

MATHS KNOWLEDGE & UNDERSTANDING OF PRIMARY STUDENT TEACHERS: initial findings from a 2 year study

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Abstract

This is an initial report about a project that arose from the recognition that the mathematics knowledge and understanding of some trainee primary teachers did not match up to the 4/98 requirements. The key areas and the nature of the challenges faced were identified through preliminary research, portfolio trialling, operating a 'drop-in' numeracy support centre, and feedback from current year 3 / 4 students. The project, run by AP [with JP's support] is linked to a 'parent' project group. It is based upon students using the project and its materials to categorise their needs in each content section according to 3 levels of support. Strategies employed are face to face workshops and input sessions, through to multiple choice, self-assessment and distance study materials.

The results to date have been very encouraging in certain respects, though the 'electronification' and 'distancing' of relevant study materials remains a challenge. The researchers are currently involved in further developments.

1 Inception

In the mid-nineties, AP led the primary mathematics team in constructing a 'mathematics portfolio' to audit & enhance students' knowledge & understanding. Later this was adapted to tie in with circulars 10/97 & then 4/98. This portfolio in its evolved state is still used by staff and primary students, and directly referred to in courses.

Circular 4/98, section C:	Trainees' K & U of Maths
10.	All trainees enter with a minimum of GCSE Grade C (or equivalent) mathematics. This may not be enough to ensure that they feel confident and competent in the mathematics they studied and are required to teach.
11.	Providers should audit trainees' knowledge, understanding and skills in mathematics. Where gaps are identified, providers must ensure that trainees gain that knowledge and understanding and that, by the end of the course, trainees are competent.
12.	All courses must ensure opportunities to understand, and use correctly, mathematical terms; identify how the different areas of mathematics relate to each other, and make conceptual links across the subject; solve problems that require the use and application of mathematics; use technology when appropriate and become aware of its strengths and limitations; enjoy mathematics.
13.	Subject knowledge and understanding: this specifies the mathematical knowledge and understanding which all trainees are required to demonstrate by the end of their course, in order to underpin effective teaching.

Figure 1 relevant extract from circular 4/98

Assessing and supporting enhancement of BAQTS Primary students' knowledge and understanding of mathematics has been a growing concern of the two researchers - who both teach primary professional courses - since the mid-nineties. During 1997, following negotiations and bidding, an appropriate allocation of time was made to AP by the BA[QTS] Primary Programme to allow research to begin. After preliminary reading of previous research findings into the nature and causes of misconceptions and misapplications of elementary mathematics, trialling began in Autumn 97.

Learner Centred Project - its importance

At UCC there is an college-wide initiative group called the Learner Centred Project to which this development was linked through AP's membership of the project group from December 97 to date.

The imprimatur of the LCP was a key to: giving focus and priority at a time when momentum could too easily have been lost amid conflicting concerns; encouraging the learner-centredness of the design to be realised effectively; improving the chances of priority support for involving the intranet; ensuring that the materials produced were not simply pragmatic responses, but indeed reflected the research base, including relevant research into preferred learning styles / multiple intelligences, and were 'sensitive to the needs of a diverse range of students'; in short, it was and remains an effective long-term insurance policy as it provides necessary support and institutional profile to the project.

2 Conception

The researchers conceived the initial auditing of knowledge and understanding of students as, in partnership with each student, identifying a personal categorisation:

- **A.** aspects where they are **fluent**, i.e. if questioned they confidently and accurately respond;
- **B.** aspects where they need **written evidence**; i.e. if questioned they refer to prepared evidence and its examples;
- **C.** aspects in which they need **more substantial help** in reaching towards and achieving the 4/98 standards.

Several models and modes were discussed, before devising a 'preferred strategy' - this had to be realistic yet offer greater economy of effort and resource-use in the longer-term.

Key Aspects

In initial research, trialling & feedback linked to primary mathematics courses & portfolio, several aspects of 4/98 were seen as feasible to be addressed within course sessions, even though these sessions were focussed on preparing to teach, and on learning about the primary curriculum. However, this was not so for

number and algebra - especially for KS1 / Early Years focussed groups - *e.g. there is a minimal connection between KS1 and 'forming equations and solving linear & simultaneous linear equations, finding exact solutions'*.

Circular 4/98 [headings]	section C: 13 a) to e]
<ul style="list-style-type: none"> ■ a) number and algebra: the real number system indices number operations and algebra equations, functions and graphs ■ b) mathematical reasoning and proof ■ c) measures ■ d) shape and space ■ e) probability and statistics 	

figure 1 the relevant section headings from 4/98

Therefore the mathematics aspects selected initially were all in the number & algebra areas of 4/98: the real number system, indices, number operations & algebra, equations, functions & graphs. Similarly, some mathematical reasoning [but not proof] was designed into the materials.

3 Strategies

The project proposed a mixture of strategies:

1. an initial audit of key areas;
2. the preparation of study and self-help materials;
3. specific training for needs identified as category C.

It was surmised that, in future years, the initial audit could be carried out largely or wholly through electronic means, and that the study and self-help materials might only need minor adjustment / updating, but the need for face-to-face training sessions would continue; therefore, time spent on developing the materials was seen as a good investment.

Multiple Choice, Study Materials, Support Sessions

Multiple Choice questions were written to allow students either quickly to confirm their abilities and regain fluency in areas where they were simply 'rusty' [category A] or to provoke written evidence of studies to enhance grasp and fluency [category B]; in summary for:

Category A: in effect the Multiple Choices were 'by-pass' questions;

Category B: study materials were written to assist their progress;

Category C: in any such aspect, both student and tutor noted this down; subsequently mathematics support sessions were devised and run to meet category

C needs.

Multiple Choice

It was a principle throughout in their design that drawing upon available previous research findings, Multiple Choice questions utilised the most prevalent errors as alternative answers; where no such research existed, the data from trialling led to a similar 'most frequent error' analysis.

Multiple Choices question sets were initially introduced through whole year group sessions, with stress laid on their function, so that students recognised that simply obtaining answers would be counterproductive.

Nevertheless it remained a time consuming task to generate several sets of questions for each area. Some marking was carried out by students collaboratively within small study groups; indeed small support groups were encouraged to form amongst those for whom this was clearly going to be a longer haul.

Study Materials

After researching and trialling, it was clear that little had been published or produced elsewhere could be applied directly to this purpose; and even that little amount needed a lot of adapting to come up to project criteria. So project materials were based upon the outcomes of trialling during the previous few years, which itself grew out of the research base. Even so, the study materials have been the aspect of the project requiring greatest adaptation during the implementation phase. Ideally this is now seen as generating a bank of study materials from which student study groups could draw selectively according to need.

Support Sessions & TTA Testing

Initially, 7 support sessions were designed, based upon the areas identified; these were first run for some 25 primary students in May 99; they were at the end of the second year of a four year programme; their evaluation of these sessions was resoundingly positive; additionally, it was clear that these students were subsequently substantially more successful in their use of study materials and in completing multiple choice questions, than they had been at the outset. However, with the TTA commissioning new national tests [to be taken by trainees in June / July 2000], but with no precise details available of their form or content, a considerable hiatus arose in the development of the project, and no major changes were made to session design before they were repeated again twice each in the September - December 1999 period. The intention was that once TTA Test form/content became public, the project materials would be reviewed at all levels to take account of this.

Findings

To date, despite the uncertainties surrounding the nature and content of the TTA testing, and the inevitable confusions in the minds of programme staff and

students alike between the purposes of this project and the preparing of students to take that test, the project is meeting its purposes well. To date approximately 75 students have used the face-to-face elements of the project, and at the other end of the provision, almost 300 have used the multiple choice sheets. One result of this has been that other students and student groups have expressed interest and enthusiasm for becoming involved. The student representatives reported to the Primary QTS Programme Board that the workshops were 'brilliant' and this reflects the growth in mathematical confidence in attendees that has been perceived by us. On the down side, there has been little progress as yet towards electronic versions of the materials, and it remains debatable how the project will be viewed once the actuality and immediacy of the TTA test is upon us.

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