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Using ICT to support interactive teaching and learning

on a Secondary Mathematics PGCE course.

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Abstract:

During the academic years 1998/1999 and 1999/2000 an Open and Distance Learning version of the full time Mathematics PGCE course was developed and trialled at the University of Wales Swansea. This was a part of a larger collaborative project (HATT 2000) between the constituent colleges of the University of Wales which aimed to use the affordances of ICT to improve the teaching of Mathematics, Modern Foreign Languages, and Educational and Professional Studies within the PGCE programme and to widen access to teacher training in Wales. The project made use of First Class conferencing e-mail, web based bulletin boards and streaming video to provide an alternative to some elements of the usual college based elements of the course. This paper focuses on the changes in the learning discourse within PGCE mathematics arising from the affordances of the technology.

Introduction

Recruitment to teacher training courses has now failed to reach targets in England and Wales for several years. The shortfall of suitably qualified applicants has been particularly acute in Mathematics, Physics and Modern Foreign Languages. In response to this trend, attempts have been made to provide a wider range of routes into teaching to encourage applicants who are discouraged by the requirement to follow a one year (36 week) course prior to employment.

The Hyfforddi Athrawon Teacher Training (HATT 2000) project, which is reported in this paper, was set up in response to an initiative from the Higher Education Funding Council for Wales (HEFCW). The aims of HEFCW were to increase the number of quality applicants by providing alternative routes into teaching; to promote greater efficiency in existing programmes; and to establish collaborative arrangements between Higher Education institutions in Wales.

The establishment of the project was supported by all the Initial Teacher Training (ITT) providers in Wales with the lead institutions being the University of Wales colleges in Aberystwyth, Bangor, and Swansea and the University of Wales Institute Cardiff (UWIC). Although the lead institutions are sister colleges within the University of Wales, in most respects they operate as separate universities. Thus although our relationships are warmly collegial, competition is intense in some aspects of our work such as the recruitment of high quality students.

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The HATT 2000 project is a collaborative venture, the first of its kind, between ITT institutes in Wales and their partner schools. It is about generating a high quality ODL Secondary ITT course for post - graduates which, through its flexible approach to learning, will allow more, urgently needed, students to train to teach 'shortage' subjects.

Phase one of the project

In the first phase of the project (1998 to 2000), two subjects were introduced: Mathematics and Modern Foreign Languages (MFL). Responsibilities for the development of materials were divided between the partners with Swansea leading in Mathematics, Aberystwyth leading in MFL, and UWIC leading in Educational and Professional Studies. Bangor led in the area of technical development of the system and course administration. This paper focuses on the course developed in mathematics at Swansea.

Even while we were negotiating our involvement in the project, we had serious concerns and reservations about the principle of attempting to teach the college based element of our PGCE course using computer supported Open and Distance Learning (ODL) techniques. Our existing face to face PGCE course had recently received the highest grade in inspection and mathematics education in Swansea had been declared a centre of excellence by HEFCW.

We became more concerned when some university and government officials, not closely involved in the project, talked about Adelivering≅ the college based element of the National Curriculum for teacher training via the web. Although the Chief Inspector of schools at that time, Chris Woodhead, claimed not to have a theory of learning, only a theory of teaching, we held theories of learning which were based on participation and active construction rather than acquisition (Askew, 1999, 3). We were concerned that some enthusiasts for web based distance learning were developing their ideas for a twenty first century teaching technology on an impoverished nineteenth century pedagogy which assumed that facts and correct answers could be delivered electronically to students who could then consume them whole.

Prior to the start of the project, a vigorous e-mail debate was established between some of the eventual members of the HATT team which focussed on the nature of teaching and learning on a PGCE course. We were pleased to discover a high degree of consensus about pedagogy.

Although our courses are allowed to grant qualified teacher status only if they can claim to develop a highly detailed list of largely behavioural outcomes prescribed by government (DfEE, 1998), we regard our task as one of professional teacher education rather than training. We wish to avoid the classic dichotomy which can develop in training courses between technical knowledge and professional competencies (Bevis & Watson, 1990; Owen, 1999).

Our face to face course is based on a partnership between schools, teachers, students and university tutors which attempts to build on the affordances of the school and college contexts appropriately without creating a division between skill and knowledge development. Our students accept that a body of technical and professional knowledge exists with regard to say, the National Curriculum or common misconceptions in the learning of algebra, but this is not their most pressing need. Unless such knowledge can be seen to impinge directly on their ability to operate as a teacher in the classroom it is of minor interest in comparison with their school based skill development. Professional knowledge must be contextualised to be useful. Furthermore, professional education is about the development of judgement in the use and application of such knowledge rather than the provision of educational facts or correct teaching approaches (Bevis & Watson, 1990; Owen, 1999).

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Our view of learning is coloured by our research into the learning of mathematics and is socio-constructivist in character. With respect to learning in initial teacher education, whilst we accept that technical and professional knowledge exists, we consider that it cannot be transmitted directly and unproblematically in usable form to the mind of the student teacher as if it were an attachment to an e-mail (cf: von Glasersfeld, 1991). The literature on problem solving suggests that if students are to be able to use and apply professional knowledge with judgement when problem solving in the context of their classrooms they require a depth of relational understanding (Skemp, 1976) and metacognitive awareness which can only be achieved through active personal construction and reflection (eg: Flavell, 1976; Schoenfeld, 1985; Dominowski, 1990; Clark & Palm, 1990; Tanner &Jones, 1994; 2000). A number of implicit principles underpin our face to face course and were raised in our early debates about ODL pedagogy:

1. Professional education must be interactive, rather than passive.

2. Although students must construct their own professional knowledge, they should not do so in isolation. They require opportunities to articulate their own emerging theories and generalisations, to formalise their ideas and to test them in the public domain (cf: Von Glasersfeld, 1991).

3. Group discussion which is based on the articulation of emergent hypotheses and generalisations for trial by peers is required to develop both professional judgement and more robust professional knowledge.

4. Tutors should intervene significantly in such discussions to ensure that the debate is based on research and existing professional knowledge rather than unsubstantiated assertion.

5. Such discussions assist in the development of corporate meaning within the group and a sense of professional knowledge against which emergent ideas can be internally judged prior to articulation (cf: Von Glasersfeld, 1991).

6. Tutors need to organise and negotiate the progress of such professional discussions, feeding in appropriate stimuli and resources, driving the debate forwards to cover a planned curriculum. The tutor should not be a neutral chair between a varied range of largely inexperienced opinions, but the key player in an interactive teaching and learning process (cf: Jones & Tanner, 2000b).

7. In order to ensure that metacognitive professional knowledge is available for use and application in classroom problem solving contexts, opportunities for reflection should be available. Collective reflection in plenaries in which students are formally required to summarise key issues and ideas assist students to reify or formalise knowledge through reflected abstraction. Several studies have shown the benefit of such activities for the development of metacognition in mathematics (eg: Cobb et al, 1992; Tanner & Jones, 1994; 1995b; 2000b).

Analysis of our existing teaching and learning strategies

From a socio-constructivist viewpoint, there are four main reasons why such processes are appropriate in a course of professional education. They are associated with: the construction of professional knowledge and evaluation of its viability; the development of corporate meanings within the group; the development of metacognitive awareness; and the

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development of a disposition to reflect on professional issues to develop higher levels of meaningful practice.

The processes involved in the construction of professional knowledge suggest that students should have opportunities to articulate their tentative constructions, and to test them for viability against the shared, corporate understanding of the class. However, articulation does more than provide an opportunity for students to test their understandings for viability against corporate meaning: it also contributes to the generation of corporate meaning by providing a further opportunity for construal to other members of the group. Whilst evaluating the contributions of other students, individuals may contrast the interpretation being offered with their own thoughts (Clarke, 1994).

Many of the techniques used by tutors to support student development during interactive seminar teaching might be described as scaffolding (Bruner, 1985). The metaphor has an unfortunately rigid sound to it and is sometimes interpreted as a series of funnelling questions leading the student down a narrowing path to a predetermined solution (cf: Bauersfeld, 1988). However, the scaffolding we attempt to use in our face to face seminars is dynamic in character with the tutor drawing on ideas articulated by students but using focusing questions to gently steer the discourse, encouraging students to contribute to strategic thinking (cf: Wood, 1994, Tanner & Jones, 2000b). Tutors are continuously assessing responses in order to evaluate student perceptions and understandings and deciding whether to adapt their teaching to provide further help, or whether to move on to the next teaching point.

The scaffolding described so far could be characterised as encouraging reflection in action (Schön 1983) as students and the teacher responded to ongoing discussions. However, during plenary sessions, focusing questions were often used to make students' explanations the object of discussion. When students attempt to explain their methods to others the explanation itself becomes the focus of their thinking and the explicit topic for class discussion. Such objectification of thought through articulation is associated with bringing the subconscious into the conscious and hence the development of reflective awareness and conscious control (Prawat, 1989).

To control a mental function, Vygotsky (1962) claims that a student must be conscious of it, but suggests that unconscious self-regulation should precede conscious self regulation, presumably appearing first on the social level between people (interpsychological) and then inside the learner (intrapsychological) in an unconscious form (cf: Vygotsky, 1978). The shift to reflective awareness and deliberate control of cognition would then be achieved through a transition to verbalised self observation which denotes a beginning process of generalisation of the inner forms of activity. This is a shift to a higher type of inner activity opening up new ways of seeing things and new possibilities for handling them (Vygotsky, 1962, p91).

> In perceiving some of our own acts in a generalising fashion, we isolate them from our total mental activity and are thus enabled to focus on this process as such and to enter into a new relationship with it. In this way, becoming conscious of our operations and viewing each as a process of a certain kind... leads to their mastery

(Vygotsky, 1962, p91-92).

Awareness of one's own professional knowledge is a pre-requisite for its application to classroom problem solving. The purpose of plenary sessions is to develop such metacognitive awareness as students reflect back on what they have learned prior to presenting their conclusions to their peers.

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Developing strategies

Following our initial e-mail debates, we began with the assumption that much of the interactivity we desired in the ODL course would be achieved through the use of First Class conferencing e-mail. Our colleagues in Bangor were facilitating this, providing software, student accounts and technical support. We began by trialing electronic seminar activities with our new students on our face to face course in September 1998. Our initial strategy was to examine our seminar notes and to select some of the key discussion questions and to send them to the students in e-mail conferences with deadlines for response.

A Aclient≅ version of First Class was made available on cd and was distributed free of charge to any student who wished to respond from a computer at home or in school during school experience. However, as many of our students did not have access to a suitable computer at home, we organised a regular block booking in one of the university=s computer rooms to ensure that access was possible for all students at a convenient point in their busy timetable.

Unfortunately, early experiences of using First Class were marred by technical failures in the university network rooms and difficulties in getting around local authority firewalls. A web based version of the software was available, but was unable to cope when more than ten students tried to use it at once - an event almost guaranteed by our block booking arrangement! However, we persisted and reliable ways of working began to develop.

Evaluation questionnaires completed at the end of the first term revealed that student opinions on First Class seminars varied considerably. Some appreciated the variety offered by a new approach, often claiming to see advantages in the format. However, many were vehemently opposed to computer based learning claiming that knowledge about teaching could only come from interaction with people and certainly not from interaction with machines. For the former group of students, the technology was transparent in operation - they could see through it to the people with whom they were communicating. For the second group, however, the technology was sometimes opaque in that when they used the computer they often seemed to see only the computer and not the person or group of people with whom they were communicating.

This was more than an issue of individual IT capability. Clearly the computer is a cultural tool, and like all cultural tools, carries with it significance and meaning which influences its capacity to mediate knowledge (Wertsch, 1985). For some students, the message of unfeeling inhumanity often associated with the use of technology barred its use as a mediator of professional knowledge. The First Class conferencing e-mail software seemed to have high cognitive overheads which did not help. Furthermore, many students objected to learning to use a new e-mail package when they were happy with the university standard - microsoft outlook.

One problem which arose quickly was due to the large numbers of students involved in the seminars (30 to 40). Student mailboxes often filled up with up with large numbers of very similar messages which had been written in parallel during AWeb time≅. When one student learned how to delete the Aunread≅ flag from messages without opening them, she passed the information around the group in an urgent e-mail and was warmly applauded by her colleagues.

In order to reduce the volume of traffic, we organised the students to work on tasks in groups and to send a group response. This also relieved pressure on computing facilities. However, this clouded our evaluation as many students gave a positive evaluation to the activities because of the group work occurring off computer!

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At the end of the first block of college work our opinions were divided. We were concerned about the very negative feedback we were receiving from a significant and vocal minority of students, but were cheered by the large group of students who claimed to find it easier to make an input to the e-mail seminars.

Positive comments were typically of the form:

> AWeb sessions were more team oriented and much more individual input was possible in comparison with normal seminars≅
>
> AI both learnt and worked differently, as it gave me the chance to offer considered answers≅
>
> AThere was more time to think about things≅
>
> AI got to hear the opinions of other people≅
>
> A It made me do the readings but I offer more opinions in the normal seminars.≅

Negative comments were typified by:

> AWhy should we use e-mail when we could just turn round and tell everyone?≅
>
> AI worked less hard as a part of a group.≅
>
> AIt was too time consuming - I can=t type quickly enough≅
>
> AI worked harder because I had to participate.≅
>
> AI don=t like computers very much! Their use should be avoided for learning about teaching.≅

In spite of our concerns, we felt that there was sufficient positive feedback to press ahead, and the remainder of the academic year was spent devising our web based materials to enable us to pilot an ODL course with a trial group of students in the 1999/2000 academic year.

The structure of our web site resources

Our intention for the pilot was to create an ODL version of our currently existing course and run that course in parallel with our standard course with volunteer students. To create this course, we produced web pages in two distinctive styles and we refer to them with reference to the predominant background colour - black pages and white pages. Our black pages were our notional blackboard on which we placed factual information, resources, and lecture summaries Our white pages were our note books for regulating and organising our activities and discussions. We examined our lesson plans and extracted our key seminar questions, and activities and organised them into blocks of work on the white web pages.

For example, factual information includes our required format for lesson planning and the requirements of the subject knowledge audit. Resources include lesson observation sheets,

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materials from school such as discipline policies and brief clips of streaming video to illustrate class management issues. Our book on practical mathematical modellingABetter thinking better mathematics≅ (Tanner and Jones, 1995a) which contains teacher guidance, lesson outlines, worksheets and assessment frameworks is available in full from the black pages as are some of our recent research papers. Lecture summaries on the black pages include, for example, all the OHT acetates from our lectures and bullet points drawn from key readings such as Kounin=s (1970) flow faults, or summaries of the changes to the National Curriculum.

Links to useful resources on other websites exist in both the black and white pages as appropriate. Thus the seminar discussion on class management and control includes a link to a government site which details the current legal position with respect to physical contact between teachers and pupils. Similarly the black pages on comparisons of international standards of attainment includes a link to the TIMSS website.

In spite of the rich resources to which we are able to link electronically, it was never our intention to neglect paper based resources. We continue to rely on our library for stimulus materials and photocopies of articles from journals where it is legal to so do. Our course has always demanded that students read the literature critically to ensure that their opinions are tempered by research evidence. This continues to be the case for the ODL course and many of the e-seminars on the white pages begin with the statementABefore entering this discussion, you should have read...≅.

Affordances and Constraints

It is in the nature of a PGCE course that it attempts to mediate between the established body of professional knowledge and the student. In so doing we hoped to build on students= initial naive knowledge of teaching and learning helping them to construct their own more formal professional knowledge. The process of mediation inevitably refracts knowledge according to the affordances and constraints of the medium.

We use the term *affordances* to describe a potential for action, the capacity of an environment or object to enable the intentions of the student within a particular problem situation. *Constraints* are provided by the properties of the environment, problem situation or social context which limit possible actions. We assume that the student=s cognitive contribution to an activity is not fixed but is dependent upon features of the environment and social context. The students= *abilities* are determined by their potential to act within the particular environment. If *abilities* change, then learning has occurred (Gibson, 1977; 1986).

The affordances of a particular environment include the opportunities presented to the student by the technology in support of a task, the social support for learning provided by the teacher or other students, and the contextual support provided by the setting in which the activity occurs. The affordances of the environment thus include intentional support in the form of *scaffolding* (Bruner, 1985), *assisted performance*, (Tharpe and Gallimore, 1988) or *contingent support for learning* (Wood and Wood, 1996) provided by the teacher, the other students, or the technology.

Effective course design demands that the affordances of the media are balanced to allow for students with a wide range of learning styles to benefit and to make best use of resources.

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The pilot year 1999/2000

Two students who had applied for our standard course agreed to pilot our new materials. We agreed that they would only attend college on the day they were required for Professional Studies and that for the other days they would try to operate as ODL students. However, no ban on college attendance was imposed and we made it clear that they would be welcome in any of our normal sessions if they felt they were missing significant experiences.

For the pilot year, we arranged sub-conferences of six or seven students to discuss issues to avoid the problems of over-filling mailboxes with repetitive responses from a large group. We also decided that for some issues, we would not require every student to respond. To this end we established interactive bulletin boards on some of the black pages so that visitors could read earlier comments and decide whether or not they had anything new to add to the debate. AMe too≅ responses were discouraged on bulletin boards. E-debates were timed to occur in advance of face to face seminars.

In our traditional course we have always directed our students to read specific texts prior to seminar discussions in order to try to link their naive learning theories with the established literature. However, we have never been able to ensure that all students did the required reading in anything beyond a superficial manner. Failure to read the research evidence about an issue has never prevented some people from having opinions to articulate (as our recent chief inspector regularly demonstrated).

As the pilot year progressed, we began to observe interesting changes in the discourse depending on the medium supporting the debate.

> Some students who were usually quiet during face to face seminars began to make significant contributions to e-debates.
>
> Although some students used e-mail conversationally and carelessly, many of the contributions made to e-debates were long and carefully constructed, showing evidence of prior reading.
>
> Many of the contributions to e-debates from novices showed insight and a depth of thinking which we would have been happy to read in essays from masters students.
>
> Some students avoided participation in e-debates, failed to take the tasks seriously and challenged their validity as a means of learning, although they continued to participate actively in face to face seminars.
>
> It became clear that many students were better prepared for seminars, in that background material seemed to be more commonly familiar.
>
> A number of students who were unwilling to read our background readings, who sometimes Aforgot≅ to pick them up at the end of the previous session, seemed willing to read our summaries off the web and to be directed to other web sites to explore issues further.

However, although there were many positive aspects to the increasing variety of learning opportunities on the web and through e-mail, the ODL pilot students were not satisfied with a course lacking in face to face contact. In fact by the Spring term, they were attending as frequently as the other students.

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They suggested that part of what they missed when not attending college with their peers was the camaraderie, but it was more than this. Some aspects of the learning experience gained in face to face sessions were not replicated in print or over the web. E-mail is just too slow for some purposes. The interactions which occur between teachers and classes during teaching are fast and furious. These are modelled during face to face sessions in a manner which cannot be reproduced asynchronously.

We aim to teach a style of teaching which is highly interactive and is based on problem solving using the dynamic scaffolding of students= thinking through focussing questions, group work, whole class brainstorming and collective reflection (see Tanner and Jones, 2000b). We aim to model that style in most of our college teaching on the assumption that students should first experience such teaching approaches socially (interpsychological), perhaps appropriating them in an unconscious form (intrapsychological), before finally becoming fully conscious of their formal professional knowledge after a period of reflection and abstraction (cf: Vygotsky, 1978). We have yet to find a way to model that process fully at a distance, and in consequence a minimum of five face to face days in college are compulsory for ODL students each year. As the technology develops, we may find ways of duplicating some of these processes using synchronous video-conferencing.

Phase 2: beginning at the other end.

In phase two of the project, rather than simply trying to reproduce our existing course in an ODL form, we tried to begin at the other end, by considering the nature of a teacher training course and planning to take advantage of the affordances and constraints of different contexts. During phase one we had written a book entitled ABecoming a successful teacher of mathematics≅ (Tanner and Jones, 2000a) which became the course reader for phase two and units of work are based around each chapter

We abandoned the use of First Class and reverted to Microsoft Outlook in an attempt to make the technology more transparent and allowed the face to face students a greater degree of choice about when they wished to engage in e-debates, although responding to some key questions individually remained a course requirement.

We have also modified our face to face practice. Every college session now ends with a plenary in which students are required to summarise key issues. We have added to this a demand that a small group of students, designated on a rota, summarises the work of the session in an e-mail after each plenary.

These changes seem to have removed many of the barriers and practical difficulties arising in phase one and although student opinions remain divided about the use of ICT to mediate professional learning, they are now generally more positive.

Three students began the year as distance learners in phase two, although at the end of the first college teaching block, only one was working at a distance in most sessions. However, his progress to date is sound.

Students attitudes to web based ODL PGCE teaching

Using statements based on student evaluations from previous years, we devised an attitude questionnaire which used a Likert scale to measure students= attitudes to web based ODL teaching for PGCE (see appendix). The questionnaire was given to 48 mathematics students at the end of their first college teaching block. The sample consisted of 25 men and 23 women. 29 were less than 26 years old and 19 were Amature≅ students of 26 and older.

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The responses to individual statements in a Likert scale can not be proved to be interval (Himmelfarb, 1993, p55) but at least give ordinal data. However if we assume that the observed score is a monotonically increasing function of the latent variable then the complete scale can be treated as interval and parametric statistics used (Davison & Sharma, 1988).

One statement (No. 12) correlated poorly with the complete scale and was dropped. The final scale consisted of 24 statements of which 11 were positively and 13 negatively phrased. The reliability of the complete scale, as given by Chronbach=s alpha was appropriate at 0.79.

The mean student attitude to Web based ODL as given by the scale was 3.24. This is significantly greater than the scale midpoint ($p<.001$). Although both men and women were generally positive, men=s attitudes were more positive than women=s ($p<.05$). There was no significant difference by age.

Factor analysis (Principle components with varimax rotation and Kaiser normalisation) revealed 5 factors covering 52% of the variance. The factors were as follows:

F1: The value of computers for learning

eg: I give a more considered opinion in an e-mail discussion.

I found it useful to read the summaries on lectures on the web posted by other students

F2: Comfort with use of IT

eg: I am comfortable using computers

Computers make me nervous

F3: Effort/motivation to learn when using IT

eg: The internet is a good place to find a wide range of opinions about teaching approaches

E-mail is used mainly by people who can=t form good relationships with other people

F4: Ability to express opinions using e-mail

eg: You can=t be completely honest in an e-mail discussion

I find it easier to express my opinions in e-mail discussions than in whole class discussions

F5: Validity of PGCE using web based ODL

eg: E-mail discussions can=t teach me as much about teaching as face to face discussions

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Most of the college based part of the course could be taught just as well by web based distance learning.

Men were more positive than women with respect to Factor one only (p<.01)

Men=s answers ranked significantly higher than women=s (Mann-Whitney) with respect to the following statements:

* I find it easier to express my opinions in e-mail discussions than in whole class discussions (p<.01)

* The internet gives me access to more up to date information about teaching

e-mail (p<.05)

* To be honest, I have not really put much effort into the web based tasks (p<.05)

* I don=t feel as if I=m talking to a real person when I use e-mail (p<.05)

More mature students scored more highly than younger students on two factors: Factor 3 (p<.05) and Factor 5 (p<.05).

Mature students= answers ranked significantly higher than younger students= (Mann-Whitney) with respect to the following statements:

* Most of the college based part of the course could be taught just as well by web based distance learning (p<.05).

* The internet is a good place to find a wide range of opinions about teaching approaches (p<.05)

* I don=t usually bother to examine the set readings in any depth (p<.01)

Whereas younger students were significantly more positive than their older peers only in:

* You can=t be completely honest in an e-mail discussion (p<.05).

perhaps reflecting their greater naïveté.

Overall univariate analysis of variance on attitude revealed a considerable interaction effect between sex and age (p<.001) with younger women being the least positive and older men being the most positive about the use of web based ODL.

Conclusion

An ODL course has been established which has improved access to our PGCE mathematics course. We have established ways of working with e-mail seminars which meet many of our initial concerns about web based ODL approaches to teacher education. The course which we have established certainly meets our initial seven underpinning pedagogical principles.

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However, there are some aspects of the learning experience gained in face to face sessions are not replicated in print or over the web. E-mail is just too slow for some purposes. The modelling of good practice which occurs in the interactions which occur between tutors and seminar groups in face to face sessions cannot be reproduced completely asynchronously. Although some of this modelling may be observed by students in the best of our partner schools, we are concerned that it is difficult to guarantee for quality assurance purposes. Furthermore in the school context the learning is often informal and divorced from principle making it less likely to be available for abstraction and generalisation in other contexts.

At this stage, therefore, we must require ODL students to attend several days of face to face teaching during the year to offer all aspects of the course.

Although only one student is following that course completely at a distance, at present, the affordances of the technology provide increased convenience for other students who are attending the course on a face to face basis.

Furthermore, we are convinced that the use of e-mail tutorials and web based learning by students following the standard course has improved the quality of that course. The more considered response demanded by asynchronous e-mail tutorials provides a different form of discourse in which students can articulate their developing concepts and have them tested for viability in the public domain.

It seems likely from the students responses to our questionnaires that through the use of a range of approaches to the mediation of professional knowledge - based on paper, internet, e-mail, traditional seminar and lecture - we are able to cater for a wider range of learning styles appropriately.

It is clear that our structure of preliminary reading from paper, web pages and resources in combination with e-mail debates has ensured that students in general arrive better prepared at their face to face seminars and that these seminars consequently operate at a higher level. We cannot force students to consider all our preparatory material in depth, but we can assist by providing them with a choice of medium.

A significant minority of students prefer to remain generally passive players in seminars, leaving the debate to their louder peers where possible. However, such students are often able to contribute effectively via e-mail. A similar minority prefers the seminar to e-mail. In future we will be able to demand a significant individual contribution via the students= preferred medium.

Our demands for plenaries via collective reflection, small group reports and e-mail reflections on stimulus materials helps us to create the opportunities for reflection and abstraction required for the development of effective professional knowledge.

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References

Askew, M. (1999). Teaching numeracy: will we ever learn. *Mathematics Teaching*, *168*, 3-5.

Bauersfeld, H. (1988). Interaction, construction and knowledge: alternative perspectives for mathematics education. In D. Grouws, T. Cooney, & D. Jones (Eds.), *Effective mathematics teaching* (pp. 27-46). NCTM, Reston, VA: Lawrence Erlbaum.

Bevis, E. O., & Watson, J. (1990). *Towards a caring curriculum: a new pedagogy for nursing*. New York: National League for Nursing.

Bruner, J. S. (1985). On teaching thinking: an afterthought. In S. F. Chipman, J. W. Segal, & R. Glaser (Eds.), *Learning and thinking skills: research and open questions* (pp. 597-608). Hillsdale,NJ: Lawrence Erlbaum.

Clark, A. J., & Palm, H. (1990). Training in metacognition: an application to industry. In K. J. Gilhooly, M. T. G. Keane, R. H. Logie, & G. Erdos (Eds.), *Lines of thinking: reflections on the psychology of thought* (Vol. 2, pp. 329-338). Chichester: John Wiley & Sons.

Clarke, D. J. (1994). The metaphorical modelling of "coming to know". *Proceedings of the eighteenth international conference for the psychology of mathematics education, Lisbon, Portugal*, *2*, 193-200.

Davison, M. L., & Sharma, A. R. (1988). Parametric statistics and levels of measurement. *Psychological Bulletin*, *104*, 137-144.

Dominowski, R. L. (1990). Problem solving and metacognition. In K. J. Gilhooly, M. T. G. Keane, R. H. Logie, & G. Erdos (Eds.), *Lines of thinking: reflections on the psychology of thought* (Vol. 2, pp. 313-328). Chichester: John Wiley & Sons.

Ernest, P. (1991). *The philosophy of mathematics education*. London: Falmer Press.

Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), *The nature of intelligence* (pp. 231-235). Hillsdale,NJ: Lawrence Erlbaum.

Gibson, J. (1977). The theory of affordances. In R. Shaw & J. Bransford (Eds.), *Perceiving, acting and knowing*. Hillsdale, NJ: Erlbaum.

Gibson, J. (1986). *The ecological approach to visual perception*. Hillsdale,NJ: Lawrence Erlbaum Associates.

Himmelfarb, S. (1993). The measurement of attitudes. In A. H. Eagly & S. Chaiken (Eds.), *The psychology of attitudes* (pp. 23-87). Fort Worth, Tex: Harcourt Brace College.

Jones, S., Tanner, H., & Treadaway, M. (2000). Raising standards in mathematics through effective classroom practice. *Teaching Mathematics and its Applications*, *19*(3), 125-134.

Kounin, J. S. (1970). *Discipline and group management in classrooms*. New York: Holt, Rinehart and Winston.

Owen, M. (1999). Paradigms for curriculum design: the design of reflective situative collaborative professional development supported by virtual learning environments. at http://rem.bangor.ac.uk/~martin*owen/reflect/refdes.htm (accessed 26.4.99).*

Paper Presented at the AARE Annual Conference, Sydney, 2000
Australian Association for Research in Education

Prawat, R. (1989). Teaching for understanding: three key attributes. *Teaching and Teacher Education*, *5*(4), 315-328.

Schön, D. (1983). *The reflective practitioner*. New York: Basic Books.

Schoenfeld, A. H. (1985). *Mathematical problem solving*. New York: Academic Press.

Schoenfeld, A. H., & Herrmann, D. (1982). problem perception and knowledge structure in expert and novice mathematical problem solvers. *Journal of Educational Psychology: Learning, memory and cognition*, *8*(5), 484-494.

Skemp, P. R. (1976). Relational understanding and instrumental understanding. *Mathematics Teaching*, *177*, 20-26.

Tanner, H. F. R., & Jones, S. A. (1994). Using peer and self assessment to develop modelling skills with students aged 11 to 16: A socio-constructive view. *Educational Studies in Mathematics*, *27*(4), 413-431.

Tanner, H. F. R., & Jones, S. A. (1995a). *Better thinking, better mathematics*. Swansea: University of Wales Swansea.

Tanner, H. F. R., & Jones, S. A. (1995b). Teaching mathematical thinking skills to accelerate cognitive development. *Psychology of mathematics education conference (PME-19), Recife, Brazil*, *3*, 121-128.

Tanner, H., & Jones, S. (2000a). *Becoming a successful teacher of Mathematics*. London: Routledge/Falmer.

Tanner, H., & Jones, S. (2000b). Scaffolding for success: reflective discourse and the effective teaching of mathematical thinking skills. In T. Rowland & C. Morgan (Eds.),*Research in Mathematics Education Volume 2: Papers of the British Society for Research into Learning Mathematics* (pp. 19-32). London: British Society for Research into Learning Mathematics.

Tharpe, R., & Gallimore, R. (1988). *Rousing minds to life*. Cambridge: Cambridge University Press.

von Glasersfeld, E. (Ed.). (1991). *Radical constructivism in mathematics education*. Dordrecht: Kluwer.

Vygotsky, L. S. (1962). *Thought and language*. Cambridge, Mass: The MIT Press.

Vygotsky, L. S. (1978). . In M. Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds.), *Mind in Society: The development of higher psychological processes*. Cambridge, Mass: Harvard University Press.

Wood, D., & Wood, H. (1996). Contingency in teaching and learning. *Learning and instruction*, *6*(4), 391-397.

Wood, T. (1994). Patterns of interaction and the culture of mathematics classrooms. In S. Lerman (Ed.), *Cultural perspectives on the mathematics classroom* (pp. 149-168). Dordrecht, Netherlands: Kluwer Academic Publishers.

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Appendix: Attitudes to Computer-based distance learning

Please circle the response which corresponds most closely to your attitude:

1=strongly agree 2=agree 3=neutral 4=disagree 5=strongly disagree

I am comfortable using computers 1 2 3 4 5

I often use e-mail to communicate with friends 1 2 3 4 5

Computers are not very useful as a learning tools 1 2 3 4 5

Computers make me nervous 1 2 3 4 5

I can=t put my real feelings down in an e-mail 1 2 3 4 5

Most of the college based part of the course could 1 2 3 4 5

be taught just as well by web based distance learning

The internet gives me access to more 1 2 3 4 5

up to date information about teaching

E-mail discussions can=t teach me as much 1 2 3 4 5

about teaching as face to face discussions

I learn more by reading on my own than by 1 2 3 4 5

listening to lectures

E-mail is used mainly by people who can=t form 1 2 3 4 5

good relationships with other people

Information found on the internet is less 1 2 3 4 5

trustworthy than that in books

I like to use e-mail just to chat 1 2 3 4 5

I find it easier to express my opinions in e-mail 1 2 3 4 5

discussions than in whole class discussions

The internet is a good place to find a wide 1 2 3 4 5

range of opinions about teaching approaches

You can=t be completely honest in an e-mail discussion 1 2 3 4 5

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I need regular face to face contact with fellow 1 2 3 4 5

students to keep me motivated to learn

I didn=t learn much in the web-based sessions 1 2 3 4 5

because I already knew how to use e-mail

I found it useful to read the summaries of 1 2 3 4 5

lectures on the web posted by other students

To be honest, I have not really put much effort 1 2 3 4 5

into the web-based tasks

I don=t usually bother to examine the set 1 2 3 4 5

readings in any depth

I read the e-mails and web pages diligently 1 2 3 4 5

I don=t feel as if I=m talking to a real person 1 2 3 4 5

when I use e-mail

We spend too much time on computer-based work 1 2 3 4 5

I give a more considered opinion in an e-mail 1 2 3 4 5

discussion

Computer based learning gives me the freedom 1 2 3 4 5

to explore my own ideas

Please write down one or two sentences to describe your opinions on the potential of web based distance learning in teacher training courses

My course is: Maths 11 to 18 Maths 11 to 16 +IT IT+ subsid Maths

My sex is: Male Female

My age is: 21 to 25 26 to 30 31 to 35 36 to 40 41 to 45 >45