'THE MATHS TASK'
A REPORT ON THE FIRST YEAR OF A LONGITUDINAL STUDY

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In response to a requirement to identify applicants to ITE who are lacking certain defined qualities, a mathematics task was designed. It has now been trialled for 8 months and indications are generally positive. It has three parts – video-, game- and misconceptions-based. The first part – video-based – is outlined here and some of the emerging illustrative data considered. However there are many questions arising from this task that need to be addressed longer term by the project team. As this is intended to become a longitudinal study with several aspects, these questions will be further addressed in later papers by the team.

ORIGINS OF THE MATHEMATICS TASK

Following an *Ofsted Inspection* of ITE in Primary Mathematics at UCC, the primary programme decided that it would need to develop a Mathematics Test for applicants to undertake at interview. This was not a new suggestion, but previous attempts over several years to introduce such a test had been actively and passively resisted by the mathematics team, on grounds including those that specific objectives for the test were not sufficiently defined, and that no such 'magic bullet' test existed.

In this case, however, it was agreed that we needed to address shortfalls in maths subject knowledge at an even earlier stage than we were doing – within their first weeks on course at UCC. Following some active debate, senior staff presented the mathematics team with the following four 'success criteria' for whatever mechanism we might wish to propose:

The Maths Task, as it became known, must identify primary ITE candidates:

- who lacked openness towards mathematics, and showed inflexibility in their views about mathematics
- who lacked mathematics subject knowledge in areas that could easily adversely affect their effectiveness in teaching able year six pupils
- who specifically lacked mental calculation abilities and strategies, and were resistant to considering and acquiring these
- whose confidence level was out of phase with the level of their abilities regarding mathematics

To these four criteria, the mathematics team added a fifth criterion:

- the task should offer a fair representation of what the team values in mathematics, and be – in itself – a potentially valuable learning experience.

From these criteria, I designed a 'Maths Task' to last under one hour [the missing 6th criterion!] It was trialled and accepted – with very minor alterations – and has now been in use for all primary ITE interview days throughout this academic year.

A key question relating to the task is whether it meets its design intention, or at least to what extent it does this. A wider question is whether or not it is possible to do so with any task. A related comment is to query whether simply because it is a more fully defined task, it is automatically subjected to much more detailed scrutiny than the various other common interview processes… and to further query the efficacy of such common interview processes. It was because the team felt that interview processes were themselves not build on particularly solid ground, that this task was worth trialling, since it had the potential to be more effective and specific.

THE FOCUS OF THE MATHS TASK

The 'Maths Task' has three elements, each of which contributes to the overall profile of each candidate in more than one way. Candidates are given a booklet into which to record their responses and ideas during the hour, and tutors keep a notes sheet. These are combined as the written evidence file, together with a same-day written [and agreed with a colleague in difficult cases] summary of notes and a grade of 1-4 against each of the first four criteria. This summary is written directly on the cover of each booklet.

The first part of the task consists of responding to a 10-minute video of extracts taken from different parts of a year six lesson on percentages. It is this part of the task upon which much of the remainder of this paper will focus.

The second part involves the introduction to each group of candidates of a mini-loop of six cards from a simple level two *Loop Cards™* game. Having grasped the principle of this, each candidate, placed within a group of five or six candidates, is given a mini-loop of six cards from a level five/six *Loop Cards™* game focused upon 'fractions of', 'percentages of' and 'multiplication by a decimal value' and their interrelationships. Having completed and recorded their individual loop, the group then play a full *Loop Cards™* game with all their card sets mixed together.

The third part of the task involves candidates in deciphering the misconceptions of a year six pupil over the ordering of fractions and decimals and the equivalences between them. The misconceptions examples are recorded in their booklet, but the first task for them is to provide the correct responses to the questions over which the pupil struggled in vain.

The repeated focus of tasks on the knowledge and understanding of fractions, decimals and percentages - the FDP of FDPRP – arises directly from previous studies carried out by members of the team and others within UCC over the preceding five years or more. Knowledge and understanding of FDP is now regarded by the team as an established touchstone for judging current abilities and dispositions and also potential. However this also a judgement call, and again it could easily be called into question as the process and study continues.

It is the current position of the team that the task remains in keeping with the promoting the positive attitude and directions that we all wish to convey to all of our applicants. To quote one LEA adviser whom I consulted during the design period: 'I don't think it would put off anyone good, not like some of the tests I hear about'.

THE VIDEO-BASED PART OF THE TASK

These were the agreed instructions to, and notes for, organising tutors:

Show the whole group [often 12 to 18 applicants at a session] the 10-minute video-clip in which XXXX is teaching percentages to a Year 6 class. Point out that they have space in their booklets to jot down their thoughts and responses as it plays, if they wish to do so. They will have time for this afterwards if they prefer.

When the video clip is completed, ask them to respond individually to note down their thoughts about the lesson and any strong feelings or views they have about it.

Ask them to respond to the relevant questions in their booklet.

This part of the task relates strongly to criterion 4, but also should give evidence for:

- criterion 2, since one question asks applicants to follow XXXX's 'model' for percentages to create a specific percentage-finding strategy, and
- criterion 3, since applicants are twice asked to calculate a percentage of an amount, and may tackle this mentally or with jottings.

There are two response pages to the Video task in the applicants' booklet. They contain the following questions, with large boxed spaces set aside for responses. Small boxed spaces are shown here just to indicate their position within the pages.

FIRST REACTIONS: Please note down individually how you responded to this lesson clip, starting from what you thought about what you saw of the lesson, and any feelings or views you have about the way [the teacher] chose to teach percentages, indicating the strength of these views and reactions.

A] [The teacher's] model for finding percentages involved a strategy where you make connections from what you know to what you don't know. Is this a teaching strategy that you could see yourself using or is it a teaching strategy you feel you would avoid?

B] In the video pupils are asked how to find 5% 'of anything' – whereupon a year six pupil says "you find 10% and halve that". Using this approach, please describe below how to find 30% 'of anything'. Check this out by finding 30% of £45, showing how you found your answer.

… and how to find 70% ‘of anything’. Check this out by finding 70% of 140, showing how you found your answer.

The headings in the remainder of this section attempt to draw illustratively on data from the response boxes to exemplify ‘noteworthy’ features from the overall response data (in ways analogous to those used by Watson). While many applicants produced convincing points and calculations, these examples focus more upon the smaller proportions of responses were there was cause for concern.

First reactions

Some applicants expectations were overturned… “I was supprised [sic] that [the teacher] went straight into teaching it by just putting numbers on the borad [sic]” … but while some recovered and saw the potential in the approach used, others showed a more inflexible viewpoint: “[The teacher’s] objectives weren’t clear at the beginning and I thought her opening quite confusing – no real explanation of percentages”

Others focused upon the enabling features of the approach… “[The teacher] uses problems and solutions found by some students to demonstrait [sic] to the rest of the class how these types of problems can be overcome” … and the fact that there was “No imposition of a set and intractable formula” or recognised other positive features of the action such as that “The pace of the lesson was good, giving time for them to think about the questioning”.

A] The model

The responses to this question were generally too uniformly compliant to the premise that the lesson exemplified a laudable approach… “I believe this is a good positive strategy which I could see myself using, as it encourages the children to try to have a go and use the knowledge they have gained to work out something they don’t know.” We must therefore reconsider how we introduce the lesson, to attempt to provide an *even more* overtly neutral stance towards it. However, some useful differences of response found here confirmed more direct and compelling evidence gathered elsewhere in the task.

B] Finding a percentage ‘of anything’

(i) 30% ‘of anything’

Some mistook 30% for 1/3… “30% of £45 by dividing the number by 3 45 ÷ 3 = £15 i.e. (30%÷ 3 = 10%)”. There was also some variety of strategies, not all as direct as each other, and some showed a cavalier approach to symbols and conventions! “Find 60% then halve it. 50% then 10% +. 50% = £22.50 10% = £4.50 + = £27. £13.50 = 30% of £45”. The following applicant did not complete the calculation. He had brought out a calculator and been asked not to use it. He had then been observed calculating by hand using an algorithm on the back of his paper before glancing at a neighbour's paper. "Find 60% then halve it." but only 'picked up' part of the successful approach used by his neighbour [above].

(ii) 70% 'of anything'

"Find 30.5% then halve that" – despite this inauspicious description, this candidate 'found' the correct answer, but the working was unclear, and contained some tally marks on his paper indicating that in some part of the calculation he was counting in ones.

"70% of 140 = 10% = 14 14 x 7 = 128" – this applicant did not include a response to the general strategy question and after a promising start did not tackle 14 x 7 correctly.

SOME OF THE LONGER TERM QUESTIONS TO ADDRESS

Along the way have been strewn a number of key questions that currently exercise the team about the whole project of this 'Maths Task'. They arise from two central questions:

- What are the qualities of a good / better teacher of mathematics?
- What are the qualities of a good / better trainee teacher of mathematics?

The first question is addressed socio-historically and culturally within this age, and the second question is addressed socio-historically and culturally at this precise time. They will need to be informed by reference to prior studies on mathematics as social practice, including that by Baker (1997).

Does the task meet its design intention, or to what extent does it do this? There is the possibility that this can be effectively criticised in ways analogous to those used by Hilton and Rowland (1999) on mathematics tests.

Does a judgement based on tasks with a repeated focus on knowledge and understanding of fractions, decimals and percentages provide an effective touchstone for the necessary wider judgements about candidates? There is considerable evidence that primary student teachers and primary teachers find this a problematic area of mathematics to understand (Brown et al. 1998, Green and Ollerton, 1999, Huckstep et al. 2003, Pinel and Pinel, 1999, Rowland et al. 1999).

Is it possible to identify those candidates whose openness, flexibility and other positive professional qualities will allow them to use the available support during their courses at UCC to overcome current shortfalls in knowledge, skills and conceptual development? Possible challenges to the current design include the variety of past experiences, especially of mental calculation strategies (Womack, 1998) and the natural but variable levels of anxiety experienced by applicants.

How effective, longer term, is the 'Maths Task' at interview as a predictor of course and career outcomes [a] for PGCE trainees, [b] for Undergraduate trainees?

Are there any useful comparisons to be drawn between the two populations of data – [1] those applying for PGCE and [2] those applying for 3-year undergraduate BA with QTS? Are there any factors that appear to be significantly different?

Will the data yield any patterns of responses from applicants, all of whom are technically suitable qualified in mathematics to take the course? For example, will there be patterns of evidence in [a] errors, [b] misconceptions, [c] understandings that do not go beyond the merely procedural. Will the data yield examples that exemplify ‘noteworthy’ features, in ways analogous to Watson’s (1998) exemplification of ‘noteworthy’ mathematics?

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