of which the author was chairman decided to investigate students' difficulties within a specific area of mathematics. It was decided to target this at Business Mathematics.

Many, perhaps most, students enrolling on Business Studies course have considerable difficulty coping with quantitative subjects either because they never acquired the necessary mathematical background or have forgotten whatever they once knew. It would be very useful to determine exactly why and where they find mathematics difficult and to frame remedial or supplementary courses accordingly. In principle, it might be possible to do this with detailed diagnostic testing. Because of practical constraints the group decided to concentrate on a specific area and chose graphical representation.

A detailed diagnostic test was devised. The intention was that this test would be administered in two institutions: South Bank University (London) and Napier University (Edinburgh) as part of a more general diagnostic test. The test is given to all students on the Business Studies programme. The results of the test would be used to improve the content of the supplementary mathematics courses. At the end of the supplementary course, the students who had taken the course would take the test again with a view to determining where improvements had and had not been made.

Continued on *Page 19*

(SI) Peer Support

Proctoring in the Faculty of Engineering and Computing at the Nottingham and Trent University

Guidance on Proctoring

These notes are intended to give an understanding of 'proctoring' in the Faculty of Engineering and Computing, its benefits and the methods used for assessment.

1. Introduction to Proctoring

A Proctor is a student who assists a less advanced student, the Proctee, under the general supervision of a lecturer.

When performed within the University, the usual system is for a final year undergraduate to work with a group of first year students to coordinate and manage group or individual project work. When proctoring in schools undergraduates will assist, for example, with individual projects (mainly in CDT subjects) or computing assignments at 4th, 5th and 6th form levels.

2. The Aims of Proctoring

The overall aim is to help in the development of skills and attitudes that will become part of the student's overall competence. Specifically these can be identified as:-

For the Proctor:

- to communicate clearly and appropriately
- to exercise leadership
- to plan and organise
- to make value judgments and to experience some of the working relation ships and responsibilities of a professional engineer.

For the Proctee:

- to benefit from recent experiential learning
- to gain from additional help and guidance
- to have further sources of information to assist in the generation of ideas and problem-solving.

3. The Assessment of Proctoring

The Proctor is assessed by a combination of methods to give a broad measure of achievements, namely:

a) A report giving a clear picture of what the Proctor actually did.
b) A reflection on the proctoring experience (to be included with the above report). This should indicate what the experience has taught the student; what might have been done with the benefit of hindsight; and how the experience could be improved.

c) A questionnaire completed by the supervising lecturer.

d) Questionnaires completed by the Proctees.
4. Recommended Form for the Proctoring Report

It is recognised that, because of the wide range of experiences, there will be of necessity variations in the format. The following is suggested to cover most situations:-

a) Use a standard front sheet to include name, group, school, etc.

b) Give an introduction to show broadly the range of work undertaken.

c) If proctoring a group detail:-

- he degree to which the group members work together - was it cohesive or divided?
- the formation of any subgroups
- the appointment of a leader; did a leader come forward immediately (and if so did that leader maintain his position or did a leader emerge later - give your perceived reasons.

d) If proctoring individual detail:-

- the amount of mutual understanding
- he degree to which you believe your assistance was helpful and appreciated

Continued on *Page* 12

R.Sims, Nottingham and Trent University

R Sims has written more extensively on the subject of Proctoring. He can be contacted at The Nottingham and Trent University, Engineering Department, Burton Street, Nottingham, NG1 4BU. Tel 0602 418418

e) The technical nature of the work, the problems experienced and how they were solved.
f) The occasions when broader issues were discussed such as University education, engineering, work experience and, very importantly, personal problems.

g)The requirements for planning and, if necessary, what methods were used.
h)The relationship with lecturers, stating whether they were helpful or restrictive.

5.Items to consider on the Reflection
a) What has been learned from the experience.

b) The aspects that give satisfaction and feelings of achievement.
c) The mistakes made.
d) The things which would be done differently with hindsight.

e) The degree of control in the proctoring situation and the feeling that professional advice was being given in the appropriate manner.

f) How proctoring could be improved. Please remember that a report should be structured in a clear and logical way such that readers are informed without having to use their imaginations. It is helpful to produce a summary of the report contained on one page immediately after the front sheet. List of contents, separate conclusions, diagrams, etc., can be used if these help communication. Additionally it may be useful to keep a log book whilst proctoring to aid the production of the report.

SI in Developmental Mathematics: Inquiring Minds Want to Know?

Because SI has historically targeted mainstream, core-curriculum courses, little is known about the impact of SI in developmental courses.In conducting dissertation research in SI for developmental mathematics courses, I have made some preliminary findings from a limited sample.
It is my wish to share these in the hope that others who may have implemented SI in similar situations can either verify or dispute them.

The findings are:

1.The developmental mathematics student has entered higher education with a negative attitude about maths that probably had origins in public elementary school, and he/she is reluctant to actively participate in the learning process now.

2.The developmental mathematics student has limited recall of previous learning. This may result from higher education material being presented in a manner that is different from that previously experienced and little or no connection is made.

3.The developmental mathematics student participates in SI to the degree of perceived instructor difficulty. An instructor who is "difficult to understand" will elicit a higher rate of participation than one who is perceived by the students as "easy to understand".

4.The success of the SI program will depend on the extent to which students are active, participatory learners in the sessions, on a continuum ranging from passive learning to active learning.

5.When the variable of repetition is applied to participant and non participant groups, significance, if it is found, will tend to be with the first-time course students rather than course-repeating students.

6.When the variable of gender is applied to participant and non participant groups in settings where there has been extensive verbalisation of processes by students, females will tend to exhibit greater increase in academic achievement than males. In settings where verbalisation has not been extensive, there will be a greater equality between the sexes.

[illegible] State University, 7424 Eden Rd. Forth Worth, Texas.
This article was reprinted with permission from the author. It was originally published in SI News, the journal about SI published by the University of Missouri at Kansas City to its 600 participating colleges.

Numeracy Work at Cheltenham and Gloucester College of Higher Education

Cheltenham and Gloucester College of Higher Education

The academic work of the College is offered within three faculties: Arts and Education, Business and Social Studies, and Environment and Leisure.

An EHE funded Cross College Numeracy Project was started in May 1993 and is now in its second phase. The overall aim of the project is to ensure that students at CGCHE have the numeracy skills for both their courses here and for employment afterwards. The following report continues the article first begun in the first edition of this newsletter (Spring 1994).

Diagnostic Numeracy Test

As part of this project a diagnostic numeracy test has been developed and been tried out.

At the beginning of this academic year the test was given to over 400 first year undergraduates from across the College, studying areas such as Business Studies; Computing; Psychology; Geography; and Sports and Exercise Science. All first year students were given the opportunity to take the test, the importance of numeracy skills having been stressed during the induction period.

The test covers basic arithmetic; fractions and decimals; percentages and ratios; basic algebra; significant figures/ decimal places/ estimation; indices; problem-solving; and charts/tables/graphs. It is multiple choice and designed to be answered on sheets that can be optically marked. No time limit is placed on the test but most students complete it in under two hours and the use of calculators is not permitted.

Examples from the Test

The following are examples of questions and answers in each of the eight categories outlined above:

•Write the number 'thirty-eight thousand and fifteen' using digits only.

A: 3815 B: 38015 C: 38150 D: 380015 E: other X: don't know

•Express $\frac{3}{8}$ as a decimal

A: 0.375 B: 3.75 C: 0.475 D: 2.667 E: other X: don't know

•Three partners, W, Y and Z divided their profit in the ratio 5:3:2. Last year Y's share of the profits was £6,000. What were the total profits?

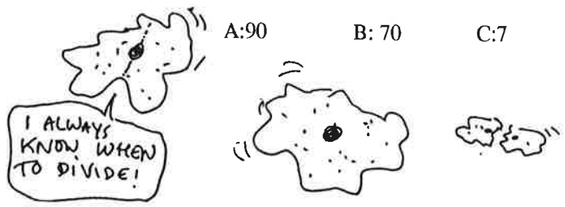
A: £12,000 B: £30,000 C: £20,000 D: £18,000 E: other X: don't know

•If $v = u + at$, what is t ?

A: $\frac{v}{a-u}$ B: $\frac{v-u}{a}$ C: $\frac{v+u}{a}$ D: $\frac{v}{a+u}$ E: other X: don't know

•What is the closest approximation to $278 + 3.9$?

A:90 B: 70 C:7 D:9 E: other X: don't know



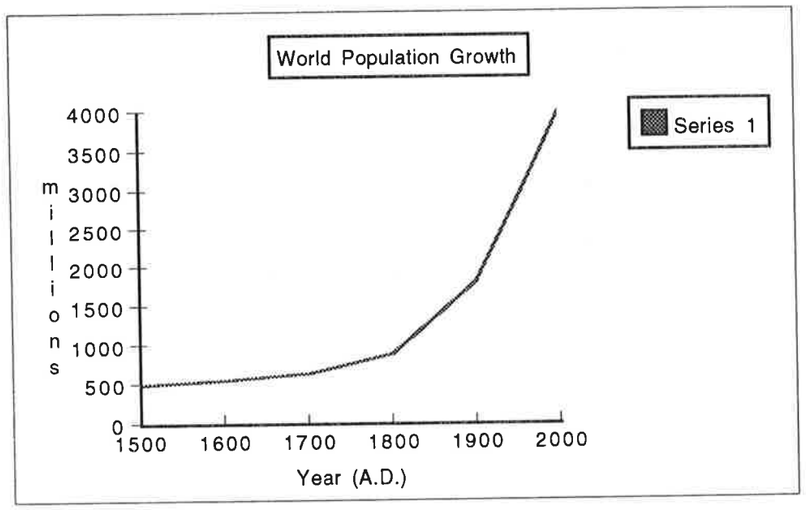
•A value of $25^{\frac{1}{2}}$ is

A: 12.5 B: 5 C: 25.5 D: 50 E: other X: don't know

•A factory employs 200 people part-time, each person being paid £90 per week. The weekly wage is increased by 10% and the workforce decreased by 10%. Calculate the new total wage bill.

A: £18,000 B: £17,850 C: £17,820 D: £18,280 E: other X: don't know

•The graph below shows the growth of world human population over the period 1500 to the present day. Over which period is the population growth the greatest?



A: 1800-1900 B:1600-1700 C: 1700-1800D: 1900-2000E: other X: don't know

Multiple Choice Options

In constructing the options we tried to include possible common errors of calculation. In the example shown below option 'A' shows incorrect cancelling of 7, option 'B' shows incorrect cancelling of 7 with 14, and option 'D' ignoring the 7s. A 'Don't Know' category was included in order to distinguish between actual areas of weakness and topics not met previously. The 'other' option was added to categories any other answers the student may calculate.

•Find the value of $\frac{7}{7+14}$

A: $\frac{1}{15}$ B: $\frac{1}{9}$ C: $\frac{1}{3}$ D: $\frac{1}{14}$ E: other X:don't know

Feedback

The student performance in the test is rated 'Excellent', 'Satisfactory' or `Needs Revision' in each of the eight areas. Written feedback is given to each student which is confidential to the student and his/her personal tutor. Depending on their results students are recommended to attend a numeracy workshop or to take a specific first year module.

Numeracy Workshop and Module

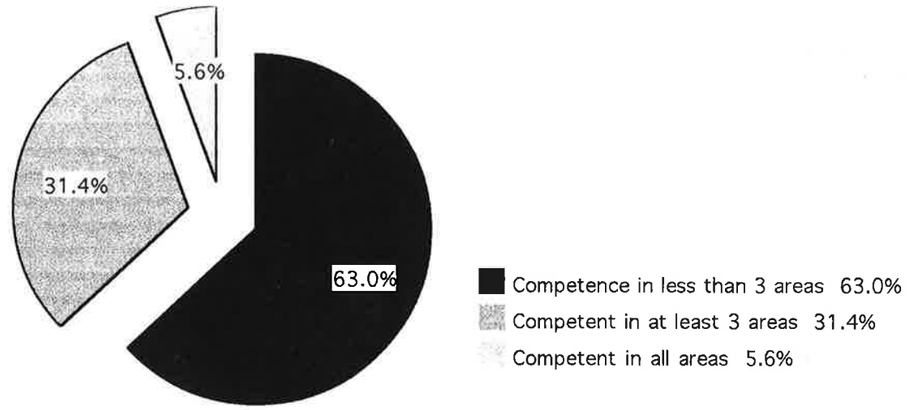
Both the workshop and the module are new this year, having been developed through the project. The module is delivered over one semester and is credited in the first year programme. It is designed for students right across the College and aims to build confidence in dealing with numbers and interpreting numeric data as well as remedying any deficits identified by the diagnostic test and underpinning later field specific quantitative work. The workshop is a drop-in facility staffed with a maths tutor and is currently offered for an hour each day. Both the module and the workshop make use of written independent study materials, identified as part of the project. Computer based materials have also been identified and are available.

Preliminary Finding for 1994

Of the 414 students tested this Autumn, 261 needed to take the module (having five or more areas needing revision), 130 were recommended to attend the numeracy workshop and only 23 had no areas needing revision. The students coming forward to take the test were self selecting and tended to be those who felt their numeracy skills were weak anyway.

The actual numbers registered for the module this semester are 122, with 39 registered to date for semester 2. Workshop attendance has so far been disappointing with only 36 students attending on a regular basis; this may be due to the fact that, unlike the module, the workshop carries no credit.

Diagnostic Numeracy Test Results in 8 areas.



Further analysis of the test results and monitoring and evaluation of the workshop and the module is ongoing. The project is due to finish in April 1995, and we then hope to have in place a system for identifying and supporting CGCHE students' numeracy needs.

Marion Canham and Vivien Ferguson from Cheltenham & Gloucester College

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A number of institutions have forged links with others to provide bespoke courses that enable students to progress, via an Access course, to a course leading to further qualifications. These are often subject-oriented to allow a basis to be laid for further study of the same or a closely related subject at the higher level. My experiences with such courses have mainly been involved with providing a mathematics component to support the main study area. I have, however, also been involved in a particular course that delivered a complete mathematics component as a free-standing module and as such could be attached to virtually any course where mathematics could usefully be integrated.

My involvement arose from the problem mature students were experiencing with reaching matriculation requirements of a local University. The University regulations meant intending students for teacher training course required a GCSE grade C (or above) in mathematics. For mature students who had left school a number of years previously without achieving this standard (or its equivalent), the prospect of entering an educational environment was daunting enough, without having the additional burden of studying mathematics (a subject a lot of them had found to be a negative experience).

There was also the problem of having to follow a syllabus that was not primarily geared to meet their interests or needs. Whilst accepting that some external examination boards did offer syllabi for "mature" students, it was nonetheless true to say that these did not reflect the life experiences of the majority of these students.

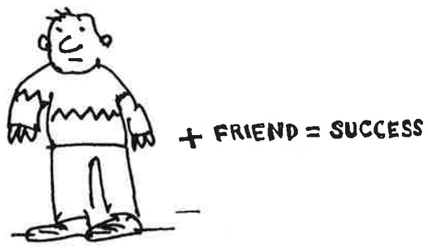
Starting from this premise, that any course should have its focus on the experiences and interests of the students, whilst at the same time maintaining a standard sufficient to meet the needs of the University, a series of negotiations resulted in the University accepting a proposal that students follow a modular course, written by myself and colleagues, offering a greater variety of subject context than traditional GCSE courses.

The content of this modular course not only challenged traditional methodologies, but also confronted stereotypes. Thus, for instance, one of the first modules aimed at trigonometrical concepts, focused on a young lady attempting to solve an engineering problem in her job. This involved consulting with working engineers in designing a realistic framework for the work; students were then presented with the problem; and class contact centred on techniques needed to solve it.

Another module concerned energy saving, and students looked at a wide range of real life problems, such as "which is cheaper?", in the context of using paper towels or hot air blowers in drying hands. This broadened into looking at environmental issues, and, dependent upon the other interests a student had, was extended beyond the original parameters.

Some students, for example, looked at energy saving in the home, and one student even utilised his new interest in mathematics by fitting a series of timers to reduce his gas bill. Other social issues were raised by working at simple things, like costing a holiday from the viewpoint of a single parent, and organisations such as "Splash!", which specialise in these, were brought in.

Having the freedom to explore mathematics in a real life scenario was an enriching experience for those students, and prepared them more confidently for higher education by focusing on issues in mathematics in social contexts.
If an Access course is to truly be a basis for entering fields of higher study, it is my belief that it should not only deliver subject content, but should look at developing social and study skills, without the straight jacket of a rigid structure of assessment that limits the scope of the rich experiences students have - flexibility to bend to meet a student-centred course is needed, and this must be recognised by institutions in considering Access policies.



Steve Martin, Luton VI th Form College

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What is an Adult Basic maths learner?

Initially, to you, the tutor, a name on a register accompanied by a set of pre-course interview notes - but step back...these students, who have just sat down on the edge of their seats with pen and paper in hand (if your are lucky!) have each brought with them their own unique life experiences of maths learning. Their maths memories are certain to be inchoate and fragmentary, ("you turn something upside down and multiply") and could be erroneous ("when you take away you start at the window side."). All these students will have formed their own ways of thought or cognitive styles. Many will be "impulsive" thinkers, rushing to get an answer. Many will be unable to tolerate uncertainty - there must be one way of getting one right answer. Many will approach a task sequentially and not be able to look at the whole picture of what is wanted. The exact preconceptions and expectations that students bring to the class will not be apparent to you, the tutor, as you are confronted by the common overt behaviour patterns of a class waiting for you to take control.

Tutor Strategies - the Art of GentleTeaching

The class is here and your overall task is to instill in these students feeling of confidence and enjoy ment of maths. Step back... First examine your feelings. Are you relaxed, concentrating on and enjoying what you are doing? How you feel will be reflected back to the students in your verbal and non-verbal behaviour - you set the scene overall. Your job is to isolate and take away those negative emotions associated with maths learning from the subject itself and to enable your students to relax yet concentrate on and enjoy it.

First task - Setting the Scene

When adults come to class we as tutors tend to discount the fact that they have lives outside our sessions. The students will have come in from a variety of activities; a long walk to the centre in the rain, putting the kids to bed, a day at work, a previous class. They may be thinking about after class - getting the car started, a dental appointment, making love. As a tutor, you must change their focus of concentration to their lesson.
A short light-hearted activity such as :

How many ways can you make 20p ?
Can you cut a cake into 8 equal pieces using 3 cuts?
A magic square...
will give all present, including you, a chance to set your mind.

Making the Products of Thinking Explicit
We cannot look inside students' heads to see their unique cognitive maps. We must establish where to start on a topic for ourselves. Students often perceive their starting points as 'not knowing' or 'being stuck'. We must let them know that this is acceptable. When I start a topic I ask the students to define it:

"What is multiplication?"
"What is a fraction?"
Just to find out what they think it is - sometimes a surprise!

As babies learn, even before they can speak or move much, they will actively direct their gaze to an object of interest; an older child or adult will automatically follow their gaze to this shared referent and start talking about or interacting with it in someway. Everyday life, or 'material world' objects, such as marches and coins can become share referents to help in physically modelling mental "maths world" topics like the 4 operations. Material world press reports of earthquakes and the Richter Scale can be used as a starter for the mathematical modelling with Dienes cubes to develop ideas of magnitude, place value, decimals, number bases, negative numbers, etc... By doing something with an object and talking about it, students are trying to make explicit those hidden "grey areas" of understanding. After working with multilink cubes on a fraction topic a student said to me, "What do you call those bits that don't fit exactly?" Who knew exactly what she meant!

Questions, Questions, Questions...

Questioning is a two-way process. As students ask questions... of the tutor, other students or themselves, listen and learn how they are thinking. Show by example how they can question themselves and explore the maths:
What do I know from the question?
What do I want from the question?
What is the same about x and y? Is it the same number?
Is it the same operation?
What if it was a different number? What if it was a different operation?
If I am stuck, can I think of a way where I could cope?

Anne Dickens, Adult Continuing Education

Anne Dickens can be contacted at this address:
Adult Continuing Education
The Old Schoolhouse 3a Almhouse, Great Linford,
Milton Keynes
MK14 5OZ

What if it was a smaller number?
What if it were....only 10ps to add...etc.?
Can you make up your own questions for the rest of the class? (This last question really shows how a student is thinking).
I use these questions all the time, not as a bolt on procedure but as a form of continuous formative assessment.

Doing it, Discussing it and Writing it Down.

By doing it practically, talking about it (especially working with other students) they will become less tutor dependent and this frees you to eavesdrop or turn your attention to others. Students will be held in the task longer and at a deeper cognitive level than they would have been by being given a worksheet only. Offer a worksheet when they feel confident enough to put some permanent marks on paper. Stress that mistakes should be lightly crossed through, not erased, as they form the basis for future learning.

"I did it like that because..."
"It didn't work because..."

Writing is an explicit signpost by the student that helps them remember what they did, now or later. Students who lack confidence have not had the experience of thinking about maths ideas, let alone expressing them verbally or on paper. Explain that this is an acquired skill that improves with practice, like driving or swimming.

If students are engrossed in the doing, talking about or recording their maths - leave them to it. Enjoying maths can be a small haven or privacy in a busy world.

The Eureka Experience

This feeling of excitement happens at all levels. When students (and tutors) discover their predictions and conjectures are correct; 3 + 7 = 2 + 8 for example, they are greatly encouraged to make generalisations in a problem solving situation. As students become more confident they can explore the more "curious" open-ended aspects of maths which is so much more intrinsically rewarding. This gives the benefit of keeping 'faster' students occupied, while others complete the task.

Number power students experience a system of extrinsic incremental rewards, boxes are ticked, criteria met. They explore beyond the activities. E.g. 003-2-b objective of measuring lengths can be extended to the marking and cutting of a 'Mobius strip;

what if there was one twist in the paper and you trace round and cut it?
what if there are two twists?
what if you divide the line into thirds and you trace and cut both lines?

In this way, I am not being prescriptive but exploring with my students.

Reflection

At the end of each lesson, I try to set aside a few minutes for students to think quietly about what they have done in that lesson. They recall what has been important for them - something they 'got a sense of', or mastered, or how they felt, and if they wish they can share it with the class. This is recorded by them on their learning programme sheet. This gives me a memory jogger and helps me in my reflection and composition of written comments on their learning programmes about what they did, talked about and achieved that lesson. More formative assessment. My comments are always avidly read by students and serve as reinforcements and mental setters for the students and lesson planners for me.

Developing Confidence

I deliberately made the title of this article ambiguous. Whose confidence is being developed - the students' or the tutor's? My students become more confident in their own maths abilities; I become more confident in their abilities to cope with and enjoy maths. Perhaps everyone is benefiting from the changing level of confidence overall - that is how it should be.

Miscellaneous: Extra bits of articles that ran over

Continued from *page 10*
Psychometric Testing

Dr. David Wright from the Department of Design at Brunel has been working for several years in the area of multi-media and user-modelling for Applied Mathematics Teaching. His group has recently developed a HyperCard system fro teaching the concepts involved in Newton's Laws of Motion.
Here in the Department of Mathematics and Statistics, Dr. Andrew Rae and I have been researching into our Discrete Mathematics course. We have a portfolio of data on about 90 students including personality type, approaches to studying and examination scripts. We hope to use this data in the redesign of the course [11].

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[2] I. Briggs-Myers and M.H.McCaulley. *Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator*. Consulting Psychologists Press, Palo Alto, 1985.

[3] N. Ford and R. Ford. Learning Strategies in an 'ideal' computer-based learning environment. *British Journal of Educational Technology*, 23(3): 195-211, September 1992.

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[5] G.H. Jensen. Learning Styles. In J.A. Provost and S. Anchors, editors, *Applications of the Myers-Briggs Type Indicator in Higher Education*, chapter 9, pages 181-206. Consulting Psychologists Press, Palo Alto, 1987.

Continued from*Page 10*
Diagnostic Testing Business Students

At South Bank, the supplementary course-module is taken in the first semester and the Quantitative Methods course-module in the second semester. Not all students attend the supplementary course but all those failing to achieve a certain level in the diagnostic test are advised to take it. Both the students who had taken the supplementary course and those who had not could be monitored on the subsequent Quantitative Methods course to determine whether the supplementary course made any significant difference.

Continued from *page 9*
Using Videos at Napier University

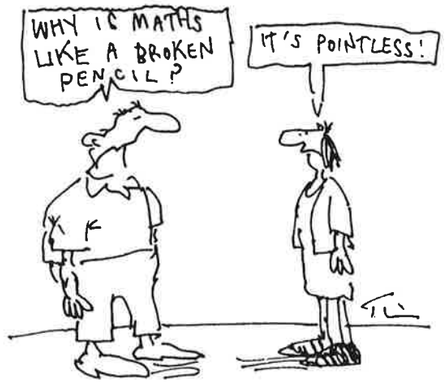
Implementation

A final version of the video will be completed for the start of the academic year 1994/1995. The University has a library on each of its three main campuses, and multiple copies of the video will be available within each of these libraries. Students will be advised that they can borrow the video either for use on their own equipment or on the machines located within the library.

References

(1) For further information on the Personal Technology Project, contact Tom Scott in the Department of Mathematics, at Napier University.

(2) For further information of the Telemaths Project, contact John Searl in the Department of Mathematics, at the University of Edinburgh.



Letters and Reviews

What is a Statistician?

A Person who tells you
that if you have one foot in a bucket of boiling water
and the other in a bucket of ice,
on the average,you should feel pretty comfortable.
Dennis Congos.

Independent Probabilities!

A person who understands probability will,
whenever they fly EL AL,
decide to bring their own bomb on board,
knowing the probability of two bombs on board,
is much smaller than one bomb.
Dave Stott.

The Vax is Down Again! or The Engineer Cometh!

The fateful glamour floats and flows
About the tangle of the nodes;
Naught answers users' urgent pleas,
And all sit 'mazed and ill-at-ease.

Computer Centre's pleasnat land
Knoweth no stir of voice or hand;
No words the sleeping screens now fill,
The restless printer lieth still.

The students wail "Deadlines draw nigh!"
And admin. workers put things by.
Then call the Mage to use his Art
And rend the slumbrous curse apart!

Here lie the hoarded bytes - the key
To all the treasure that shall be.
Come, Thaumaturge, thy power take,
And smite the sleeping VAX awake!

June Pitcher

Reference: William Morris

"The Legend of the Briar Rose".

The Maths Bill of Rights

I have the right to...

...learn at my own pace and not feel stupid if I'm slower than someone else

...ask whatever questions I want

...need extra help

...ask a lecturer for help

...say "I don't understand"

...feel clever even if maths never makes sense to me

...not to understand

...believe there is no maths which I can't understand should I choose

...evaluate maths lecturers' ability to teach me

...dislike maths

...define success in my own terms

...insist on understanding why I learn what I learn

...feel cheated when a maths lecturer does my thinking for me

Sandra Davis.

adapted by the editor.