Contents

Assessment activities in a secondary PGCE Course

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Assessment underpins our PGCE course, but this article describes some of the sessions and activities offered to mathematics PGCE students which focus specifically on assessment.

Being asked to write about how we address assessment issues with our mathematics PGCE students at the University of Bristol left me feeling I needed to write about the whole course (don't worry, I'm not going to!). We all know that assessment is an integral part of teaching and that is a key part of how we treat it in the course. However, there are, of course, sessions and activities which focus specifically on assessment and these are what I will write about here.

I will offer here some of the activities which take place on the course during the Autumn term and then consider the bigger picture.

Listening

Students are paired up and given a task in which they take it in turns to pose a mathematical problem to their partner. The questioner's role is to try to understand the mathematical thinking of their partner. They can question in order to probe the thinking but should not lead the mathematical work or get involved in solving the problem themselves. This is very difficult! The model of 'clinical interviewing' comes from Ginsberg (1981). Once both partners have taken a turn at posing a problem and listening to a response, we discuss the issues about assessment arising from the experience. Students appreciate the difficulty of really listening to a learner and trying to understand what they are thinking rather than simply imposing their own thinking on them. Of course, as with many activities, this is both about assessment and teaching skills.

Mental arithmetic tests

Students answer the questions in the Key Stage 3 higher tier mental arithmetic test. We play the tape and they complete the questions as

pupils do. This raises the interesting issue of perfectly competent mathematicians not getting full marks! The questions often produce issues about misunderstanding or ambiguity as well as ones of acceptability of answers. For example, a discussion ensued this year about an answer given to the question: 'State the co-ordinates of a point on the line y=4x' One solution given by a student was (n, 4n). Right or not? We decided it was acceptable but it raises the issue of over-interpreting a 'simple' question.

Collection of methods seen in school

In groups, students collect and organise methods of assessment seen in school. This activity is carried out during half term week when they have all been school based for the previous two weeks. The collection is always pleasingly wide ranging, but we work on developing their ideas of what 'questioning' or 'marking work' really mean and how they are (or could be) used as assessment activities.

Designing assessment activities

Using some frameworks from Suffolk County Council (undated) as a starting point, students generate classroom activities they can use for assessment as well as learning purposes. They choose a topic and, in small groups, design an activity based on one of the frameworks, for example, 'True, False, Iffy' – testing some algebraic statements for truth (always, never, sometimes). Or 'Key words' – creating a sheet of key words in a topic for pupils to exemplify or define in their own ways. The methods they work with during this session often appear later in the year in their practice and using self-assessment with pupils is a key strategy which we see reappearing in their classrooms.

Working on a GCSE paper

In the first week of the course students are given a higher level GCSE paper to complete. They are also given the mark scheme and told to complete the paper and then use the mark scheme to mark it and identify any problems. (Maybe they do the paper 'honestly' – but that's up to them!) Then we invite a local teacher, who is a GCSE marker, in to work with them on issues arising from the paper and from exam marking in general. It is an eye-opening session for them in terms of understanding the subtleties and complexities of exam marking. They are always astonished by the low number of marks needed to gain a C grade but begin to understand the complexities of exam paper construction. They look at the mysteries of A, B and M marks and the subtleties of 'f.t.' marks. They consider accuracy of solutions, the relationship between

methods and answers and what pupils need to learn about how to tackle exams.

Building pictures of pupils

Using data from the LEARN research project (1999) carried out at Bristol students consider individual pupils and their experiences of assessment. The LEARN project interviewed about 200 pupils from year 3 to year 12. Students are presented with a set of quotes (about 25-30) from interviews with individual pupils and, in groups, use these to build up a picture of what 'their' pupil's experiences have been of learning and the assessment process. They then present a brief outline of their pupil to the rest of the group and we consider the different attitudes, motivations and understandings these pupils have. As part of the LEARN interviews pupils were asked to express a preference about how they learned and were assessed, from a set of five statements in each case. We also look at the data on the responses to these questions and how they change as pupils get older.

LEARN – a lecture!

This is as close as it gets to a lecture in our work with students. I use a PowerPoint presentation to introduce them to the LEARN project and its findings and how these fit into the developing work on 'assessment for learning'. We underpin our work with students with research in many ways and using our own research is important both in terms of its findings but also in building a model of teachers as learners about practice.

AfL principles

Following the input on LEARN, and using both the ARG (2002) principles for assessment for learning (AfL) and some materials from Suffolk (2000), students work in groups discussing how they have put any of these principles into practice in their teaching and developing ideas of how they can teach more effectively using them. (This is carried out after a six week period in school on which they can draw) They all read Dylan Wiliam's (2002) chapter, Formative Assessment in Mathematics in preparation for the session to inform the discussion and comments from Ofsted's advice on good assessment practice are fed in (Ofsted, 2003).

Assignments

The assessed assignment which most directly addresses assessment is one in which students are asked to design a task for pupils which will

generate some written evidence of their achievements. They then submit the work of one or more pupils with a commentary on what it tells them about their understanding of the mathematics being learned. they also explain how they chose or designed the activity to generate good assessment information.

Other assignments include aspects of assessment in a more integrated way – for example, the submission of a topic plan taught during their main school experience. This includes information about teaching strategies and activities designed to assess learning and inform the progression of the topic. They write about key issues for them, which often include ones related to assessment issues. They also make self-assessments of their own progress at several points during the year, both formally and informally, and discuss these with tutors.

So what's it all for?

The purposes of the activities described above are various. Firstly, they are to encourage students to think about their own beliefs about assessment. Often, they are students who have only experienced success and need to think about the needs of pupils who will not always be in that position. They may have quite a mechanistic attitude to assessment and not consider the difficulties inherent in assessment design.

The use of such activities also aims to enable students to think about assessment from the learner's point of view. This is only a very early experience of these ideas so all have to be tried and tested in practice, but with a recognition of how the issues impact on learners we hope they will approach assessment with a deeper understanding of its subtleties.

We aim to provide students with some practical starting points on which to build their own repertoire of teaching skills. This is about integrating assessment into their practices, so we want them to see assessment activities as contributing to learning as well as providing information. The kind of activities we offer are intended to broaden their thinking beyond some of the standard approaches they will have experienced.

We also aim to introduce them to research and the new ideas this brings into teaching. The work of a range of research projects and the use of reading encourages them to think of teaching as growing and changing, making it possible for them to teach in imaginative ways rather than only reproducing what was done to them.

We recognise the need for them to integrate work on examinations and formal assessment and try to help them find the right place for it in their teaching. We hope they will understand the debates about 'grades' versus 'comments' – indeed this always provokes a lot of discussion – and will

want to make decisions in their assessment practices which support pupils' learning as well as their ability to pass exams.

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The Cambridge Approach to ILPs in PGCE courses

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This paper offers a course document on monitoring, recording and supporting individual learning, with the resulting individual learning profiles (ILPs), from our Secondary PGCE course and discusses its implications for my practice.

The secondary team has had much discussion amongst itself, and within its Secondary Subjects Advisory Committee, [SSAC]; a group comprising the chair of each subject mentor panel and one faculty subject lecturer from each subject, over the past year. The resultant document, produced below, summarises the agreed procedures within our partnership, for ensuring that we meet individual trainee's needs throughout the year.

MONITORING, RECORDING AND SUPPORTING INDIVIDUAL LEARNING

a paper produced by the Subject Studies Advisory Group May 2003 on agreed common practices which combine to ensure every trainee's individual learning is explicitly monitored, recorded and supported during the PGCE year

Using information from the admissions process as a starting point for the planning of individual training needs

The admissions process is the starting point for gathering information about trainees' prior experiences and subject knowledge for teaching, via the GTTR form, interview questions and group activities. A common Faculty form is used before, during and after the interview to record relevant information.

Either immediately or later on, as appropriate, trainees receive focused guidance on how to develop their subject knowledge in areas identified at interview plus information about how/where to document their learning.

Providing pre-course guidance as a way of beginning focused reflection on subject studies issues prior to the September start

Trainees receive advance reading lists and guidance on preparation for subject studies plus information about how/where to document their learning. They may also receive subject-specific guidance on initial school experience in the primary school to supplement generic guidance sent by the Faculty to all trainees, plus information about how/where to document their learning.

Undertaking a subject knowledge review and monitoring individual learning

All trainees carry out a subject knowledge review/audit. They monitor their own individual learning, in ongoing discussions with subject lecturers, subject mentors and (where relevant) professional tutors. The development of individual learning is overseen by subject lecturers in the Faculty and subject mentors in school through the weekly mentor meeting, target-setting, and training activities. All trainees' ICT needs are monitored. They receive subject-specific support when planning, tracking, reviewing and assessing their use of ICT for teaching and learning.

Incorporating opportunities for trainees to 'stand back' and reflect in a more global way on their progress and learning

From time to time, subject lecturers ask trainees for some form of ongoing reflection on, and evaluation of, their learning. Information arising out of these reflections/evaluations will help subject lecturers to fine-tune their teaching and plan more precisely for trainees' learning.

Supervisions/tutorials during the Faculty-based course in order to discuss ongoing progress with the subject lecturer

Trainees have supervisions/tutorials with a subject lecturer, as necessary, during Faculty-based days/weeks in Terms 1 & 2/3 to review progress and especially to discuss the learning plans and target-setting process that is evolving in school. For some trainees, more tutorial time may be necessary. During tutorials, subject lecturers can draw upon the teaching file (especially mentor meeting record sheets) and reflective evaluations of subject studies in discussions with the trainee about the training and learning that these documents embody. In this way, subject lecturers can review the quality and appropriateness of the individualised target-setting process taking place in school.

Using mentor meeting record sheets as a basis for planning and monitoring progress

Trainees use mentor meeting record sheets to record discussions, targets,

training activities and review progress within a weekly cycle of mentor meetings. This is a key means by which the mentor can respond to individual trainees' strengths and weaknesses, in a carefully targeted way. Training activities agreed between mentor and trainee might include reading, revisiting subject studies work, focused observation, planning tasks, investigation and evaluation as well as continued practice in developing aspects of teaching repertoire. Through carefully designed training activities the mentor supports individual trainees' learning needs and ensures that targets are met. Continuity and progression between PP1 and PP2 are supported by discussions between PP1 and PP2 mentors at the December/January mentor conferences.

Using lesson observation report forms as a way of ensuring regular and coherent feedback to the trainee and the trainers

Written feedback is offered by all teachers working with a trainee, so that mentors and trainees can build a picture of progression within a weekly cycle of planning, teaching, learning, evaluating, assessing. Other (non-mentor) teachers supporting the trainee need access to the weekly targets and agreed training activities so that their written feedback and/or oral discussion with the trainee is both appropriately challenging and explicitly linked to current targets.

Using the reports as a way of offering global, formative feedback to the trainee

Reports submitted to the Faculty summarise progress to date and offer formative feedback to support progression. Although drafted by the mentor and trainee, they are filtered through the professional tutor to enable him/her to gain an overview of all trainees within the school. It should always be possible to substantiate the report with evidence in the teaching file, such as improvements in medium-term planning or sustained efforts to tackle weaknesses in teaching to which regular mentor meeting record sheets attest.

Using the subject studies assignments as a means of conducting practical, research-based investigation of educational objectives

Section I(a) assignments, including ongoing discussions about them with lecturers and mentors, plus formative feedback from subject lecturers, provide an important source of evidence of the trainee's learning. Section I(c), the study in depth with a core studies strand, offers synoptic evidence. Mentors' involvement in setting up the 1(c) assignment (e.g. early discussion of a title and choice of classes or groups to work with) and supporting trainees during their classroom-based action research,

allows mentors to use the 1(c) as yet another way of focusing on areas for individual development and building on specific strengths in trainees' learning.

Using the core studies assignment to work towards a closer awareness by key staff of the links between core and subject studies for each trainee

Section I(b) provides evidence of trainees' developing understanding of a key issue in education. It should be discussed by trainees with subject mentors and professional tutors to broaden the overview of the trainee's learning. In order to build a fuller picture of the trainees' strengths, weaknesses and needs, mentors should be helped to draw upon the Section 1(b) assignment and core studies tutor feedback in the same way that they already draw upon the Section 1(a) assignments and subject lecturer feedback.

Using the Standards Index as a way of looking back, identifying and signalling standards-related evidence visible in the trainee's working documents

On various occasions during the year, trainees update their Standards Index to point to where evidence for progress against the Standards may be found e.g. long- and short-term planning; evaluation of sequences of lessons; assignments; lesson observations; reports. All the evidence gathered during the course of the PGCE year is used when completing Transition Point 1 of the Career Entry and Development Profile.

[University of Cambridge, 2003]

What does this mean in practice in the secondary mathematics course?

Using information from the admissions process as a starting point for the planning of individual training needs

At interview various, although certainly not all, subject knowledge strengths and areas for development may be identified and will be recorded on the interview documentation. The same is true for prior experience of working with young people, ICT, working as a team and so on as well as particular factors which might influence decisions regarding school placements. We allocate both school placements before they start the course, so it is important that we know of individual needs and preferences at interview. Particular individual needs such as additional/alternative needs for dyslexics in the faculty-based course and

in school are noted here too.

Providing pre-course guidance as a way of beginning focused reflection on subject studies issues prior to the September start

All trainees are sent a short, pre-course reading list from which we hope they gain some inkling of the nature of mathematics education research and how that links with practice. From subject knowledge perspective they are asked to visit the National Curriculum for Mathematics on the website and: 'take some time to study it and decide which aspects of the Key Stage 3 and 4 programmes of study will need some further work before you are confident to teach the material'. They are asked to do the same with an A level syllabus and to attempt some specimen A level questions which they should bring with them to faculty sessions. I shall take those specimen questions from them in the week before half-term and match them against the subject knowledge audits they have completed recently. Additionally, they are asked to visit the ATM and MA websites to gain insight into the kinds of things the associations are addressing currently.

Undertaking a subject knowledge review and monitoring individual learning

After the first subject studies induction session trainees complete an initial trawl of the subject knowledge and ICT audits, indicating their current 'confidence level' on a range of ICT hardware/software and on all statements in the KS3 and 4 National Curriculum, the A level Core and P3-6, M1-6, S1-6, D1and 2. This is an ongoing document which they use in school and in the faculty. I take it in during the induction week and feedback individually on as many of the statements of content as I can where a trainee has indicated that they have no knowledge whatever of that topic. Feedback centres on ways in which they might go about gaining knowledge and understanding – through self-study, web-based materials, working with other, named trainees, discussing opportunities with mentors to join relevant lessons as a learner and so on. I then compile an overview of the 'experts' and 'those who need to learn from scratch' in each section of the post 16 curriculum. This year we have allocated 6 two-hour teaching slots to subject knowledge gaps which will be tutor-led. We decide on the content of those sessions through reviewing trainees' subject knowledge audits and using the 'experts' within those taught sessions. As the year progresses, trainees add to their audit, noting what they have done and where they have learned about each aspect of subject knowledge. The audits then come in to me for further review and suggestions at the end of term 1 and term 2. They are

also be monitored regularly by mentors and by subject lecturers during the school visit in the long placement. Similar procedures are used with the ICT audit, although we do not timetable tutor-led sessions for content.

Half-term in term 1 has been redesignated a study week this year across the whole partnership. It is here that there will be many opportunities for trainees to address their identified individual needs in terms of subject knowledge, ICT and assignment reading, through organised and informal peer-support sessions. These will be monitored by me in terms of content, who participates and outcomes and will feed into the individual records I keep of each trainee's progress and needs during the year.

Incorporating opportunities for trainees to 'stand back' and reflect in a more global way on their progress and learning

This is another function of having no timetabled teaching during the first school half-term holiday. Trainees will have some space to do this, to see me or to discuss their needs and progress via electronic means. They will have an opportunity to review all the evidence showing their progress to date, from school and from the faculty, and to identify where they see their most pressing needs are for the coming half-term. They will be invited to list, very briefly, their achievements and most pressing needs for the coming half-term, possibly relating them to the Standards, although I doubt that they will have progressed sufficiently to have really met any Standards by mid October – these will add to the monitoring data I keep on each trainee.

Supervisions/tutorials during the Faculty-based course in order to discuss ongoing progress with the subject lecturer

Half-term provides an opportunity for this, although the strategies above should ensure that not all 42 trainees want individual appointments with me…it's not a non-timetabled week for me! Nevertheless, I am always accessible to trainees and they know they can come and talk about any aspect of the course at any times throughout the year.

Using mentor meeting record sheets as a basis for planning and monitoring progress

Trainees keep a brief, weekly record of all mentor training meetings throughout the year. These record their targets for the following week, their level of achievement of previous targets and the specific training activities they are undertaking in order to achieve the targets. This is a very important measure through which we – faculty-based tutors and school staff, monitor an individual trainee's achievements and needs. Trainees send me a copy every week throughout their school-based

experience and I return with suggestions of additional training activities or needs which I feel might be able to be addressed during the following week. They are explicitly linked to the Standards and are, as such, another way of tracking development and needs on an individual basis.

Using lesson observation report forms as a way of ensuring regular and coherent feedback to the trainee and the trainers

These are self-explanatory really – each trainee is entitled to at least one written lesson observation per class taught per week. Many receive far more. Mentors try to help the other teachers in their department who are working with the trainee to focus those written observations on the targets and training activities for that week, thereby providing tangible feedback on that trainee's needs. These are all kept in the teaching file and monitored on a regular basis within the school. During serial placement trainees will give me a copy of all lesson observations, which I feed into my overall view of each trainee's needs. I take in teaching files at the end of each term and provide each trainee and mentor with some ideas and suggestions for future development during the next term.

Using the reports as a way of offering global, formative feedback to the trainee

Trainees receive negotiated reports from their placement schools at three points prior to the final 'have/have not' passed the school placement aspect of the course. These reports detail specific achievements, list targets for the next phase of training and are specifically related to the Standards, so can be used as a source of evidence for achievement of particular Standards. They are progressive and developmental and highly individual, so provide all concerned with detailed knowledge of individual needs.

Using the subject studies assignments as a means of conducting practical, research-based investigation of educational objectives

The subject studies assignments which are formally assessed in order to achieve our PGCE all receive detailed, written, formative feedback by right, provided they are handed in by the due formative feedback date. Such feedback is related explicitly to the task requirements, to the assessment criteria and to the Standards. It thus provides clear evidence of achievements and areas for development. In term 1 we have five formal assignments which are assessed summatively as a portfolio in February. This enables trainees to show that, over the course of the five assignments, they have addressed identified needs and made progress. There are also any number of informal assignments carried out during

subject studies sessions which I take in and provide feedback on – these are normally group tasks and so feedback is more general here.

Using the core studies assignment to work towards a closer awareness by key staff of the links between core and subject studies for each trainee

Trainees write a core studies assignment in November, for which they receive both formative and summative feedback. They will submit the formative feedback to me [or the summative feedback if they chose not to hand in the work for formative feedback] and I use that within the feedback I provide on a regular basis to support their development.

Using the Standards Index as a way of looking back, identifying and signalling standards-related evidence visible in the trainee's working documents

Every trainee is responsible for compiling, over the course of the training year, a personal Standards Index. This is simply a 'locator of evidence', on which they note the location of a really good piece of evidence which they, their mentor, and for some Standards, me, feel really shows how they have achieved that Standard, or part of the Standard. Such evidence may be a lesson observation record, assignment feedback, personal lesson evaluation, reporting stage form or a combination of any of those. This Index is reviewed, at regular intervals, by all concerned with the trainee's progress and development. No trainee can pass our PGCE without the professional tutor signing the final placement form to indicate that this Index is completed satisfactorily and that there is, indeed, evidence for all Standards having been achieved.

What are the implications for tutors' practice and workload?

Assessing, providing for, monitoring and recording each trainee's individual needs and development have huge implications on my workload. That does, of course, relate to they ways in which I choose to put into practice the whole-course principles above, which we, as a partnership, have agreed. Nevertheless, there is a big emphasis on trainees being very proactive and taking responsibility for their own needs, opportunities and development. Most of our trainees do so very effectively, so my involvement, apart from the written assessment aspects, which does take me vast amounts of time, is perhaps, not as onerous as it may, at first, seem. Having said that, it does place a significant burden on me, particularly when the cohort is large. I do find it hard, but also feel that the benefits outweigh the disadvantages!

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Monitoring Supported Open Learning in Mathematics Education Modules: A Pilot Study

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At a time when there is a move towards less face-to-face contact between tutors and students and more emphasis on students working independently in Higher Education, systems are needed to ensure that initial teacher education trainees complete the un-assessed tasks they are given that provide sufficient evidence for the standards for teacher training laid out in Circular 02/02. This is a report of a pilot scheme set up to monitor the completion of supported open learning tasks by Year 1 ITE trainees through the use of Web Communication Technology (WebCT). It highlights the need to plan such undertakings carefully and to provide adequate support systems to ensure their success.

Introduction

Alexander and Bond report that there has been a

> *... crisis of confidence in traditional education and increasing demands for higher and continuing education that have not been able to be adequately met by institutions constrained by years of public sector financial stringency and regulation. (2001, p.3)*

Such increasing demands have led to a reduction in the amount of face-to-face contact between tutors and students and an increase in the use of open and distance learning (ODL) supported by the use of information and communication technologies (ICT). Alexander and Bond go on to warn that the use of technology will not necessarily improve learning. Thorpe (2002) supports this view saying that '[ODL] will not necessarily be collaborative and constructivist just by virtue of the use of these technologies.' (p.107) However, if the use of the available technologies to support more independent learning is to be pursued within Higher Education, as seems maybe the case, then we must consider how best to do this.

Insung Jung et al (2002) studied 3 groups of students taught using either academic, collaborative or social interaction within their web-based module. These types of interactions were chosen for study as they were 'prominent in web based instruction (WBI)'. They defined them as follows:

- Academic interaction involves the student reading materials or participating in task-orientated activities provided online.
- Collaborative interaction involves the students in collaborating in solving

problems and discussing their learning via discussion boards.

- Social interaction arises when students get social feedback from their tutor or peers (i.e. through 'personal encouragement and motivational assistance.' (p.154)

Insung Jung et al. found that the group which were given social interaction outperformed the others and highlighted the importance of interpersonal feedback from instructors when attempting to improve learning achievement in WBI. This must be borne in mind when developing any web based independent learning packages.

The NCODE (1996, p.1) highlight the fact that 'many students have difficulty in learning how to take responsibility for their own learning' and Fraser (1997) warns that

> *...student centred teaching strategies, which hand over the responsibility and control of the learning process to the student, actually require a very motivated member of staff. A great deal of work must be put into the development, establishment and maintenance of the teaching strategy to be implemented. The lecturer needs to ensure that the students have adequate skill to get the most from the innovation... All this requires a commitment of time, energy and resources. (p.1)*

Research by the University of Canterbury Christchurch Educational Research and Advisory Unit (2000) into instrumental behaviours in students found that the most prevalent behaviour according to lecturers within the institution was students 'not doing extra reading or other non-assessed work' (p.4). The majority of respondents believed that behaviours such as this had increased in recent years and that the increase was influenced by a number of factors such as students having to work part-time to pay university fees, students being poorly prepared for university study and pressure from workload and/or assessment demands (p.7). This has implications for any institution planning to move to a teaching and learning model that involves independent work on the part of the students, especially if the work is un-assessed. Fraser and Dean (1998) feel there is no incentive for students to carry out tasks which are not assessed. Motivation appears to be an important issue here. Biggs (1999, p.61) lists four categories of motivation when planning learning activities. These are: extrinsic (the motivation comes from what the outcome produces); intrinsic (the motivation is in the process of carrying out the task); social (the motivation stems from what others value) and achievement (where the motivation is an opportunity to enhance the ego). If students are short of time due to the reasons listed by the Canterbury Christchurch Advisory Unit then it may be that module designers need to opt for extrinsic motivation in order to encourage students to carry out the required work. It would seem then that the trend reported by Alexander and Bond (2001) may not be an easy one to pursue.

In September 2002 all level 1 modules within my institution moved to a new teaching and learning model. The model is based on reduced face-to-face contact with trainees and the provision of 'supported open learning' (SOL). In the level 1 mathematics education, 10 credit modules I direct, this meant that tutors were allocated 18 hours contact time per teaching group and were required to provide 15 hours of SOL. In order to prepare, monitor and support the SOL tasks each tutor was allocated 2 hours per group. A number of support systems were put in place to aid the move towards the new model of teaching. One of these was the purchase of WebCT, a Virtual Learning Environment (VLE) software package.

Mathematics education modules in the past had been workshop-based, involving lots of practical work and interaction, a model advocated by Cockroft (1982) for use in school. Apart from the benefits these methods bring, they allowed us to model the very methods we wanted the trainees to use in schools. For pedagogical reasons it was therefore desirable that, if at all possible in the new system, this model of workshop-based teaching and learning should continue in the same form. Often our trainees are lacking in confidence in mathematics at their own level and this is something we need to address in addition to considerations of how children learn mathematics and how mathematics can be taught at the primary level. The teaching styles used have always been valued by trainees in past module evaluations and we needed to ensure that they were maintained within the new system.

Trainee teachers are required to show evidence of a wide range of professional standards (DfES, 2002) and it was possible that, unless the SOL was closely monitored, insufficient independent work would be carried out by trainees to allow them to provide satisfactory evidence of meeting these standards. I was, therefore, faced with a dilemma. How could I be sure that trainees were carrying out the un-assessed SOL tasks and were learning what I intended from these tasks? It was decided that a monitoring system for mathematics education module SOL tasks should be developed and trialled, within the Y1 mathematics education module of 2002/03 in the first instance. It was also decided that WebCT would be used to monitor some of the SOL tasks. It was hoped that the system would encourage trainees to carry out the SOL tasks and to allow them to provide evidence over and above their assessed work for the professional standards that they have to meet.

Methodology

Trainees were asked:

- to keep all SOL task outcomes and evidence of background reading in a mathematics file which was checked during their mathematics tests at the end of the module. Due to time constraints tutors could not read the files

carefully and had to make snap judgements. As the files were not being formally assessed this was felt to be acceptable. They were provided with a contents sheet to put at the front of their files with a simple recording mechanism to show which of the tasks had been completed and when. Tutors noted 'good', 'satisfactory' or 'unsatisfactory' against each trainee's name and notified academic tutors of any trainees found to have gaps via a module report form. Such trainees could then be asked to prioritise SOL in future and to try to complete tasks outstanding before the start of Y2.

- to access tutors' model answers for some of the SOL tasks. These were meant to be downloaded after they had tried the task themselves.
- to post some SOL task responses to WebCT discussion boards and read others' responses. They were invited to comment on others' responses in order to allow for some discussion of ideas put forward. (This would replicate what we would have done in session time had it been available to us.)

In planning the SOL tasks an attempt was made, verbally and in the module handbook, to ensure that all were related to the learning outcomes of the module and could be seen to be useful in preparing trainees for their end of module tests and for school experiences. In other words, we used extrinsic motivation.

Tutors kept records on the outcomes of these activities throughout the course of the module. An additional issue which needs to be borne in mind was that the Y1 cohort consisted of 157 trainees split into 6 groups. For their mathematics education module the groups were shared between myself and a visiting lecturer (VL).

The module was evaluated by students during the final teaching session through the use of a questionnaire which included the following questions related to SOL and the use of WebCT discussion boards:

Questions on SOL in general [rated on 1 (very good) – 4 (poor) scale]

(a) How effective were the SOL tasks in helping achieve the module's learning outcomes?

(b) How appropriate was the amount of time allocated to individual SOL tasks?

(c) To what extent were SOL tasks were followed up by tutors to ensure effective learning?

(d) How thoroughly did you engage in the SOL tasks?

Questions on the use of WebCT [rated as always / often / seldom / never]

1. To what extent did you make special efforts to engage in SOL tasks that involved the use of WebCT

2. To what extent did you download / value tutor responses to the 6 SOL tasks involving WebCT?
3. To what extent did you make the effort to read other people's contributions to the 4 SOL tasks that required this?
4. To what extent did you find other people's contributions to these 4 tasks useful?
5. To what extent would you prefer more SOL tasks to involve the use of WebCT?

If your answer to 1 or 3 above was 'seldom' or 'never' how could we encourage you to take a more active part?

The intention is that lessons learnt from this pilot would be used to improve and develop the system for use with Y2 trainees during the autumn 2003/04. The system would then be further refined after evaluation of this second stage and, if found to be satisfactory, used in future runs of both modules.

Results

Trainees' responses to the three types of task listed above can be seen in table 1. As far as the mathematics files are concerned the majority of trainees were graded either good or satisfactory with regard to completion of SOL tasks. 83% of my own trainees seemed to have ensured that most of these were carried out reasonably well. Evidence of background reading was lacking in many files.

Within my own groups 40% of trainees' files contained no such evidence, 16% of these within those awarded a 'good' for their SOL tasks (i.e. the most conscientious of trainees).

Table 1: Procedures used and outcomes achieved in the monitoring of SOL tasks with Y1 U/G ITE trainees

<table>
<tr><th>Procedure</th><th>Trainees informed via:</th><th>Outcomes</th><th>Tutor group comparisons</th></tr>
<tr><td>Completion of the maths file contents list and its inclusion in the front of their file when it was brought in for checking</td><td>• Detailed tutor input at start of the first session and, particularly, during the last session.
• Information given in the student handbook.</td><td>The majority of trainees followed the instructions given.</td><td>Little difference between groups.
Data from my own 3 groups showed:
<table><tr><th>Grade awarded</th><th>% trainees</th><th>% with no evidence of background reading</th></tr><tr><td>Good</td><td>53</td><td>29</td></tr><tr><td>Satisfactory</td><td>35</td><td>70</td></tr><tr><td>Unsatisfactory</td><td>12</td><td>100</td></tr></table></td></tr>
<tr><td>Logging on to their WebCT home-page as soon as possible during the start of semester 1 and responding directly to a ‘logged on message’ left there.</td><td>• Tutor input at start of the first session
• A number of verbal reminders throughout the first few weeks.</td><td>• After an initial flurry the trainees were slow to do this.
• Some e-mailed me outside the WebCT system so I could not add them to my WebCT-based log-on</td><td>Numbers logged on according to tutor / week:
<table><tr><th>Week</th><th>RE</th><th>VL</th></tr><tr><td>1</td><td>24</td><td>6</td></tr><tr><td>2</td><td>26</td><td>4</td></tr></table></td></tr>
</table>

<table>
<tr><td></td><td></td><td>archive. I had to ask these trainees to re-send their message directly to the WebCT discussion list.
• By two thirds of the way through the module 109 trainees out of the possible 157 had responded.</td><td></td><td>3
4
5
6
Total</td><td>13
6
1
0
70/78 (90%)
81% by week 3</td><td>14
6
8
1
39/79 (49%)
30% by week 3</td></tr>
<tr><td>Downloading tutor responses to two SOL tasks to check against their own responses.</td><td>• Brief comment in the module handbook within the section on SOL.
• Brief verbal explanations of these procedures during the SOL task preparation inputs.
• E-mails sent in, by myself, to each of the task discussion lists, explaining the procedures for each of the 2 SOL tasks simply requiring downloading.</td><td>The only way of checking whether or not trainees had downloaded tutor responses to the other two tasks to compare with their own was by looking in their files for printouts.</td><td colspan="4">N/A</td></tr>
</table>

Table 2: Evaluation of SOL tasks

Rating (Numbers are % of trainees)	1 Good	2	3	4 Poor	No comment
1. How effective were the SOL tasks in helping achieve the module's learning outcomes?	17	66	17	0	0
2. How appropriate was the amount of time allocated to individual SOL tasks?	19	63	14	3	2
3. To what extent were SOL tasks were followed up by tutors to ensure effective learning?	14	56	22	7	1
4. How thoroughly did you engage in the SOL tasks?	24	65	11	1	0

Although the majority of trainees (over 80% for questions 1,2 & 4 and 70% for question 3) gave good or satisfactory ratings, the negative ratings highlighted above do need consideration and trainees' comments to support these are listed below (numbers of students making these comments are given in brackets):

- Some tasks were very time consuming (4).
- There were a large number of tasks (4) - sometimes more than 1 a week (1).
- There seemed more tasks than in other modules (1).
- It was difficult to find time to do all the tasks (4).
- Assignments and SOL had to take priority over background reading (1).
- Little feedback for tasks was given in class (11).
- There was too much unsupported work (2).
- SOL tasks were not collected in for marking (2) – collecting in / going through in class would increase motivation to carry out the tasks (4).
- Practical activities in class would be of more use (1).
- Some tasks were unclear – especially on WebCT (3).

The trainees' evaluation of the use of WebCT showed a discrepancy between the 3 groups taught by myself and those taught by the VL (see figures 1& 2).

Figure 1: Response rate = 72 / 78 (92%)

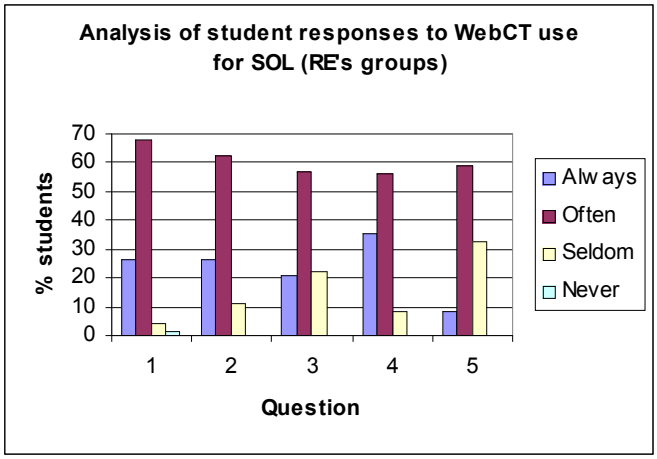
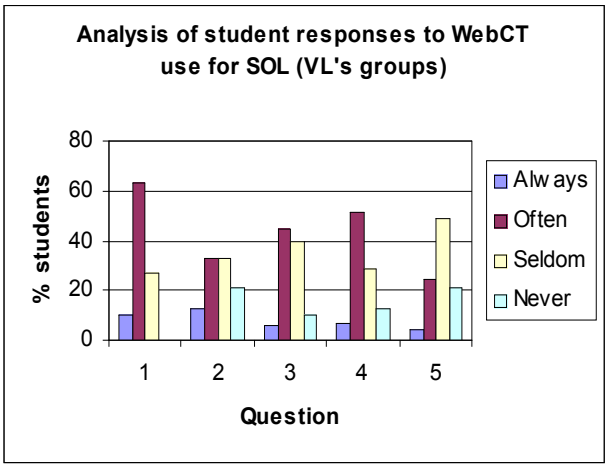


Figure 2: Response rate = 70 / 79 (89%)



Negative feedback centred on:

- problems accessing WebCT.
- lack of understanding of how to go about using the discussion board facility.
- lack of time to post or read others' responses (even though the tasks had been carried out), especially when large numbers of responses had been posted.
- preference for discussing the tasks in sessions (this was done with one or two tasks).

Positive comments can be seen in table 3.

Table 3: Positive comments made by trainees.

Question	*Positive comments*
1. To what extent did you make special efforts to engage in SOL tasks that involved the use of WebCT	Easy to access SOL – tasks useful (7) *At first unsure – now value it / think it useful (2)*
2. To what extent did you download / value tutor responses to the 6 SOL tasks involving WebCT?	Tutor responses were helpful when writing own (1) Read them but didn't print them off (1) *Helpful to compare tutor's responses with own (3) (!)* *Valued these (1)*
3. To what extent did you find these contributions useful?	Sometimes others' ideas were helpful (1) It was good to read others' views (3) Useful when they were the same as mine (2) (!) *Helped to extend my own ideas (1)* *Some discussions were good (1)* *Gives you ideas to put into practice (1)*

4. To what extent would you prefer more SOL tasks to involve the use of WebCT?	More tasks on WebCT would be good, especially if living at home (1) *Better to be able to check responses on WebCT as it saves session time (1)*
7. Other comments on the use of WebCT within this module (WebCT was also used to provide module documentation and teaching materials electronically for trainees.	Sometimes a lot of info. but could always catch up missed lectures (1) Useful but confusing (4) Own IT knowledge helped a great deal with WebCT use (1) Links to course materials good (11) *WebCT is a valuable tool / aids work / effective form of feedback (14)* *Easy to use and well laid out (4)* *WebCT is very good – lots of materials – saves time copying in sessions(2)* *More modules should use it (1)* *Always help available on WebCT for SOL (3)* *Enjoyable to use (1)*

Discussion

The responses of trainees to the three types of task set and the results of the trainees' evaluation of SOL in general prompted mathematics tutors to consider whether large-scale use of SOL in this way is an appropriate teaching & learning style for Y1 trainees who have not been trained in the skills needed for it to be effective. Trainees were unaware that tutors only received 2 hours per group for the setting up and support of SOL work and were expecting all tasks to be discussed and marked. This is unrealistic in the time available and would only add to the assessment load of tutors, something that the institution is trying to reduce. It could be argued that SOL task work could form the basis of the following session but, due to the sheer volume of work that has to be covered, this is not possible. These tasks enrich what is done in sessions.

Insung Jung et al (2002), The Open University (2002) and Moore & Kearsley (1996) all highlighted the importance of feedback to trainees in order to motivate them. Owing to a lack of available time there had been little tutor involvement in the discussion boards during the pilot, apart from sending in 'tutor responses' once trainees had had chance to post ideas. The OU's view of responding to every individual's first contribution so that they receive positive feedback (2002, p.112) appeared to be a sensible suggestion and made me decide to reply at least to everyone's initial log on message and their first SOL task. In view of the amount of time allocated to tutors for the support of SOL it may be difficult to do much more than that. However, it is now the intention that,

in future all tutors involved in the mathematics education modules using WebCT will participate in responding to postings and encouraging other trainees to do the same as far as time allows. The amount of time allocated to tutors is unlikely to be sufficient for full participation. Robinson (2001) cited under-resourcing in human terms ('buy-out' time for staff) as one of the problems encountered by staff from a number of institutions involved in the development of open and distance learning programmes, so this is not an uncommon problem. Thorpe (2002, p.112) states that '...the impact of technology is being constrained by what is both affordable and reasonable. The management of expectations has become a crucial issue, not only because of the costs, but also in terms of the finite resources of time of ... staff.'

With regard to the number of tasks and the time allocated to these – tutors felt that the 15 hours had been allocated reasonably. However, it was decided to remove one task from the list and reduce the amount of work involved in another task.

The SOL task schedule in the module handbook showed trainees when to complete each task – these deadlines needed to be highlighted so that trainees would keep on top of their work. One possible way of ensuring this would be to increase the number involving WebCT discussion lists and closing the lists off to contributions after each deadline. It was decided to trial this in the next stage of the project.

The use of WebCT discussion boards by trainees was disappointing and this was likely to be the result of two unrelated issues.

- Firstly, it was evident that there was a discrepancy between the two sets of groups. The reasons for this were likely to be that, as a full time member of staff, I had received training in WebCT and set up and moderated discussions & tasks. Due to circumstances beyond our control the VL had had to be contracted at a late stage and had been unable to attend WebCT training. An informal introduction to the software by myself and delayed access to WebCT until well after the start of the module meant that she was less well prepared to deal with the system that had been put in place. My own groups, therefore, were advantaged when we talked about WebCT. I knew the system well having set it up myself.
- Secondly, no training in the use of WebCT could be given to trainees in session time because:
    a) there were far too many other things to cover in the reduced face-to-face contact model
    b) at the time there was no internet access in most of the teaching

> rooms timetabled for this module so we were unable to show trainees what we were referring to when we talked about WebCT.

Trainees were given the option of attending WebCT training during semester 1 but the trainer had reported that the take up rate for this was low. As none of their semester 1 modules had used WebCT trainees saw no reason to attend such sessions.

Because of the difference between the two sets of tutor groups it is important to consider the trainees' experiences separately. The VL's groups tended to be, on the whole, more negative towards the use of WebCT discussion boards. This could well be due to the VL's lack of training in, and understanding of, WebCT. Although no training of the trainees was carried out, those in my own groups may well have been given a more positive message about the importance of taking part in the WebCT tasks. This is not surprising as it was I who set up the discussion lists and understood them well. It is far more difficult to be enthusiastic or knowledgeable about something that you have not had a hand in preparing.

Further research into the subject of open learning and asynchronous discussions has provided a number of useful suggestions to improve student motivation to take part in SOL, in particular the web-based aspects. The original system will be refined in the light of these and will be used for the Y2 module.

Salmon (2000) highlighted the importance of training trainees in the use of the technologies that would support their open learning. This was also the view of Kelly (2003). Salmon (2002) stated that the best way to achieve this was while they were taking part in on-line 'e-tivities'. However, I felt that some basic introduction was needed before they started; therefore a brief WebCT training session for all Y1 trainees is needed during induction week. All discussion topics and preliminary messages for the module need to be ready at the start of the year so that the College WebCT trainer can use these in his training session and, therefore, make it more meaningful to them. Time-tabling in rooms with internet connections so that Y2 tutors can show the Y2 trainees exactly what they should be accessing and responding to on WebCT is crucial.

Rossner & Stockley (1997) stressed the importance of the provision of training in the use of interactive technologies. As a result of the pilot scheme training for all tutors (including VLs) involved in the U/G mathematics education modules using WebCT will now become the norm.

Another point raised by Salmon (2002) was that in order to motivate trainees to carry out the 'e-tivities' the purposes and benefits of the tasks should be made clear to them. To this end the initial, explanatory discussion topic messages for the Y2 module were written with this in mind.

Kelly (2003) holds the view that trainees may be reluctant to commit themselves to writing a response to others' postings which would remain 'on show' for the duration of the module. She goes on to say that

> *Of course, not all trainees will contribute to on-line asynchronous discussionsin the same way as not all trainees contribute in traditiona understanding....However, their understanding ...is not usually as great as those contributing.' (p.3)*

Salmon (2000) is also of the view that lurkers can learn from computer-mediated communication. The WebCT evaluation and the supporting comments (question 4) did show that trainees were reading others' postings and were finding their views helpful and interesting and it is because of this that the practice will be pursued in the future.

Conclusion

Discussion of the pilot scheme's outcomes with the College's WebCT trainer allowed us to list a number of valuable lessons learnt with regard to the use of WebCT to monitor SOL. The first of these is that the use of discussion boards cannot be approached as a casual addition to courses if they are to be educationally useful and satisfying (as evidenced by the differing responses of my own and the VL's groups). All college tutors teaching on U/G mathematics education modules using WebCT must be trained in the use of the system and have a part in setting up the discussion boards so that they have joint ownership and understand what is expected of trainees. They should also be formally introduced to and encouraged to spend time reading around the subject of open learning in general, and the use of asynchronous discussions via VLEs in particular, before they start to initiate systems that use them.

Secondly, VLs drafted in (often at short notice) would benefit from being given immediate access to a WebCT account, training in the use of the system and some additional preparation time to familiarise themselves with the discussion lists set up by the full time tutor responsible for the module.

Thirdly, we should not make assumptions about trainees ICT skills, communication skills, ability and enthusiasm to work independently. Trainees need support in all of these areas. The Y1 trainees need to be given training in WebCT before the start of the module in which it is used

and this should not be optional. They also need to be clear about why they are being asked to use WebCT and what they can expect from their peers and tutors. Tutors should ensure that the trainees are fully aware of expectations, both verbally and through the module handbooks.

Finally, ways to encourage trainees to carry out additional background reading in private study time need to be found.

Although there have been problems with the introduction of SOL and the use of WebCT I feel that the system set up is worth improving and pursuing. The positive comments and good or satisfactory ratings by the majority of trainees are evidence of this. Although the model was meant to encourage trainees to work independently I feel, like Fraser and Dean (1998) that many are more likely to give SOL tasks a low priority unless they are assessed. The majority of the trainees at the College have to work to pay their way and this may well prevent them from engaging fully in the planned learning programme. The system I am trialling gives tutors a way of checking that SOL is being done throughout the module and the discussion boards, if managed properly, give an opportunity for discussion of ideas that cannot now be done in taught sessions. Time allocation is a problem here but now that the tasks have been set up there can be a greater focus on moderation of discussion boards.

There is obviously some work to do in encouraging trainees to carry out additional background reading, as the data from the file check shows. One way to do this would be to re-write the SOL tasks to include some tasks based on reading done. However, this would reduce the number of practical and software evaluation SOL tasks which are designed to help trainees' understanding of the subject matter. I would like to try to pursue the idea that reading around the subject is something done in addition to the SOL work. This is certainly the intention of the new teaching and learning model that allocates 69 hours of private study time for reading and assessment preparation. All mathematics education tutors will be asked to keep pushing for this to be done each week during the academic year 2003-04, highlighting the fact that it is likely to be those trainees who do such reading who fare better in their end of module tests.

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Assignments as a Tool for Professional Learning about Assessment.

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This paper describes two assignments based on different aspects of assessment that were given as part of a PGCE secondary mathematics course. The students' scripts were analysed to identify ways in which the students responded to the tasks and how this may contribute to our understanding of their learning about teaching.

Introduction

Assessment is an issue that has gained much political importance in England over the last few years, with the setting of targets for levels in the National Tests and constant importuning to "raise standards". Many documents (e.g. HMI, 2003) complain that this is an aspect of teachers' practice that is weak.

For those following courses to become teachers there are the competencies (TTA 2002) that expect:

> *3.2.1 They make appropriate use of a range of monitoring and assessment strategies to evaluate pupils' progress towards planned learning objectives, and use this information to improve their own planning and teaching.*

For the authors, when we began as teachers, the knowledge about assessment came from an apprenticeship model. Other than the lectures for our PGCE courses, we followed what had been done to us and we did what our department expected of us. Marking work and assessment were assumed to be unproblematic. Assessment is an everyday part of the teachers' work, so it was assumed that we would absorb the 'right' way to do things. Of course, we read some literature when we did our master's degrees. But when we began as teacher educators our model for becoming an assessor remain unchallenged, despite the changes to examinations at 16, the introduction of coursework and the new words that were creeping into the language of assessment, formative, summative, ipsative ....

We review our course each year and as we began to account more formally for aspects of assessment in our courses because of the introduction of the standards and Ofsted inspections our assignments began to change. The first change was when our "Doing maths" assignment was adapted so that it changed into one

which was marked and assessed by a fellow student, then we marked the marking! This offered some very useful pointers, but it was, perhaps, too easily dismissed as 'unreal' by our students. More adaptations were made as we looked to introduce more classroom-based research into assignments and 'targets' came to the fore. The assignments given in the academic years 2001-2 and 2002-3 are described in the following section, with the information given to students in figures 1 and 2.

Our students following this course come from two routes, the standard one-year PGCE and the second year of a subject conversion course. Our target number for the group is 40, of whom less than half come through the two-year route.

The Assignments

The secondary PGCE course at Birmingham asks for different sorts of written evidence dependent upon the subject, but to offer some uniformity we all agreed to have four written, formally assessed assignments plus other course requirements. Of the four assignments, one has to be based on a generic issue(s) such as special needs, gender, race etc. and one on using information technology. In mathematics, our other two assignments are based on aspects of assessment.

For each assignment there is a set of criteria which are included on the cover sheet for the assignment as well as in the assignment booklet. Figure 1 shows the page from the assignment booklet for the first of these 'assessment' assignments.

This is the second assignment that our students are asked to complete and is based upon work they are asked to do during their first secondary school placement (SP1). This placement lasts five weeks beginning in November. The assignment is completed and handed in for marking in December during the two weeks they spend at the University. In 2002-3 there was a change to the way we organised SP1. The students spent the first three weeks team teaching with their paired student, the fourth week taking turns to be the lead person for planning and teaching with the other student acting as support, and the fifth week observing rather than observing then teaching. This meant that the students could discuss all aspects of the assignment with their partner and there was time for the interviewing of pupils to take place in the fifth week if that was not possible during the time they were teaching the class.

The second 'assessment' assignment is based on evidence gathered in their second placement, their main placement of twelve weeks. The students, usually in the same pairs, spend the spring term in a second school. The assignment, described in figure 2, is handed in after Easter.

Figure 1: Assignment 2

2nd ASSIGNMENT

Assessing mathematics **Thursday 12th December 2002**

This assignment is designed for you to consider ways in which you assess on a regular basis pupils' written work and the usefulness of the feedback you provide for the pupils' learning of mathematics.

With one class, collect in their homework and assess it giving marks out of ten as the only feedback written in their books, and the only information entered in your own records. For the next homework assess their work giving written comments about the mathematics as the only feedback in their books and make a written comment only in your own records. The written comments to the pupils should include a mixture of explanatory statements and questions for them to consider. On both occasions when handing back the books, the pupils should be given about 5-10 minutes to look at their books and consider their mathematics in the light of the feedback. They should then be asked to write a few sentences saying how useful the marking has been for their own learning of mathematics. In addition, following the second marking, ask pupils to state which of these styles of marking they prefer.

In the light of these written comments, choose one or two pupils to interview (we will give you guidelines about this before you go to your first placement) outside lesson time to ask them about what sort of written feedback they find helpful for their learning of mathematics. (Obviously this is voluntary on behalf of the pupils and you should discuss the practical arrangements for this with your mentor).

Write up this small piece of research in the following way:

(a) Describe the usual way in which marking has been carried out prior to you taking over responsibility for marking;

(b) Describe the way you have usually been marking prior to this research;

(c) Put in an appendix a photocopy of the two sets of marking for two pupils – one who usually attains well in mathematics and one who does not;

(d) Give a summary of the findings of which style of marking the pupils prefer and include some quotes from what pupils wrote and said to you in the interviews;

(e) Discuss your own thoughts about marking and what you feel the purpose of marking is (i) for yourself and (ii) for pupils. In particular, say how the results from this research have or have not changed the way in which you view marking.

Criteria for assessment of the marking

Assessing Mathematics	**Good** **Satisfactory** **Needs Attention**
All aspects (a)-(e) of the assignment included	⟷
Clear and well constructed summary of pupils' preferences and comments	⟷
Relate own position on marking to results from research	⟷
Consideration of alternative positions on marking and justification of own position	⟷

Figure 2: Assignment 3

3rd ASSIGNMENT

A Case Study **Thursday, 1st May 2003.**

This assignment is designed for you to focus on one pupil's learning of mathematics in detail and how that develops over a period of time. In particular how their learning relates to the lessons taught and the targets set for that pupil. The structure for the assignment is as follows:

By half term of the Spring Term:

- identify a pupil in one group you teach (you will follow the mathematical development of this pupil in more detail over the rest of the term);
- identify reasons for your choice of pupil and have an overview of the pupil's current attainment in the mathematics topics you have taught (include SEN Codes of Practice where applicable, IEPs and/or evidence of any formal assessments made);
- set targets for the pupil's learning of mathematics over the two weeks following half term.

During the first two weeks after half term:

- pay particular attention to this pupil's learning of mathematics, collecting examples of their work and (if relevant) comparison with the rest of the group.

At the end of these two weeks:

- review progress made by the pupil in the light of the targets which were set (you should include some evidence to support your judgement – this might be from the pupil's book, work carried out during a lesson, or from an interview with the pupil. If the latter then make sure you have consulted with your mentor about correct procedures for carrying out an interview, as you will have done for the second assignment);
- consider how your lesson planning is affected by the monitoring of this (and other) pupil(s);
- set new targets for the next two weeks.

At the end of the fourth week following half term:

- review progress made by the pupil in the light of the new targets which were set (you should include some evidence as before to support your judgement);
- reflect upon the appropriateness of teaching methods and subject content;
- offer some suggestions for future support for this pupil in their mathematics lessons, relating your suggestions and findings to some relevant research literature.

N.B. All subjects must be **anonymous**, please use pseudonyms for pupils and staff.

Criteria for assessment

A Case Study	***Good*** **Satisfactory** **Needs Attention**
Description of pupil and reasons for choice (including mathematics attainment over first half term)	⟷
Statements of targets set and lessons taught	⟷
Reviewing of mathematical progress (evidence to be provided) at second and fourth week after half term	⟷
Relationship between monitoring of pupil(s) progress and lesson planning	⟷
Reflection on appropriateness of teaching methods and subject content	⟷
Implications for future practice (both teaching and assessment)	⟷

Their Purpose

The first of these two assignments was designed to allow our students to focus on the marking aspect of assessment, here marks out of ten and comments only. As most of our students are successful and were regular recipients of 'ten out of ten' they have rarely reflected on the impact of low marks or competition (except perhaps to relish being at the top). The role of remarks or rewards can be taken for granted by them, as is the school method of marking, recording and reporting (if the students are even aware of it). Asking the students to comment on the methods previously used allows them to become explicitly aware of those used by at least one teacher, even if this does not necessarily extend to the school or department policy. As they have to mark work in two different ways, the students have practical experience which they can discuss with others to aid them in developing their ideas. The feedback from the students' pupils is intended to allow them to investigate differing views to the types of marking and to follow this up in more detail through some pupil interviews, again to begin to challenge accepted beliefs.

The second assignment is designed to help the students to think about the practice of setting individual targets. Most of them consider this to be impractical (time is a perpetual problem for the learner-teacher). By working on the targets for one pupil, target-setting becomes manageable with the hope that the technique will become more valued. It is also hoped that observing one pupil closely will allow our students to notice more clearly the effect of teaching on learning (or non-learning) and that this will in turn affect their lesson planning to improve their case study student's learning opportunities which may help all the students in that class.

Reviewing the Assignments

The scripts from the academic year 2002-3 were photocopied and analysed to consider the role of these assignments in the future and how we can best help our students gain the most from the task. There were 39 scripts for the first assignment and 37 for the second (you always lose some!)

Learner-Knowledge

SP 1 is, for the majority of the one-year students, the first experience of being responsible for a class and for marking and assessing homework – for the two-year students this is their second experience. So they are novice teachers with their ideas about assessment often most strongly based in their own experience as school pupils, as one of them wrote

I was marking how I remembered being marked when I was a pupil.

This is a very similar situation to the development of their mathematics subject knowledge. We have written about the model for this development elsewhere,

the combining of learner-knowledge, practical wisdom and professional traditions by reflection to develop teacher knowledge (Prestage & Perks, 1999, 2001). But we can extend the model to consider how pre-service teachers may develop their knowledge of assessment as a pupil into the skills and understanding needed to work as a teacher. The learner-knowledge of the student is what was done to them and how they interpret the other terminology in terms of their own pupil experience.

For the target-setting in the case study, there was the expectation, before collecting the data together, that the majority of the targets would be ones for behaviour. The types of pupils that the students chose are given in Table 1. The majority of pupils were lower school (y7-9, 11-13 year olds) probably reflecting the timetables the students were given, but less than half the pupils chosen were from bottom sets.

Table 1: Groups worked with in assignment 1.

Year Group		
7	14	
8	10	
9	6	
10	4	
not known	3	all bottom
	37	

Set Designation	
Top	7
Middle	10
Bottom	14
not known	6
	37

Particular attributes		
Dyslexic	2	2 set nk, y7,8
Behaviour	4	2 set nk,Y8,Y9
		Y91top, Y8,1bottom
Visually Impaired	2	set nk, Y9

The types of targets given varied from 14 mathematics targets followed by 9 mathematics targets to one behaviour target which was the same on both occasions. Seven students gave only behaviour targets on both occasions (three exactly the same) and seven students gave only mathematics targets (three exactly the same). Only one student's targets are difficult to separate from the lesson plans. The relationship between the number of mathematics targets and behaviour targets for 36 students first target setting is shown in figure 3. Ten students gave mathematics targets with no behaviour targets and five gave behaviour targets but no mathematics targets. Even at this first stage of target setting there are a majority of the students who are working on the mathematics. amongst those who did not focus on mathematics, at least one student made the reasons for such choice explicit.

> *The targets I set MP were not maths specific. I wanted MP to be involved in class discussion and have more confidence in her own abilities.*

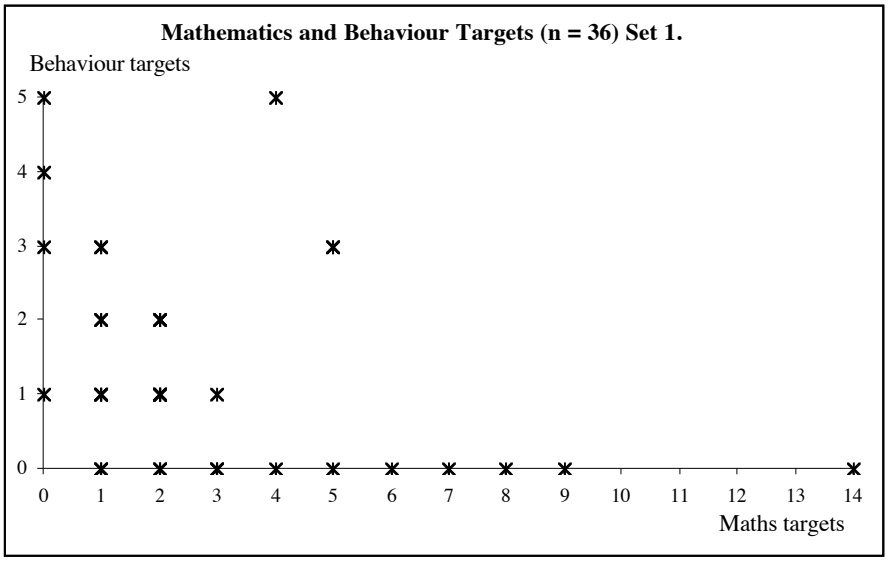

figure 3: Mathematics versus Behaviour Targets

For the second target setting, over a third of the students (14) remained with the same targets, one of whom stated that this was decided with the pupil. The pattern remained similar, but with lower numbers overall.

Apart from the knowledge that the students bring from their own learning experience there are two other elements we consider important in terms of their developing teacher-knowledge, professional traditions and practical wisdom.

Professional Traditions

From the school

For the first assignment, the students have to gather data at the same time as the majority are having their first formal teaching practice. The expectation that they will all be aware of the expectations of their school department is perhaps over-ambitious, despite their doing a survey of the each teacher's expectation of the classes they will be teaching before the placement begins. The assignment has the expectation that the students will ensure that they find out about assessment policies, but this was not in evidence in the assignment. Four students did not make clear whether the marking they did was based on a school/departmental policy, three others were more explicit including the one who stated:

> *I didn't give an attainment grade or effort mark at first, as I was at the time unaware of the department's marking policy and wanted to focus on whether they had grasped the concept.*

It may be that our students, like us, are so familiar with assessment on the receiving end that they assume that their learner knowledge is sufficient.

Others wrote in detail about either the school or departmental policy

> *Staff were encouraged ... to give constructive comments, which included explanations of problems, correct examples, spelling corrections and the highlighting of common errors. Staff were also encouraged to give positive comments and to set targets for the pupils' improvement. Along with this, pupils were given a mathematical achievement grade ranging from A(highest) to 1 (lowest).*

Many students offered reflection on the professional traditions expected and demonstrating their linking to practical wisdom, for example:

> *I have realised just how important it is to distinguish between effort and attainment and making sure the marks are easily understood. What's a good mark? Doesn't it depend on the level of difficulty of the homework?*

The use of effort marks was quite common (about two-thirds of the schools) and for all but two of the 19 students who commented, the problem of giving effort grades was highlighted as in:

> *... I only gave A5 for a piece of homework that was almost all correct and I only really looked at presentation and the amount of work when giving effort mark. I found it quite difficult to be sure of how much effort pupils actually put into their homework.*

For the case study, there was less expectation in the criteria for its assessment that reference would be made to the schools' policies, but even so there was evidence of the students seeking advice about the professional traditions in their school:

When I questioned the class teacher to see a copy of his IEP, ignorance was claimed, knowing nothing about this child or a further six others having individual education plans. However, a photocopied version of the register revealed dots next to Tom's name ,,, Intrigued I took my question to the school's SENCO, who was on long term sick leave, so I only found the answers as I was about to leave. Tom's IEP had been withdrawn recently, and I was told he was being monitored within his lessons. As to how this was being maintained I'm not sure, if his maths teacher was unaware of such happenings!

There was, on occasions, evidence of the realisation that the professional traditions imposed on the school were acting against the students' philosophy for classroom events.

> *The schemes of work did have a degree of flexibility in them but the political climate at the time meant that there was such a commotion about impending examinations to decide set changes (because they were not carried out on two preceding occasions) that there was not enough time for investigational type lessons. There was such an emphasis on*

trying to do SATS style questions from textbooks, this stigmatised approach, as this study would endorse, that this affects the way in which the learning environment is fostered and developed.

From literature

The other aspect of professional traditions comes from the literature. Although there was no specific mention of the use of literature in either assignment description, there is a difference between students in the amount of use made to external sources. For the first assignment only one student used any references, one from the Times Educational Supplement and one from a chapter in a book. For the second assignment there was much wider use of references, see table 2. Although the majority still did not use any references to literature, two students used a good range of references.

Table 2: The number of references for the Case Study assignment.

Number of References	Number of students
0	21
1	5
2	5
3	2
4	2
7	1
8	1

Amongst these there were references to sources of mathematics material used, but alongside chapters from books there were two citations of web sites and five of academic papers. It is the awareness of research and its role in professional learning that we need to extend further. Since this research was done, we have modularised our course at level M. The introduction of more literature in assignments have thus been an important addition.

Practical Wisdom

Practical wisdom (the on-the-job thinking and doing) is demonstrated in a number of ways in the students' writing, for example in one comment, there is the thinking ahead to how a comment style of marking could be managed :

Due to the amount of writing I might do for this style of marking and therefore the amount of time spent by the pupils reading the comments I'd written, maybe it would be a good idea to set aside time for them to read through the comments at the beginning of the lesson. Then, while they are working on that lessons work I could go around and answer any questions they had about marking while also marking their classwork as I went. Another time saving device!

From the case study

> *Children like Sonia become stereotyped as a low achiever because of their behaviour ...*
>
> *I agree that it is always the children who end up being disruptive but they always will be if the method of teaching does not appeal to them. ... I found that when Sonia was given an alternative approach and spoke to with a little respect, she responded very well.*

The activity also seemed to highlight the awareness of different needs of learners (in some cases this also highlights the interconnection between practical wisdom and professional traditions, for example some had had sessions on visual, auditory and kinaesthetic learners.

> *I tried to incorporate visual images into explanations to help visual learners, verbal explanations, aural questions, games and role-play. However, I feel that I did not incorporate enough kinaesthetic teaching methods.*

One student commented that the targeted pupil preferred 'learning in an investigative or spatial way' which had meant he included flow diagrams as part of the lesson explanation. Another student tried to include more practical work as he realised that his pupil was 'particularly responsive to paired work and activities that required moving about'. For another pupil a different environment from the usual observed classroom was considered as he was:

> *individual worker who had great inspirational moments and he would benefit from and contribute to group work'*

recommending a fundamental change because he

> *would thrive in a task-centred environment and in a classroom culture where pupils are trained not to be passive participants but active learners who take responsibility for their own learning.'*

Gains from doing the task

From the marking task, most students commented on the value of the assignment, even if they did not feel that it changed their views of on how to mark (this can be a limitation of such small scale research when wider reading is not expected.) What seemed to be of greatest value was the contrasting viewpoints of some pupils, which can come as a surprise to those who have nearly always been successful.

> *However, the assignment has given me an insight into the conflicting ways in which pupils can react to different styles of marking, for example how some people can feel inadequate if they receive a lower mark than their peers.*

The pupils' view on the style of marking was also useful.

> *This piece of research has had a significant impact on the way I think about marking. It has raised many issues I had not previously considered, such as how marking effects the individuals' learning of mathematics, and what types of marking are more suitable for which groups.*
>
> *Overall, I now know how I would like to mark work and the feedback from this research has been useful in terms of seeing how pupils would like their work to be marked.*
>
> *As I have thought about this assignment, it seems that assessment should be carried out as often as possible in different ways having a fresh focus each time. The feedback from pupils and their own target setting or evaluation should be a vital part of the assessment process.*

From the case study

> *As I have undertaken this assignment I have wondered about the meaning of: 'a pupil's learning of mathematics and how that develops over time'. The scheme of work and assessment policy apeared to intepret this as: more knowledge and more skills rather than better-connected knowledge and skills (Perks 2002). I would like to see a change in the "learning environment" by planning activities where pupils express their thinking and ideas within a small group.*
>
> *Monitoring a pupil meant that K & I were continually discussing our belief of the pupils' understanding and this informed our planning for the next few lessons. Our targeted pupils were average or to the lower end of the class. If they were coping with the exercises we could see that the rest of the class were also happy with the work. The downside was in ensuring that there was sufficient extension work for the few girls at the other end of the spectrum.*
>
> *Over the first four weeks of the second half of the term I felt that my planning for this class improved a lot. The main reason for this improvement was the monitoring of J's work as it highlighted the areas needed to worked on (sic) with J. However, the monitoring didn't only benefit J, but I felt it was beneficial for all the pupils in the class as I had to adapt my plans to accommodate all the attainment level in the class.*

Focusing on one pupil's individual needs forced me to differentiate by task in some cases, which is something I hadn't really done much before and it was a valuable learning experience

Tutor Marking

The activity also allowed a closer comparison between the two tutors methods of marking. For both tutors there was a difference in the types of comments within the scripts and on the front cover – the formal comments, copies of which are kept on file. The marks within the scripts vary from ticks (do our students see these as 'being right' whereas we use them for the bits we like, so should we offer a key?) to comments. One of the most important factors here is, we feel, the use of hedges. You will see "mm are you" "I think.." "It feels to me .." – this could be a stronger aspect to emphasise the idea of beginning a debate.

On the front cover of the marked assignments there is a strong difference between the two authors. We both dislike this part of the marking, we enjoy the reading and the comments inside, but the formality and the seeming repetition of the official sheet is inhibiting. Stephanie is, however, much more true to a philosophy based on Dweck (2000). Her comments appear to reflect her belief in the mastery theory of intelligence. (Dweck describes two theories of intelligence: the entity theory that intelligence is fixed and the mastery theory where intelligence can be increased through appropriate challenge.) Dweck discusses the kinds of praise and criticism that can increase vulnerability and the learned helplessness that accompanies those that believe in the entity theory. She has demonstrated that

- critical feedback that focused the child on alternative strategies produced the most mastery-oriented pattern (p 111)

and that we must work to use

- effort and strategy praise (p 113)

Stephanie offered strategies, whereas Pat needs to find ways of using strategy remarks on all scripts. (Why can we hold a strong belief and yet not act in a way which reflects this?) However, the assignment was graded Good/Pass/Refer so will our comments ever be read?

For our partnership, two issues emerged for discussion with mentors:

- should students be allowed to mark without consulting school/department policy?
- would it be worth discussing marking policy at a mentor meeting?

For us as tutors, there was the reminder about out styles of marking but we also need to consider our session, for example:

- Do we discuss the purpose of corrections in sessions? Is it important enough?

  I marked the first lot of homework by doing a couple of corrections and handing it back to the pupils with an instruction asking them to finish off the corrections for the following lesson. .... Not many of the pupils actually did this. I'm not sure why, maybe because they didn't understand the principal behind this homework or because they forgot or because they couldn't be bothered?

- Do we need to work on the differences between marking and assessment more explicitly?

The matters arising from the assignments are valuable and we need to ensure that there is the opportunity for a whole group feedback and discussions.

Future Changes

Our PGCE course has had to be modularised to fit the university requirement and we have decided to assess these modules at level M rather than level 3. As a consequence we have to ensure that the research aspects of any tasks are more explicit. As these two assignments are mini-research activities, it is the use of literature that is the biggest aspect of any changes we need to make

If we believe that grades mitigate against real development, as any comments from the assessors are then likely to be ignored, how do we fight against a University system that would like us to use a full range of percentages?

Reviewing a whole set of assignments is time-consuming, but it allowed a re-consideration in a way we found very valuable. As a team of three, we always discuss the changes each year, but there was a depth to this activity that we have not made time for before.

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The Interactive Whiteboard and the PGCE

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In this paper, we describe how we work with out PGCE student on the role of teaching and learning mathematics with interactive whiteboards. The course encourages students to develop materials in order to improve their expertise but also focuses on the pedagogical implications of this new technology.

Introduction and Rationale

In the light of the rapid increase in the number of interactive whiteboards (IAWs) in schools, those who prepare students for the classroom should endeavour to equip them with the requisite knowledge, skills and understanding in order for them to operate effectively and efficiently in front of pupils. We believe that the arrival of poorly equipped professionals in the classroom will not only mean that that resources and investment are wasted but also that the opportunity for growth and development will be lost.

Our research to date (see website address at the end) suggests that the nature of pedagogy in the future should change in order to meet the demands of the pupils, since they will require a more technological and sophisticated approach. As IAWs are being installed in schools at an ever increasing rate we, the teacher educators, face an increasing challenge to adapt our pedagogy in order to help our students maximise the potential of the IAW. In addition the market is providing more and more packages that are intended for use on IAWs, and that whilst some will help make a contribution to the learning process others will not.

With this in mind we devised a course focussed on the contribution of IAWs to the teaching and learning of mathematics. This course was to be taught on the first year of our two-year PGCE conversion course in mathematics. Our aims were to:

- define and demonstrate good practice in the use of the IAW;
- demonstrate, and provide workshop opportunities for, the development of resources for the IAW;
- demonstrate, and give an opportunity to work with, software packages on the IAW (e.g. Geometer's SketchPad/Cabri, Omnigraph/Autograph);
- provide an initial input into a pedagogy of IAW use;

- ensure that students are proficient in its use by providing opportunities for them to present material to their peers using the IAW;
- help them become aware of the IAW's potential in dealing with classroom management;
- help students become aware of the significant contribution that the IAW can make to learning;
- develop a culture in which students might be made aware of the nature of research and academic writing that focuses on the use of the IAW in the mathematics classroom.

Hence the course was designed to give knowledge of theory, research and practice; training and practice in the skills of the IAW's use and some understanding of why, how and when to use one. Furthermore, it is important to note that this has to be addressed in the context of the mathematics curriculum and in this sense has both discrete and diffuse aspects. In addition we would expect that our 'tuition' would demonstrate good practice and reflect all that the course sets out to achieve.

The course is delivered in 18 one-hour sessions and is complemented by an additional course that addresses key themes of the National Curriculum. Thus it is possible to present classroom material in context using the IAW.

In order to strengthen the course we made it so that assessment was centred on a small portfolio with direct reference to the aims. First, students are required to compose a Flipchart (the software available with the IAW we use) to deliver a National Curriculum topic and at the same time demonstrate the full range of IAW manipulations covered during the course. This Flipchart is then presented by the student to the rest of the group and is then the focus of discussion with them. A second part of the assessment is a report written – as if by a Head of Department to a Board of Governors – supporting an application for IAWs in a mathematics department. The report is required to give a discussion of the advantages of IAWs and the contribution they make to the teaching and learning of mathematics based on current research and evidence.

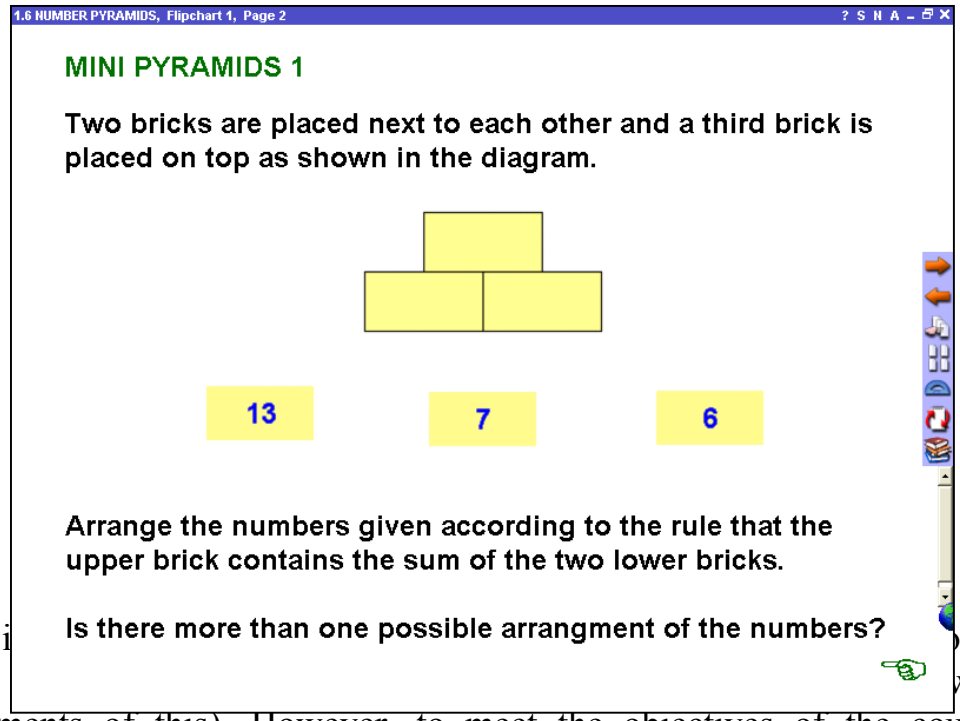
We now provide an example of one of the early sessions that attempts to give a flavour of the course. The session in question concerns the building and use of number pyramids in order to introduce algebra. This is a particularly useful topic in the context of the course since it forms the basis of the ArAl project (Malara and Navarra, 2003) and as such is well documented in terms of its pedagogy and its contribution towards learning. Further it is a technique suggested in the Framework (DfEE, 2001) and can be used as a source of interesting mathematics.

In what follows, the intention is to demonstrate how these aims and objectives are tackled in this particular session. In order to give a sense of the focus of

discussion during the session we have talked about tutor and student when describing the session itself and teacher and pupil when suggesting how the material is best used in the classroom.

Define and demonstrate good practice in the use of the IAW

The tutor presents material for the session through a Flipchart with a front Contents page which hyperlinks to each of the sections thus indicating what will be addressed during the session. This not only signals what will be covered during the session but also supports a considered structure. Typically we arrange that each session begins with a teaching situation likely to be found in the mathematics classroom. In this case the session begins with a demonstration of an elementary pyramid in which the number in each brick is equal to the sum of the two bricks immediately below it (see Figure 1).



In this si n the top and the wo equal arrangements of this). However, to meet the objectives of the course, and emphasise good practice with the IAW, the point would be made that alternatives (and reasons for their dismissal) would be considered. In the mathematics classroom a teacher would expect pupils to be explicit about what was being attempted and explain why it would and would not be acceptable. Similarly, to help with the compilation of this and other similar flipchart pages, the tutor is able to discuss with students general presentation features: the fonts used, the colours used, the hyperlinks available, the white space available, the positioning of the text and the way the numbers are able to 'fit' into the bricks of the pyramid. Consideration of these and similar features are significant when considering best practice.

In this way and using a simple example, we believe that it is possible to replicate

good practice and identify the key features that support good pedagogy in using the IAW.

Figure 2: preparing the pyramid in Excel

Demonstrate, and provide workshop opportunities for, the development of resources for the IAW

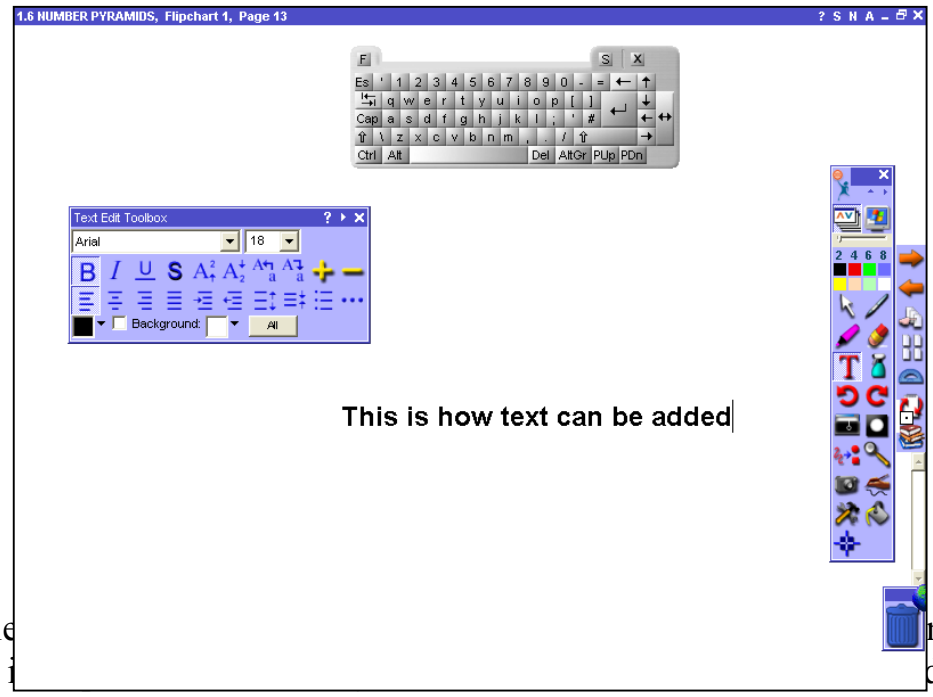
A particular skill required by students is the ability to use the IAW, and its associated software, to organise and present material developed in other environments. Throughout the course we encourage the students to consider how a range of sources from Word through to the Internet might be used in this way. In this session, the tutor demonstrates how Excel can be used to construct both the pyramid templates (figure 2) and the number tiles. First the cells are sized to give reasonable bricks and tiles. In this case each cell is 50 pixels by 60 pixels. Then with the whole spreadsheet highlighted the background is made white (this removes the cell outlines), the cells are formatted for text (Arial 18, Bold and Centred with the required colour) and appropriate cells are merged to give the required pyramid structure. (In this case this means two cells are merged into one in appropriate places. It is also possible to simply copy and paste a merged double cell as required). These merged pyramid cells are then coloured and bordered as required, copied using the 'camera' facility of the Flipchart software and sent to the correct e-screen.

At this stage, when the picture is automatically pasted by the camera it is necessary to make the white parts of the transferred image transparent so that the white does not create layering problems later. With the elementary pyramid template now in place it is possible to make the required number tiles.

The tiles are made by a similar process to that of the pyramid (using the camera after creating the image in the Excel file). However, in this case it is necessary to copy only one 'double cell' at a time with the required number in place (so

that they can be used individually); for presentational effect, the cell sizes are reduced by 5 pixels in each direction in order that the tiles might fit in the pyramid template without 'crossing' the edges. In this example it is required to make three such number tiles that will fit into the pyramid as required.

When the number tiles have been transferred to the Flipchart and their position relative to the pyramid fixed, it is necessary to add any required text. This can be achieved in one of two ways. First, text can be added directly to the Flipchart using the Text Tool - elements of this are shown in Figure 3.



It is possible ng the palette (and i d once completed the text can be positioned anywhere on the screen according to taste and requirements. Alternatively, text can be copied from another source (a Word document for example) and copied directly onto the Flipchart page via the Text Tool. As part of this course, presentational styles and effects are considered and discussed in detail. In fact students very quickly establish their own preferred style of presentation and this provides useful discussion points during the sessions.

This elementary technique of copying from one environment to another can be used to great effect across a range of software. By encouraging students to be creative in this way and respond to their work, the tutor is able to focus on the generalities of the process rather than specific content. We believe that being able to manipulate software in this way is an essential feature of best practice using the IAW.

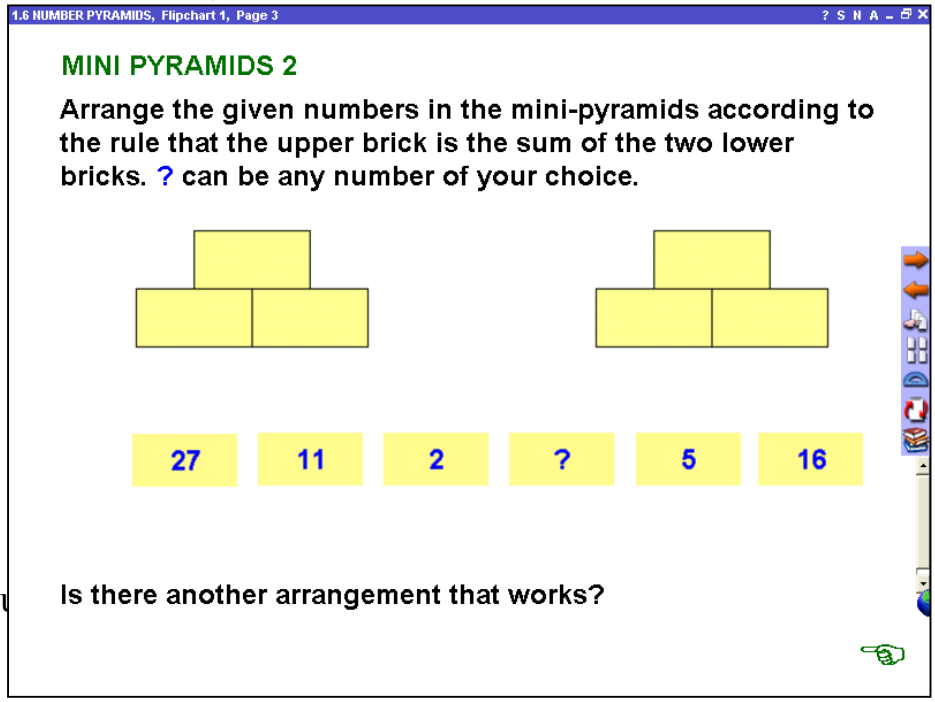
Demonstrate, and give an opportunity to work with, software packages on the board (e.g. Geometer's SketchPad/Cabri, Omnigraph/Autograph)

Here the focus is on Excel. However, this technique of using e-screens from other sources and integrating them into a Flipchart is a powerful one and throughout the course a number of different software packages are used. In many cases the process is the same. The Flipchart is used to look at particular case and its tools are used to manipulate elements in such a way that promotes discussion and interaction. Here single cells with particular values can be moved around the e-screen with ease. When using this with pupils, teachers can clarify terms and rules before moving back into the original software to look at further and more general cases.

In the same way we use geometry programs and graphing packages and encourage the students to think carefully how they might be used to promote effective teaching and learning.

Provide an initial input into a pedagogy of IAW use

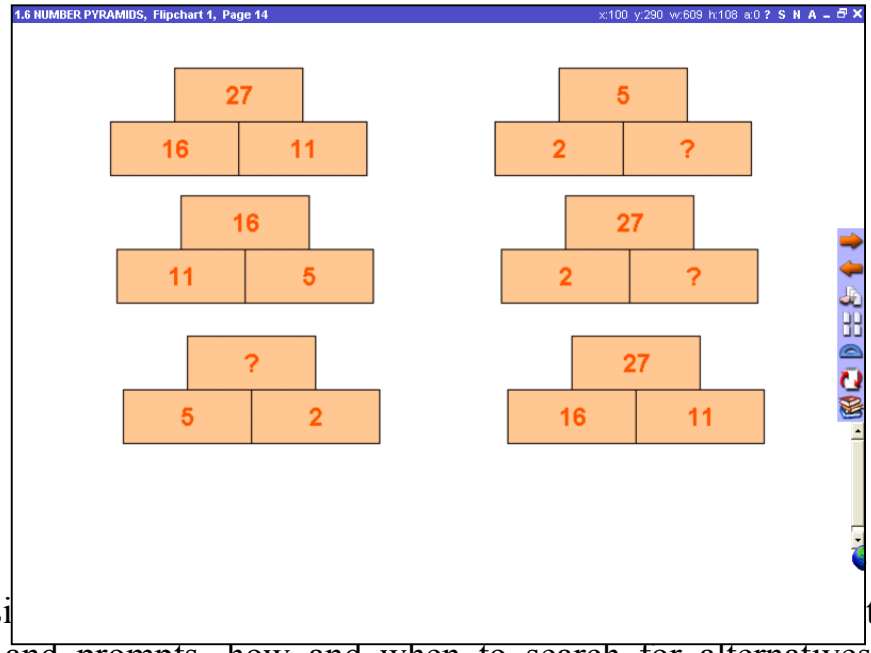
With the number tiles and elementary pyramid template now in place, it is possible to move the tiles into position. This is achieved by using drag and drop, a manipulation whereby the teacher in accordance with requirements positions e-screen elements (i.e. picks up the elements with the IAW's equivalent of a mouse click, moves them to a new position with the equivalent of the mouse button still depressed, and then places the element in the desired position by releasing the equivalent of the mouse button). Here we see the manipulation used to place the tile in the pyramid. (The largest number must be placed in the top cell and the remaining tiles in the lower cells.)



Figu

Students are able to complete this first activity quickly and with ease though there is little scope for discussion about pedagogy and presentational style with this example. The use of colour sometimes is an issue and font style can be inappropriate on occasions. However, developing a Flipchart page with two such elementary pyramids (see Figure 4) where the sixth number tile contains an unknown number begins to demonstrate the potential of the IAW to support interactive teaching as well as lead towards the beginnings of algebra as demonstrated in the ArAl project. During the session students are asked to construct such a Flipchart and begin to consider how it is a next step in the search for algebra.

In this example the discussion with students focuses on how the teacher might manage the alternative solutions to the problem. As a first step pupils might be invited by the teacher to arrive at a solution by using drag and drop to place the tiles in a way that meets the requirements of the problem. Using the IAW allows pupils to correct 'incorrect' arrangements with ease thus removing any stress brought about by the need to be 'right first time'. Tiles can simply be repositioned. In working with students, the tutor would emphasise the importance of asking children to explain their particular movement of the tiles as they are working with them. The link with language in this context is considered to be important from a learning point of view. Working with pupils, the next stage would be the exploration for alternative solutions. The first solution can be saved using the camera facility and a second, third, … solution obtained each requiring pupils to be creative, systematic and clear about their strategies.



In the sessi the nature of questions and prompts, how and when to search for alternatives, promoting cognitive conflict, seeking justification and generalisation. These features lie at the centre of 'enhanced interactivity' (Miller et al., 2004). The IAW gives the opportunity to present and collect alternatives for discussion. Additional

manipulations such as hide and reveal (in which prepared solutions are shown to pupils after appropriate discussion) enhance the quality of the discussion and maintain pace and focus in the lesson.

Figure 6: using Excel to prepare solutions

At some stage in the process, it is likely that the tutor will move to an Excel spreadsheet in order to generate a number of pyramids quickly (see Figure 6). In the session with students, the tutor then invites them to develop further Flipchart pages that move towards elementary algebra and perhaps the solution of simple linear equations. They are encouraged to explore the richness of this format and approach by: increasing the number of layers in the pyramid; changing the position of the unknown within the pyramid and establishing generalisations about what is possible and what is not.

Later students would discuss how the use of such pyramid templates is managed in the ArAl project and in the Framework. This gives status and validity to the approach although in both these cases the material is used within a static as opposed to a dynamic environment. In addition two examples of such an activity, Pyramid numbers and Pyramid equations from EXP 7 could also be considered. This allows for a discussion of the advantages brought to the teaching and learning process by the IAW.

Ensure that students are proficient in IAW use by providing opportunities for them to present material to their peers

An important feature of our course is the encouragement and opportunity given to students to use the IAW to present material to their peers. In all sessions students are expected to come to the IAW and show features of their work. Without this experience we believe that students will not have the facility with the IAW's tools to be proficient in the classroom. As part of the final assessment students have to compile a substantive Flipchart demonstrating the features of the IAW covered during the course and arrange for them to be used in a way to

show how pedagogy can be enhanced. Each student is then timetabled to present their Flipchart to the remainder of the group. At the end of the presentation there is a discussion of its features and how these support interactive teaching.

Help them become aware of the IAW's potential in dealing with classroom management and its significant contribution to learning

The aim of the course is to expose pre-service teachers to the potential of the IAW to support and enhance teaching and learning in the classroom. This is achieved both by example and by specific reference. Such references will include:

- consideration of classroom layout and the relative positioning of IAW and desks;
- health and safety issues related to the use of the data projector;
- question and answer techniques to ensure an optimum level of interaction with all pupils;
- management of and advice to pupils working at the IAW;
- orchestration of activities to include pupils working at their desks as well as at the IAW;
- how the IAW might be used to support visual, audio and kinaesthetic learning;
- the use of multi-representations to support cognitive and concept development.

Such items are not always apparent to early users of the IAW who see it as something to be mastered only in a technological sense. However, as mathematics educators we believe that it is precisely these features of the use of the IAW that we need to be discussing with our students. The sessions, structured around particular topics of mathematics, provide the opportunities for them to be discussed and explored.

Develop a culture in which students might be made aware of the nature of research and academic writing that focuses on the use of the IAW in the mathematics classroom

In our view, it is important that we should establish clear links between what appears to be good practice in the classroom and what has been the finding of current research. To this end as part of the course students are asked to read both texts and research papers related to learning styles and the use of IAWs. Whilst there is opportunity to discuss what is written during the sessions, as part of the assessment of the course students are expected to justify the use of IAWs in school with reference to the latest publications. The results of our own recent

research are particularly relevant in this respect.

Conclusion

Although all these features are demonstrated using the IAW we would expect our students to prepare resources like these away from the IAW since it is much quicker. To this end we have been allowed to provide them all with the relevant software by the IAW manufacturers and have ensured that we have enough software licences and available machines to allow this to happen. We also provide opportunities for students to use the IAWs by making suitable rooms available on a regular basis.

Whilst our course seeks to equip students with the technical skills necessary to operate an IAW at an advanced level, we do not see it simply as a technical or skill based course. It is our belief that best practice in the mathematics classroom is built around properly managed and orchestrated pupil-pupil and pupil-teacher interaction. What we suggest in our course is that the IAW offers new and better opportunities for this interaction to take place effectively and efficiently and in our sessions we focus on examples of how this might happen. Throughout the course there is discussion of learning styles and appropriate pedagogy as well as resources and how to manage them. Our aim is that our students should know and understand what is meant by enhanced interactivity when working with the IAW and be well on the way to achieving this when they enter their first teaching post.

Currently we are in the second year of this course and continue to reflect on how it might be improved. We would welcome comments or advice from others.

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Recommended interactive whiteboard specific software

EXP Maths 7, 8 and 9 from Nelson Thornes found at
http://www.nelsonthornes.com/secondary/maths/marketing/books_exp.htm
Interactive Teaching Programs (ITPs) from the DfES found at
http://www.standards.dfes.gov.uk/numeracy/publications/ - Interactive teaching programs
Interactive Mathematics from the Association of Teachers of Mathematics found at
http://www.atm.org.uk/buyonline/products/software/sof065.html
Advice for teachers of mathematics
Major sites of interactive whiteboard information for mathematics teachers
Advice for teachers of mathematics found at
http://www.keele.ac.uk/depts/ed/iaw/docs/Advice for teachers of mathematics.pdf
Keele interactive whiteboard site for teachers of secondary mathematics, research and resources found at
http://www.keele.ac.uk/depts/ed/iaw/
Advice for those new to interactive whiteboards: The REVIEW Project found at
http://www.thereviewproject.org/index.htm
The National Whiteboard Network: a numeracy website found at
http://www.nwnet.org.uk/pages/index.html
Health and safety found at
http://www.becta.org.uk/leaders/leaders.cfm?section=3_1&id=3173

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National Numeracy: a brief exploration

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The introduction of the National Numeracy Strategy has been a strong influence on English schools. The findings from research as to the benefits are not clear-cut. We suggest that features such as the rush to standard algorithms may hinder mathematical development.

Introduction

The National Numeracy Strategy (NNS) was introduced in pilot form during 1996 in primary schools as a response to the perceived underachievement of pupils educated in England compared to pupils educated in other comparable countries (TIMSS (1995)). Evidence that our pupils may have had relatively sound problem solving capabilities was available but generally down-played as part of the drive to improve standards (TIMSS (1995), PISA (2000)). As a result of the success of the strategy in primary schools, its main features were introduced at Key Stage 3 in 2001 following pilots introduced in 1999.

The basic features of the strategy include:

- direct whole class interactive teaching,
- clear objectives for lessons,
- increased emphasis on mental mathematics,
- three part lessons.

Discussion

It is clear that schools, LEAs, universities and NNS consultants have made considerable efforts to support teachers to implement the strategy. Most official reports suggest that whole class teaching now plays a significant part in lessons and the use of mental starters is well embedded in most schools.

Visitors to schools would notice the use of lesson objectives and a keen observer might see some evidence of some teachers encouraging the use of informal mathematics at Key Stages 1 and 2. At Key Stage 3, however, apart from the mental starter and the use of objectives, it is difficult to recognise significant changes since the introduction of the strategy. Teachers perceive greater change than pupils: "There is evidence to suggest that pupils discuss mistakes and misconceptions in a minority of lessons, whereas teachers discuss mistakes in a majority of lessons" (Wilson, 2003).

Venkatakrishnan (2004) stated that in taking the strategy on board schools teachers seek to interpret the strategy in terms of their traditional teaching approaches. In many respects they take on the superficial features of the strategy such as the three part lesson and stating objectives, but reinterpret, say, whole class interactive teaching to become direct teaching utilising telling and pupils doing exercises in the main body of the lesson.

TIMSS (2003) indicates significant improvement at Key Stage 2 compared to 1997. Although the strategy concentrates on numeracy, the greatest improvements are in geometry and data handling and the least in number and pre-algebra. At Key Stage 3, however, the report indicates no significant changes (see NFER website for more details). Evidence on pupils' problem solving skills at 15 (PISA, 2003) is not available as not enough schools in England participated in the survey. Some authors put this, in part, down to the heavy burden of testing imposed on English schools (Hirsch, TES, December 2004).

Anecdotally, university tutors suggest that using test questions generated by APU and CSMS from the 1980s with pupils in recent years indicates little evidence of improvement or the reduction of common misconceptions. The Leverhulme Project and associated research (Askew et al., 2001) suggests the need to be very cautious in accepting the Government's claim that the NNS has generated a significant improvement in standards at Key Stage 2. Certainly secondary teachers, while recognising improvements, are reluctant to accept Key Stage 2 national test results as reliable indicators of attainment or potential. Many argue that the pressure of school league tables leads to cramming for these tests, providing little basis for a belief in sustained achievement in mathematics.

Perhaps the research by Anghileri (2002) provides some of the most interesting clues as to why our pupils are not building on their achievements. There is at least tentative evidence of the potentially destructive nature of learning algorithms in mathematical development. Table 1 (adapted from Anghileri, 2002)) provides an interesting comparison between year 4 pupils in England and Holland tested on division with a gap of six months between the tests. Given that the research was conducted in the early stages of the strategy it will be interesting to read about the follow-up study conducted by her and soon to be published.

Our own initial studies of year 7 pupils attempting proportional reasoning questions, as part of a project funded by the Gatsby Charitable Foundation, suggest that many either rush too quickly to a standard algorithm or play with numbers to find patterns without taking appropriate cognisance of the context.

Table 1

	English	Dutch

	test 1		test 2		test 1		test 2	
	attempt	correct	attempt	correct	attempt	correct	attempt	correct
Repeated use of divisor	17%	7%	11%	6%	10%	4%	1%	1%
Partitioning (inappropriate)	5%	0%	3%	0%	7%	1%	6%	2%
Low level chunking	6%	2%	8%	2%	16%	7%	6%	5%
High level chunking	**8%**	**5%**	**7%**	**5%**	**41%**	**28%**	**69%**	**51%**
Algorithm	**38%**	**18%**	**49%**	**25%**	**4%**	**1%**	**3%**	**1%**
Mental (answer only)	9%	5%	11%	6%	9%	6%	11%	7%
Wrong operation	3%	0%	2%	0%	5%	0%	1%	0%
Unclear	4%	1%	3%	0%	2%	0%	1%	0%
O	9%	0%	8%	0%	8%	0%	2%	0%
Total	100%	**38%**	100%	**44%**	100%	**47%**	100%	**68%**

Conclusion

Clearly the strategy has had significant influence on the structural features of lessons. Many teachers seem pleased with the results and support the changes that have taken place. Many researchers, however, are more cautious: they accept that there is some limited evidence of change in pupils' approaches and achievements but consider that it is difficult to attribute all of these to the strategy alone and that there may be some grounds to believe that the achievements may be difficult to sustain and build upon.

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