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Mathematics Teachers and ICT: Factors Affecting Pre-service use in School Placements

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Abstract

This study examines the factors influencing student teachers' use of information and communication technology (ICT) to teach mathematics. Data collection involved questionnaire surveys and individual follow-up semi-structured interviews of student teachers concerning the factors that they felt had hindered or promoted their development in the use of ICT. This study shows that this particular group of student teachers is committed to using ICT in their teaching; they are mostly confident and mostly believe in the value of ICT in mathematics teaching. However, findings indicate that the barriers inhibiting the student teachers' use relate to poor access to facilities, limited encouragement from mentors and the other teachers in mathematics department and irregular use of ICT of existing teachers in teaching, lack of links in the scheme of work, and time constraint.

Key words: Mathematics education; Pre-service teachers; Use of ICT; Encouragers of ICT; Constraints on ICT

Introduction

The domination of ICT (information and communications technology) in people's lives has been continuously increasing during the past decades. In accordance with it, the use of ICT to improve teaching and learning in schools in the United Kingdom has been clearly emphasised over the last decade (Taylor, 2004; Haydn and Barton, 2007). UK teachers have been promoted to use ICT for their teaching and to enable pupils to gain competencies in ICT within all subject fields (Cuckle, Clarke and Jenkins, 2000). However, research on the use of ICT in UK schools points out that there has not been a considerable increase on uptake in teachers' use of new technology (Harrison et al. 2002; Nichol & Watson 2003; Reynolds et al. 2003; Selwyn 2003) According to Kenneth Baker (1988), initial training courses would initiate these skills of using ICT 'the problem of getting teachers aware of IT will soon be phased out as all new entrants will soon have IT expertise' (as cited in Barton & Haydn, 2006, p. 258). Nevertheless, there has been concern regarding the competency of student teachers' effective use of ICT in their teaching (Willis & Mehlinger, 1996).

In the late 1990s, some requirements for student teachers have been stated that they should have substantial knowledge and teaching competencies in ICT in their fields in UK secondary schools (Cuckle, Clarke and Jenkins, 2000). In other words, in order to obtain Qualified Teacher Status, they should not only have good understanding of ICT use, but also gain experiences in its use in schools and become capable of showing their use of ICT in their classrooms (Cuckle & Clarke, 2002; Sime & Priestley, 2005). Thus, what is of paramount significance is assuring that student teachers have adequate training and chances to use competencies during their school practices (Cuckle & Clarke, 2002). It is important for teacher educators to know what factors influencing student teachers' use of ICT during their training in order to improve the preparation of student teachers for their initial school experiences. Therefore, I aim to address the following question: "What factors encourage/discourage student mathematics teachers' use of ICT during their school placements?"

It is argued that student teachers' use of ICT in their teaching during school placements could have a positive impact on their competent and confident in-service use whereas insufficient use might influence future teachers' effective use of ICT (Monaghan, 1993; Watson, 1997). Thus, the matter of use of ICT in pre-service training is of crucial importance. To identify what factors encourage or discourage student teachers' use of ICT during school placement will enable teacher educators to create an appropriate environment for future students. There is now a considerable amount of published research on student teachers' use of ICT (e.g. Galanouli & McNair, 2001; Cuckle & Clarke, 2002, Barton and Haydn, 2006; Hammond et al., 2009). However, research focuses mainly on whole cohorts and provides insufficient insight into individual subject areas, whereas this research study aims to provide a more cohesive picture of the use of ICT of pre-service mathematics teachers. Therefore, a discussion of this study's findings will contribute to the literature on the subject of mathematics teaching and will be of relevance to UK researchers as well as researchers in other countries.

Research Design

The design of this study involved collection of “mixed” forms of data, quantitative survey data and qualitative semi-structured interview data. The rationale for this was to gain complementary results by compensating for the weaknesses of research methods, and thus to make use of the strengths of both quantitative and qualitative research, since the research methods connected with both have their own weaknesses and strengths (Morgan, 1998).

The participants in this research consisted of a cohort of secondary Post Graduate Certificate in Education (PGCE) mathematics trainees on a one-year postgraduate course at a university in the UK. Questionnaires were administered to the cohort comprising 38 students, 22 male and 16 female students. The aim of the questionnaire was to prompt student teachers to consider their attitudes towards the use of ICT in mathematics and the factors that they felt had hindered or promoted their development in the use of ICT. Questionnaire items were based on pertinent research findings, with some items also drawn from relevant previously published scales tapping similar constructs, or modified versions of them (e.g. Haydn and Barton, 2006; Dawson, 2008; Parkinson, 1998). The questionnaire (see Appendix) consists of three sections including 35-items comprising both open and closed response formats. Items were clustered under the three headings. The first section of the instrument included a question asking for description of student teachers’ feeling about teaching and learning with ICT in mathematics which is a part of questionnaire by Haydn and Barton (2006). The second section of the instrument covers factors encouraging student teachers’ use of ICT in mathematics teaching. The third section of the instrument covers factors discouraging student teachers’ use of ICT in mathematics teaching. They were asked to tick appropriate boxes in a five-point Likert-type scale ranging from ‘strongly disagree’ to ‘strongly agree’ with regard to a series of statements. In addition, there were open-ended questions asking the most helpful factors and the most significant barriers of their preference in their use of ICT. All of the questionnaires were returned, and included in the analysis, although there were some missing values in some questionnaires.

An additional question asking participants if they were willing to be interviewed was added to the end of the questionnaire. Five student teachers, which agreed and provided their names, were interviewed. The interviews aimed to expand the information gathered on the questionnaires and capture deeper information about individuals’ reasons for using or not using ICT in their mathematics lesson. Interview data also revealed their opinions about how to improve their school experiences regarding ICT use. It was practical for my research to use semi-structured interviews by establishing topics and open-ended questions, which can increase the comparability of results and reduce interview subjectivity and bias thereby facilitating data analysis. Interview results, when combined with the analysis of the survey sample, allowed me to triangulate findings to develop a richer understanding of the factors affecting student mathematics teachers’ use of ICT in secondary school placements. However, I must acknowledge that the interview findings need to be read more tentatively given the limited scope of the study. A complete set of questionnaire data was collected from one visit. After that, follow up interviews were made. All of the interviews were audio-recorded, lasted for approximately 25 minutes. Having completed data collection, the audio-recorded interviews were transcribed manually and NVIVO used for qualitative data analysis. The quantitative data from the questionnaires, on the other hand, was entered into SPSS for further statistical analysis. The findings generated by the analysis were joined together in order for them to be discussed; finally, conclusions were drawn. Methodological triangulation (including questionnaires with interviews and literature) was used to strengthen the validity (Cohen et al., 2007). Participants were informed that participation in the survey and the interview was voluntary; that they had the right to refuse taking part in the study, either for questionnaires or interviews. It was also specified in the questionnaire that participants had the right to ask questions either during the implementation of the questionnaire or via email. During the interviews, interviewees were asked if they were comfortable being audio-recorded. Furthermore, due to the importance of the right to privacy of participants, all questionnaires and interview transcripts were anonymous and confidential; their names and personal information were not required and not used in reporting the outcomes of this research.

Findings

Student Teachers’ Views on ICT

At the beginning of the questionnaire, student teachers were asked about their feelings to using ICT in teaching mathematics. This question endeavoured to determine their general attitudes towards using ICT, both during the PGCE course and in the future. According to the results of the questionnaires, it is evident that almost all (92 %)

of students were fairly positive or very positive (see Figure 1). Thus, it could be said that this cohort of trainees had a relatively positive attitude towards using ICT in their teaching.

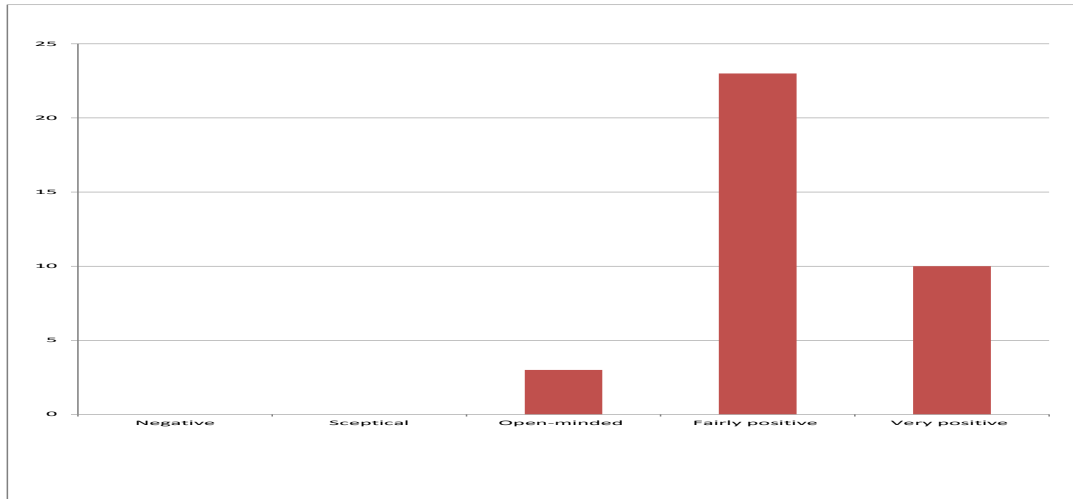


Figure 1. Attitudes to use of ICT in mathematics

Of the 92% detailed above, five participants agreed to be interviewed. They all expressed a belief in the usefulness of ICT in mathematics classrooms. Particular emphasis was made regarding the dynamic and visual elements of ICT. For example:

I think it has made a big difference because you can see how it gives kids more visual elements and it also increases the pace... the interactiveness of it... and the fact they can see what is going on, actually interact with things as well.

Analysis of the questionnaire suggests that the key factor encouraging student teachers' use of ICT in mathematics teaching was a belief that such use would change the way in which pupils learn (see Figure 2) and make pupils motivated (see Figure 3). This also can be seen in the interview comments. For instance:

I think some students might not understand or be interested in unless it presented in a way which to them is not just book work. There are some people for whom watching a graph being drawn or something that is moving, something that is more animated...

Furthermore, a substantial majority (92%) of the student teachers reported being convinced of the value of ICT in helping pupils to learn. In addition, 80% of the student teachers responded that ICT is a priority to them.

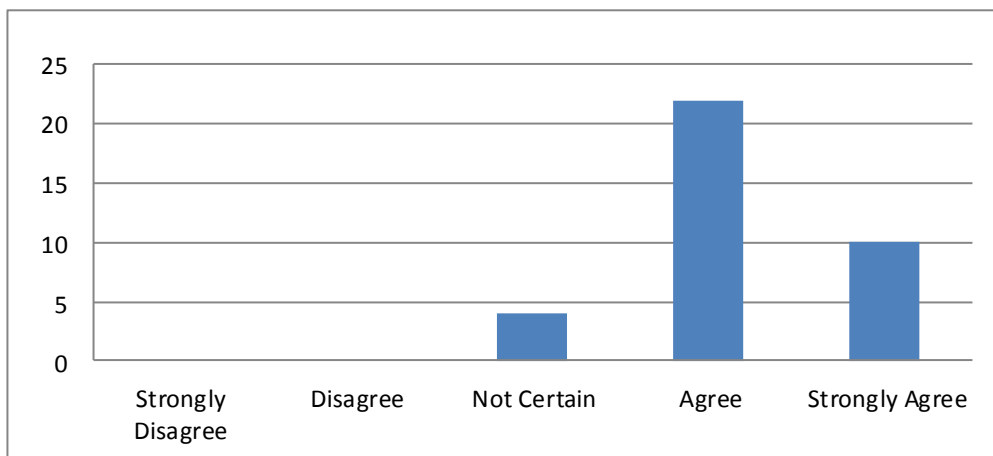


Figure 2. ICT changes the way pupils learn

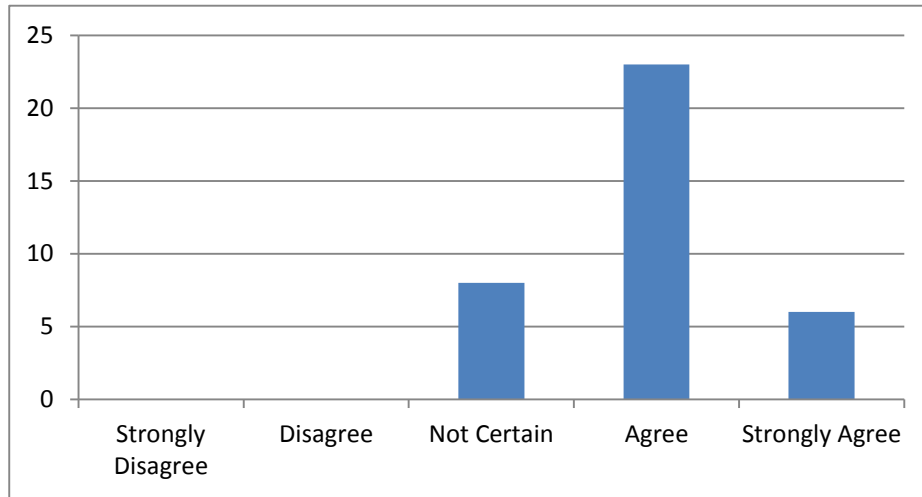


Figure 3. Pupils feel motivated when they use ICT

Confidence/ Competence

In this study, the majority of the students (74%) reported that they were confident in using computers in teaching, and only 5% said they were not confident. In this regard, it is not surprising to note that student teachers interviewed mostly expressed that they felt very confident in using technology in teaching as well as in their personal use of ICT:

I feel very confident about technology. I grew up with it, and I have used it all my life .So, it is something that I will definitely be using it in my career, I am looking forward to starting it in my new school.

I am pretty comfortable with computers. I wouldn't ever claim to be an expert but I am quite happy to knock about it until I work it out. So I have never had a problem with that.

According to all the factors stated so far, this particular group of student teachers appeared to be very committed to using ICT in their teaching. However, there are still some factors that discourage student mathematics teachers using ICT in their teaching. One of the latter is access, which will now be discussed.

Access

As Brinkerhoff (2006) indicated that resource barriers could be categorized into two parts: quantitative issues such as insufficient number of computers, difficulties in booking an ICT room, software licences and limited internet access, or qualitative issues such as unreliability of hardware and software and slow internet connections.

Quantitative Issues

More than half of the respondents experienced difficulties booking an ICT room. Similar findings emerged from the interview data in this study:

I once wanted to book a room so that the kids could use computers. I could not get a room for that lesson at all that just wasn't possible, partly because some of the rooms were block booked by other departments.

Thus, respondents mostly commented on the difficulties in getting the pupils to use ICT:

We don't have a place where we can get the kids really into and on the computers themselves to interactive with.

In terms of access to a room where the kids can use computers, that is far more problematic. You have got to book it in advance; and finding a slot where your lesson matches a room you can book, it is quite tricky. There are rooms which you are going to do a long term in advance.

60% of questionnaire respondents reported that the number of computers in their department was not sufficient. In addition, a considerable majority (70%) of trainees reported that one of the major factors that influenced student teachers' use of ICT was the availability of computers. However, access to mathematics specific software seems not to be problematic. Around half of the respondents had access to mathematics software resources, although a quarter of them reported a lack of access. In addition, a significant number (73%) of the respondents are familiar with the mathematics packages available in their schools.

Likewise, teacher access to the internet in lessons appeared not to be problematic, with only around 15% of the student teachers stating that they could not easily access the internet in lessons. One of the student teachers stressed in the interview that access to the Internet was a helpful factor in encouraging him to use ICT:

It is the availability of the internet; sometimes to do a starter, you just want a set of questions to get them thinking. There are a few websites, you can just go to these and just generate those questions. So you don't have to look around for a worksheet; just press the button and it comes up with a fresh set of questions which can be good just to get them involved and thinking.

Qualitative Issues

In terms of quality of resources, the reliability of equipment is stated as a discouraging factor by more than half of the student teachers. This can be seen as a barrier in the interview comments as well as in the open-ended response questions of the questionnaire (see Table 1).

When you have got to set something up, does it work reliably? Do they not get frustrated? The school where I am has got one lab which is quite small and getting old. You can use it, but I have seen people who get into difficulties; machines are slow and then people get fed up, and they have to move.

Support

Departmental Culture Support

It was clear from both questionnaire and interview data that school support was an issue affecting student teachers' use of ICT during school placement. According to the questionnaire results, more than half (53%) of the student teachers were not encouraged by the culture of their school regarding innovating by using ICT. In addition, 18% of them have chosen "not certain".

Part of the problem is because the rest of the department does not use it, you are not encouraged to do so ... well not to say encourage ... you are not discouraged, no one's saying that don't do it, but there is no support.

This was not the only response indicating that departmental culture was an issue in using ICT:

Some do not use it because they don't want to be bothered to learn it because they have been teaching for a long time and they are happy the way they are teaching ... and that is it ... good enough, do not need to do anything else.

Another student teacher mentioned teaching for exams:

I do not think the school is in any particular rush to really push for ICT, just because they are an outstanding school at the moment. They get very good grades. Their teachers are very set in their ways. They do their job very well, they still achieve very highly, and they still get very good grades... It is almost teaching for the exams rather than teaching kids about the maths. That is where the difference is.

On the other hand, over 60% of the students from the questionnaire results did not think that attitudes towards ICT in the mathematics department are negative overall. Also, nearly half of the students agreed that

mathematics teachers believe in the value of using technology in their classrooms. However, half of student teachers reported that other teachers in the mathematics department did not use ICT regularly, which is reinforced by the interview data in which student teachers mostly reported that the use of ICT resources in their department was not widespread:

Where I am in at the moment, I d say it is patchy...

In terms of widespread use, no not really...

Hardly

Interview comments revealed that even when teachers used ICT in their teaching, they tended to use mostly Power-point; even IWB was used in a static way, which contradicts the aforementioned importance of the dynamic aspect of ICT.

They use Power-point most of the time.

Power-points used all the time. If it is the whiteboard, it gets used to write on and to display Power-points, but other than that I have never seen them used. I have used them, but I have never seen anybody else use it for anything dynamic at all. I am not sure if anyone knows how to use it, to be honest.

Nevertheless, interview comments emphasized the importance of ICT where it adds value to learning:

It has got to be adding rather than as well, it has got to be something that adds to the learning experience. If we just replacing the text book with certain questions on the projector, you don't need the ICT. It is expensive textbook.

Interview data of five student teachers clearly demonstrates that they understood the importance of how and why technology is used in mathematics classrooms.

Mentor Support

Nearly 45% of the student teachers stated that their mentor did not provide guidance and support concerning the use of ICT during their teaching. It is not particularly evident whether or not their mentors had difficulties when they encountered the changes in technologies, as a considerable number (50%) of the students were not certain about this. Nevertheless, it could be the result of confidence issues, since only 6 out of 37 students reported that mathematics teachers were confident in their ICT skills.

Interview comments on mentor support varied. While some of the student teachers said that their mentor was supportive, the others said that although their mentors did not discourage them in using ICT, they did not provide student teachers with any particular support either. In the following extracts the student teachers all relate to mentor support in using ICT.

My mentor would say it is a good idea but it will be up to me to organize. The first time I did do something I brought in my laptop to use Cabri to show something to the kids ... he said "Don't bother; it is too much hard work". So I did it anyway and it worked out okay, it was quite good.

One of them related the lack of access to lack of mentor support:

It is very, very difficult in the school I am in, because the ICT facilities really are not there to support that interactivity for the pupils, something like I have not really pushed in that school.

Technical IT Support

Half of the respondents reported that they received technical help when they needed it. However, the other half was still either uncertain or had difficulties in receiving technical help. One of the interviewees said that he did not know where to get help:

One of the problems at a low level is nobody really knows anything about the systems here... So basically you are doing on your own, because nobody is actually bothered. So after a while hang on I'm just "bashing my head against a brick wall"...Some bits you can sort out yourself, some bits you just think "I have got too many other things to do".

The other one mentioned that there was a lack of qualified technicians in his school.

The technical issues I did face this time, I feel like it could have done better by the ICT technicians themselves, because I felt they were very understaffed. And there was really only one member who actually knew what she was doing. She was very good at her job but the other technicians were very young and were not as highly skilled as her. I think they need more qualified technicians if they are going to improve their ICT facilities.

PGCE Course Support

A considerable number (60%) of the students believed that they were trained appropriately; however, a small number of student teachers (20% of the sample) remain who thought that they needed more training. PGCE course encouragement was also stated as the second most helpful factor through the open-ended response questions of the questionnaire (See Table 2). In terms of support from the other trainees, 45% of them stated that they shared ideas with the other student teachers regarding the use of ICT and they helped each other. Similarly, fellow PGCE students' use of ICT was regarded as a helpful factor shown in Table 2.

Time

Lack of time was considered to be another significant barrier to the use of ICT in school placements. 62% of students (23 out of 37) agreed that they did not have the time to find and evaluate software due to workload issues.

The biggest enemy for any teacher is the time available to plan or to assess... If you get into creating things, it can rapidly take a few hours...

...from my point of view, I am comfortable with using it. It is just a question of building that knowledge with time.

One of the student teachers mentioned that he saw time as a problem in the future by the time he started actual teaching:

Time to create the activities for the students to do because I know it took me quite a while to put together the activity... I probably won't use it as much as I want to, because I will get to the point that I don't have time to think how I can use IT for everything.

Scheme of Work

One of the biggest hindrances for the student teachers seems to be a lack of suitable examples of opportunities for using ICT in the mathematics scheme of work (SOW). This was expressed by a significant number (73%) of the student teachers. This factor became apparent in the open-ended response questions of the questionnaire (see Table 1) as well as in the interview comments. For instance:

My use, it is mainly if I can find a way of working into the lesson. Some lessons and some subjects do not really have a lot. There is no obvious way to use it, not for me anyway.

I think also what topics you are teaching at the time..., because some stuff does not lend itself very well when using a computer. There is not so much, well actually saying that, I have seen a pretty much every topic in GCSE maths done with computer, so maybe it is possible to do everything.

Lack of Ideas/ Experience

Another implicit impediment to the use of ICT appeared to be lack of ideas about how to use ICT to support pupils' learning. This is seen as an issue by around 45% of the respondents. However, nearly 70% of students did not view that lack of experience as a factor discouraging their use of ICT during school placements.

Open-Ended Response Questions in the Questionnaire

The student teachers were asked in the questionnaire to list three barriers to their own use of ICT in their teaching in order of preference. After organizing the list provided, some key factors were identified (shown in Table 1).

Table 1. Barriers to information and communication technology use

Barriers cited by at least one trainee	Mathematics trainees (number of times cited)
Availability of computers and computer rooms	12
Time to prepare	10
Lack of links in SOW	7
Lack of ICT resources	6
Pupils behaviour	6
No interactive whiteboard	4
Not reliable	4

Availability of computers and computer rooms appeared to be the most considerable factor for the mathematics trainees, whereas time to prepare and lack of links in the scheme of work were also reported as crucial barriers. Most of the factors apart from pupils' behaviour in the Table 1 are already mentioned in the results of the questionnaire and interview data.

Table 2. Helpful factors to information and communication technology use

Helpful factors cited by at least one trainee	Mathematics trainees (number of times cited)
Motivation of pupils	5
PGCE course encouragement	4
Seeing it used by fellow PGCE students	3
Increase pace and visual	2
Instant feedback	2
Confidence in the software	2

Six participants stated that pupils tended to go off-task and play games since pupils generally treat mathematics lessons with ICT as a free time. Therefore, some of the student teachers had difficulties in making pupils keep on-task. The same process was used to analyse the data from the student teachers concerning the most helpful factors. The mathematics trainees stated a number of factors (Table 2) that helped their use of ICT in their

teaching. Motivation of pupils (which is also shown in Figure 3) and PGCE course encouragement seemed to be the most important helpful factors. However, none of these factors has been cited by a large number of students. There does not seem to be a consistent opinion amongst the student teachers about what factors are more helpful in encouraging ICT use in mathematics teaching. To summarise, this section has indicated the main findings revealed by the analysis of the data from the questionnaire and the interview. The discussion of the data follows in the next section.

Discussion

The purpose of this research was to ascertain the factors that might encourage or discourage student mathematics teachers' use of ICT during their school placements.

It was found in this sample that pre-service mathematics teachers appeared to think that ICT was important for teaching and learning. Some of the interviewees emphasised that it also depended on how it was used.

Sometimes the ICT can get in the way of delivering lesson. It can make it too complicated or it distracts the kids from the actual maths involved. So well it can be very useful but *you had better think about how you use it.*

The interview data clearly demonstrated that the student teachers were trying to use ICT where it improves their pupils' learning.

I would use ICT where I really think it makes a difference for their learning. If I think it is going to influence their learning like they understand it better or it is going to challenge them in a different way, it is going to make them think about that problem in a different way then I use ICT.

The student teachers were also unanimously convinced of the value of ICT in helping pupils to learn, and they believed that ICT use changed the *way* pupils learn. A study of Hennessy, Ruthven and Brindley (2005) showed that teachers were interested in using technology only where they thought it improved learning in comparison with other approaches. The researchers concluded that teacher commitment to integrating technology was connected with "recognising the educational value and believing in the transformative potential of the technology" (p. 185). From this perspective, this particular group of student teachers could be considered a committed group using ICT in their teaching.

In addition, it is crucial to note that they mostly expressed positive views on using ICT in teaching mathematics; in particular with respect to student teachers' confidence, the majority of them felt confident using ICT to support teaching and learning. This is in contrast to some earlier work (e.g. Summers & Easdown, 1996; Easdown 1994), but confirms previous findings in Cuckle and Clarke, (2003). There appears to be a number of reasons why student teachers' confidence has been on the increase compared to what it was in the 1990s when early research was conducted. A highly likely reason is university-based education in the use of ICT that has become apparent in England for around 20 years after the requirements for student teachers to be a qualified teacher (Department for Education and Employment [DfEE], 1998). PGCE course encouragement is clearly revealed in the questionnaire data. Most of the student teachers found university-based education helpful in their intention to use ICT. Secondly, as one of the student teachers mentioned "*I feel very confident about technology, I grew up with it, and I have used it all my life*", a new generation of student teachers has grown up with technology; they use technology in their everyday lives, in particular at home, and thus it is part of their lives. They could therefore be said to be more digitally fluent than 10 years ago. More specifically with respect to the internet use, it has been used increasingly for last 10 years. Recently, people tend to communicate through email or online websites regardless of age, which might be a possible factor in the growing interest in technology.

This study also found that student teachers believed that use of ICT in secondary mathematics teaching motivated their pupils. This finding reflected what Forgasz (2006) and Pierce and Ball (2009) had found earlier. To summarise, this particular cohort of student teachers were mostly supportive of the idea of using ICT in mathematics teaching. They were mostly confident and believed in the educational value of ICT use. In other words, teacher level factors generally are encouraging. However, this study has provided evidence that student teachers identified a number of significant barriers to their use of ICT in their placement schools. It is apparent in data from both the questionnaires and the interviews that one of the major factors influencing teachers' use of ICT is their access to ICT facilities. As discussed in earlier literature (e.g. Mumtaz, 2000; Opie & Katsu, 2000;

Selwood & Pilkington, 2005; Hammond et al. 2009) access to resources is a basic prerequisite for effective teacher use of ICT in schools, and this was also expressed by one of the student teachers interviewed: *“if it is not there to start with you can’t possibly get going in the first place.”*

In terms of quantitative issues, the number of computers and the availability of computers are problematic. In particular, difficulty in booking an ICT room seemed to be a permanent problem. This reflected what Cuckle and Clarke (2002) and Hammond et al. (2009) had found earlier. Despite the fact that the number of computers with Internet connection and Interactive whiteboards (IWBs) in UK schools has increased over that decade as reported by British Education Suppliers Association (2007), access issues have still been apparent in many studies (e.g. Barton, 1996; Parkinson, 1998; Galanouli & McNair, 2001; Cuckle & Clarke, 2002; Barton & Haydn, 2006).

It could be argued that the access issues recognised in this study are not simply a lack of hardware, which could have been a reason in the 1990s, but highly probably due to exceeding demand. In other words, schools might fail in providing enough equipment for increasing number of teachers wanting use ICT in their teaching (Cuckle and Clarke, 2003). A straightforward shortage of equipment might still be a valid reason for not using ICT in some schools. In terms of qualitative issues, the reliability of equipment in some schools was reported to be an issue. Access and familiarity with mathematics specific software in schools did not appear to be a problematic in this study. However, one of the student teachers pointed out that some software only had a teacher license, and was not cleared for pupils’ use. Therefore, he emphasised the easy accessibility of GeoGebra (which is open-source mathematical software) in order for pupils to be able to interact and explore things by themselves:

We do not have anything interactive which they can explore and use themselves. That is why I ended up using Geogebra because Autograph we don’t have a site license, just a teacher license. We can’t get the pupils to use and investigate it. They can access to Geogebra for free.

Secondly, in-school support appeared to be a barrier to the student teachers’ use of ICT in this study. According to data from the questionnaires and the interviews, the position of ICT in schools is still not necessarily fully integrated. There is no regular ICT use by mathematics teachers, most of who do not feel confident in their ICT skills. Interview comments revealed that mathematics teachers in schools tended not to change their traditional teaching practices. One possible explanation given by a student teacher was that:

I do not think they really understand the benefit from it, because they are getting good grades without it. Why should they invest in something really they do not see a problem at the moment?

Another student teacher also summarised the same problem as follows;

I think in a nutshell, one of the things is that the department does produce very good GCSE results, and I think you could probably sum it up as a case of right approach being used at the moment. That may be largely traditional, but it works, it produces good exam results. That means there is no need to change things for the sake of it, for instance ICT.

This suggests that, teachers tend to guide their pupils through passing the examination and to teach for examinations, which confirms the previous studies (Demetriadis et al. 2003, Hennessy, et al. 2005). These findings relate to those of Selwyn (1999), who argued that the nature of the qualifications being taught and the final examinations dictate teaching for many teachers in particular at post-16 level. As a result, “while areas such as ‘the knowledge’ and examination technique were fundamental to the content of A level teaching, other areas such as IT were inevitably... ‘left behind’” (p.37). Hennessy et al. (2005) also found that conformity to external examination requirements creates a problem with using ICT in mathematics teaching. Mathematics teachers expressed their concern regarding particularly the use of graphical calculators, as these calculators cannot be used in advanced-level examinations in England. The researchers emphasised, therefore, the necessity of a change in assessment system. “Clearly, new assessment systems are needed to address the new kinds of skills and knowledge which using ICT can help to develop” (p. 172). A second possible explanation could be the mathematics curriculum that is discussed in the earlier literature (Manouchehri, 1999; Hennessy et al., 2005). Manouchehri, (1999) showed that mathematics curriculum is considered to be a barrier for teachers to integrate technology in their teaching. Teachers reported that they did not see technology as relevant to the mathematics curriculum they taught. Hennessy et al., (2005) also found that one of the constraints for teachers to use ICT involved “lack of professional control linked to the pressure to conform to centralized curriculum...” (p. 185)

However, Crisan et al. (2007) argued that teachers' use of ICT is related to their conceptions of mathematics. Their study showed that when teachers considered mathematics "as a unified system of ideas" they tended to use ICT "to move beyond the set school curriculum and the requirements for successfully passing an exam" (p.32). Another possible explanation given by one of the student teachers was a lack of time in creating resources, which confirms previous findings (Coffland and Strickland, 2004; Crisan et al., 2007; Pierce and Ball, 2009).

I think the established teachers are not wanting or not engaging in using ICT so much, because they don't want to reinvent things. Teachers have been teaching sort of ten years or more in a certain way, and they don't normally create things from scratch. They have a worksheet that fits the bill or have a task they normally do for a particular topic...If a teacher has to invest time in creating resources, there is going to be a lack of willingness to do that, and it is going to be difficult to overcome.

Time also appeared to be a hindrance to student teachers' use of ICT. The student teachers mostly reported that time represents a big barrier, since they all had other activities such as marking, planning, and paperwork to do. One of the student teachers pointed out: "How much time do you give ICT alongside all the other things you have to do? That is another thing; it is just fighting for competition with everything else". Lack of time to prepare ICT-based lessons due to workload issues, for student teachers in school placements, is an issue also raised in other studies (for example, see Galanouli & McNair, 2001; Hammond et al, 2009).

The strongest agreement regarding a barrier statement was with a lack of suitable examples of opportunities for using ICT in the mathematics scheme of work. This is in contrast to earlier work (e.g. Hennessy, Ruthven and Brindley, 2005) that had found that ICT integration into the schemes of work was not problematic for mathematics teachers, although there was variation amongst schools. However, this finding reflected what Crisan et al. (2007) had found earlier. "All teachers pointed to the need of having the use of ICT embedded into the mathematics scheme of work. They believed that they would be more likely to make regular use of ICT in their lessons if there was a pool of ICT-based mathematics ready-to-use resources, easily and readily accessible to them and clearly mapped to the mathematical objectives of the scheme of work." (p.30).

The implications of both the questionnaire and the interview data for schools involve placing student teachers within a supportive community of practice regarding effective and regular use of ICT (Dawes, 2001; Hammond et al, 2009). In a wider context this study emphasises "developing and sharing pedagogic expertise concerning ICT use in subject teaching and learning and re-evaluating objectives, curricula, and assessment" (Hennessy, Ruthven and Brindley, 2005, p. 187)

Conclusion

It was encouraging to find that student mathematics teachers in this study appeared generally supportive and confident in their intention to use ICT in secondary mathematics classes. However, the findings indicate that supportive attitudes alone are not sufficient. The student teachers identified the significant issues affecting their use of ICT during school placement. The barriers reported as inhibiting student teachers' use seem to relate to poor access to ICT facilities, limited encouragement from mentors and the other teachers in mathematics department and irregular use of ICT by existing teachers in teaching, lack of links in the scheme of work, and time constraint. To conclude, the challenge for training programmes and placement schools is to ensure sufficient support and resources in order to provide student teachers with an appropriate context where they can develop their ICT pedagogic skills and exploit ICT more fully.

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Appendix: Questionnaire

Please read each question carefully and try to be accurate; remember there is no right or wrong answer.

Please complete the questionnaire in full.

Please tick (✓) the appropriate box.

Are you? Male

Female

1- Which of the following statements most closely describes your feelings about teaching and learning in mathematics: (Please tick **only one** of the following statements.)

a) Negative - **I don't think that computers have much to offer teaching and learning.**

b) Sceptical - **Computers might be of some use in teaching and learning, but their importance has been overstated.**

c) Open-minded - **Computers seem to have a much to offer but it remains to be seen whether they will bring major benefits to teachers and learners.**

d) Fairly positive - **Computers have considerable potential for enhancing teaching and learning, but they have to compete alongside several other important priorities in terms of my professional development.**

e) Very positive - **Computers have enormous potential for enhancing teaching and learning. I see ICT as one of the most important priorities in terms of improving teaching and learning.**

f) None of the above

	Strongly disagree	Disagree	Not certain	Agree	Strongly agree
I can book an ICT room without difficulties	1	2	3	4	5
There is a sufficient number of computers in my department	1	2	3	4	5
I can easily access to the Internet in lessons	1	2	3	4	5
There is access to mathematics software resources	1	2	3	4	5
The mathematics packages available in school are familiar to me	1	2	3	4	5
I am confident with using ICT during my teaching	1	2	3	4	5
It is a requirement in the National Curriculum to use ICT	1	2	3	4	5
The culture of my school placement encourages me to innovate using ICT	1	2	3	4	5
I share ideas with other student teachers about using ICT, and we support each other	1	2	3	4	5
Pupils are competent with ICT	1	2	3	4	5
Mathematics teachers believe in the value of using technology in their classrooms	1	2	3	4	5
My mentor provides guidance and support regarding the use of ICT during my teaching	1	2	3	4	5
Mathematics teachers are confident in their ICT skills	1	2	3	4	5
If I have a problem with equipment, I am provided with technical support	1	2	3	4	5
ICT changes the way pupils learn	1	2	3	4	5
Pupils feel motivated when they use ICT	1	2	3	4	5
Other teachers in the mathematics department use ICT regularly	1	2	3	4	5

2- Think about factors encouraging your use of ICT in mathematics teaching. Please tick the appropriate boxes indicating whether you agree or disagree with a series of statements

Are there any **other factors** that have encouraged you to use ICT?

If so, please list below:

Please state, in order of preference, the **three most helpful factors** you experienced (of any kind) in encouraging you to use ICT:

3- Think about factors discouraging your use of ICT in mathematics teaching. Please tick the appropriate boxes indicating whether you agree or disagree with a series of statements

	Strongly disagree	Disagree	Not certain	Agree	Strongly agree
There is a lack of available computers	1	2	3	4	5
Insufficient software resources are available	1	2	3	4	5
There are some packages that I am not familiar with	1	2	3	4	5
Equipment is unreliable	1	2	3	4	5
I lack appropriate training	1	2	3	4	5
There is a lack of suitable examples of opportunities for using ICT in the mathematics scheme of work	1	2	3	4	5
I do not feel competent in making use of ICT to support my classroom teaching	1	2	3	4	5
The main obstacle to using ICT in the classroom was my lack of experience	1	2	3	4	5
ICT is not a priority to me	1	2	3	4	5
I am not convinced of the value of ICT in helping pupils to learn	1	2	3	4	5
I lack ideas about how to use ICT to support pupils' learning	1	2	3	4	5
My mentor is not very supportive of me using ICT	1	2	3	4	5
I do not have the time to find and evaluate software due to workload issues	1	2	3	4	5
Mentor-teachers have difficulties when they encounter the changes in technologies	1	2	3	4	5
Attitudes to ICT within the mathematics department are negative overall	1	2	3	4	5

Are there any **other factors** that have discouraged you to use ICT?
If so, please list below:

Please state, in order of preference, the three most significant barriers you found to using ICT:

Thanks for taking the time to complete this questionnaire. It is very much appreciated!

For investigation purposes, if you would like to be interviewed as a follow-up to the information you have given here please write your name below. Your information will still be kept confidential.

Name: _____