STUDENT TEACHERS' EXPERIENCES OF USING SPREADSHEETS

Declan O'Reilly

University of Sheffield

Abstract: This paper recounts 14 student teachers' experiences of using spreadsheets to teach mathematics in secondary schools. As part of their formal assessment, they submitted accounts, listing the problems and benefits encountered in using this software. These accounts form the basis of the analysis. The results suggest that knowing where the problems occur may help student teachers to forestall them. Secondly, the results indicate that student teachers incur additional costs through using spreadsheets: in terms of planning and teaching. The benefits accrue to the children in terms of better understanding and attitudes towards learning - and ultimately to the teacher – in achieving these goals.

INTRODUCTION

Spreadsheets have been in use in industry for many years, and increasingly they are being used in schools for mathematics and for other subjects. Indeed, their use is specifically encouraged in the mathematics national curriculum for England (1999) in both Key Stages 3 and 4:

> **KS3:** 5f. Pupils could use a spreadsheet to construct formulae to model situations.
>
> 6g. Pupils could use a spreadsheet to generate points and plots graphs. (p. 34 - 35)
>
> **KS4:** 6d. Pupils could use a spreadsheet to calculate points and draw graphs to explore the effects of varying m and c in the graph of $y = mx + c$. (p. 48)
>
> 1c. Pupils could use databases or spreadsheets to present their findings and display their data. (p. 69)

The fact that the spreadsheet package Excel is already installed on many school computers means that one of the barriers to using ICT, namely the cost of buying software, is removed. Of course, neither legislation nor availability ensures that teachers, or student teachers, will use this software. All too often, there are barriers both at the institutional and the individual level that act as constraints on the use of ICT (Becta, 2004). For teacher educators, the challenge is to motivate student teachers to overcome these barriers. At the University of Sheffield, we have chosen to do so by means of an assessed ICT portfolio (O'Reilly, 2003). In the academic year 2003-2004, fourteen students wrote portfolio accounts described their experiences of using spreadsheets and these form the data for this study. In analysing their accounts, the aim of this paper to draw out implications for other student teachers, teachers in general and teacher educators.

METHODOLOGY

As part of their assessment, the student teachers submitted an ICT portfolio detailing how they had used ICT on four occasions over the course of their two block teaching practices. This paper examines the spreadsheet accounts submitted by 14 secondary mathematics student teachers undertaking the one-year Post Graduate Certificate in Education (PGCE) course during the academic year 2003-2004. The framework for the portfolio advises students to bracket their experiences into four categories: 'ICT problems', 'Mathematics problems', 'ICT benefits', and 'Mathematics benefits'. These categories formed the basis of the initial content analysis (Cohen, Manion and Morrison, 2001). A secondary analysis identified three different - but not necessarily disjoint - strands of data according to whether these problems and benefits were related to the computers (hardware or software), the children or the teachers. A third level of analysis clustered groups of related data within these categories and these form the basis for the ensuing discussion (Tables 1 and 2).

Problem	Resources	Program Limitations	Attitudes/ Familiarity	Input/ Output	Under-standing	Planning / Teaching	Totals
ICT	8	4	14	4	1	13	44
Maths	-	5	4	2	17	2	30
	8 (10.8%)	9 (12.2%)	18 (24.3%)	6 (8.1%)	18 (24.3%)	15 (20.3%)	74 (100%)

Table 1: Distribution of Problems

Problem	Resources	Program facilities	Attitudes/ Amplification	Skills	Under-standing	Planning / Teaching	Totals
ICT	-	7	22	5	6	2	42
Maths	-	4	6	2	18	3	33
	0 (0%)	11 (14.7%)	28 (37.3%)	7 (9.3%)	24 (32%)	5 (6.7%)	75 (100%)

Table 2: Distribution of Benefits

ANALYSIS

In terms of resources, the student teachers encountered problems in booking or accessing rooms (2), technical hitches with the school network or printing (3), and difficulties in using laptops (3). Of course, these problems are not unique to spreadsheets but it might be noted in passing that while laptops may have overcome

some problems, such as room booking or access, they appear to have introduced new problems of their own. None of the students identified resource benefits for the teacher from using spreadsheets.

> The main problem I found with using the laptops was their unreliability to work. They were all wireless, but connected to a network. It took 20 minutes at the start of the lesson to get all pupils logged on, as there were a few 'black spots' in the classroom, where for some reason, the laptops wouldn't work; however, when moved a different part of the classroom, they did work! (ICT – Edmund)

Other problems were attributed directly to Excel: editing or printing (1), graph options (1) graph wizard could promote bad practice (3):

> The numerous options at each stage in the construction of the charts confused Thomas. When generating a pie chart, for the data range he entered series in columns instead of rows and when he produced the chart below which was obviously not correct, he became disheartened, infuriated and lost interest. (ICT - Tina)

By contrast, there were eleven statements praising the facilities of Excel: easy to use (1), interactive (1) can handle large data sets (1), graph options (5) graph wizard could promote good practice (3):

> Microsoft Excel is a very large program and this enabled the sequences to go on for as long as pupils wished. Nick had great fun seeing how large the sheet actually went down i.e., how many rows a sheet has. He eventually gave up! (ICT – Hazel)

At the intersection between the computer and children, problems arose through children's general lack of confidence or familiarity (2), specific lack of knowledge of cell referencing (3), dragging down (1) using equations (4), or graphing data (8):

> Lorand did not understand how to enter the equations in Excel; he got confused with having to enter the '=' sign and did not understand how to get the equation to work in all of the cells in the row. (ICT – Tim)

> One of the most frequent problems that pupils, such as Vicky and Matthew, had was that when highlighting cells in their worksheet they would highlight the cells surrounding their tables instead of just the information they wanted. (ICT – Ian)

The main sources of benefits for children also lay at the human-computer interface. There were two quite different forms of benefits: cognitive and affective. The student teachers listed eighteen amplification effects: the speed to manipulate data (1), to redo tasks (3), to free up time to explore different charts (5) to focus on interpreting charts (9). These effects were sometimes linked to individual children, the suggestion being that the spreadsheet program was enabling them to overcome problems perhaps caused by motor skills.

> Most of the pupils managed to produce more graphs than they would have done by hand,

> which gave them the chance to compare two or more sets of data, rather than simply commenting on one. Even Sophie, who usually worked quite slowly, managed to create two pie charts. (ICT – Fiona)
>
> Laura was pleased because she had not used Microsoft Excel prior to the lesson and had found it much easier to draw the pie charts and more enjoyable because "you can find out more about what the pie chart is telling you since you're not spending loads of time drawing it." (ICT – Ian)

Many student teachers reported that it was through the removal of drudgery and the speed of getting results that children became motivated, enjoyed the activity and became more involved in it. Terms such as 'novelty' (2), 'interest' (2), 'involvement' (1), 'confidence' (3) and motivation (2) were used, often linked to children whose normal way of working was seen to be problematic:

> This class is a very demotivated group but with the change of location and activity all the group produced some work this lesson, including three pupils, Daniel, Richard and Tom who can very rarely be persuaded to do anything in normal lessons. (ICT – Hannah)
>
> Using ICT also meant that the graphs produced were of a high standard, clearly labelled and easy to read. This gave the pupils a real confidence boost, something to be proud of, particularly Andrew and Aaron, who have both got quite weak writing skills and presentation. (ICT – Fiona)

Input/output problems formed another source of children's difficulties (6). The student teachers reported that pupils made errors in entering data or accepted the display without question:

> The initial ICT problems were related to lack of practice in typing in data, a number of pupils missing data values, for example Adam B, who then had to check through the data and compare to the data entered to see which item he had missed. (ICT - Chris)
>
> The only other problem was the classic one of pupils believing whatever the computer churns out. A couple of the pupils (Claire and Emily) highlighted the wrong section of the data to plot the pie chart from and consequently the computer churned out nonsense. (ICT - Paul)

Against this, they listed benefits of transferable ICT skills to and from Excel (7):

> Excel was particularly easy from the aspect of formatting with the options being the same as in other Microsoft programs. (ICT - Hazel)
>
> Sarah had used Excel at home; she had previously used Excel to draw bar charts. This confidence in using Excel meant that she quickly understood what she had to do. (ICT - Tim)

The term 'understanding' has been used here to encompass groups of problems and benefits lying at the intersection of children and teachers. In the first case, student teachers identified general problems of understanding (2), children having 'black-

box' understanding (4), being unable to interpret results (3) or unable to connect their spreadsheet work with what they were doing in normal lessons (9):

> Another potential problem is that creating all these charts using ICT means that the pupils could potentially have little knowledge of the pencil and paper method. This may be especially true of pie charts. (Maths – Jo)

> The pie chart tasks required them to plot the pie chart of the results of a poll of 100 people coming out of a voting booth for a by-election and compare them with the results for the actual election. The pupils could spot that the pie charts were similar but a bit different; however, they had trouble reasoning why. (Maths – Paul)

On the other hand, they said that Excel helped children to better what they were doing in normal lessons (4), fostered co-operative learning and discussion (2), engendered independent learning (4) systematic exploration (7), and gave children the means to predict and generalise (7).

> The computers made it easier to generate larger sequences of numbers. Once pupils understood how to use Excel they could quickly enter in their equations and generate the sequences. Pupils then compared these with the numbers that they had worked out in the previous lesson. Timmy felt encouraged that he had worked out all of the terms correctly in the previous lesson. (ICT – Tim)

> Trying to understand what they are asking the computer to do seem to lead to a greater depth of understanding for Laura when she was inputting the data into the spreadsheet to produce a scattergraph. She began to 'guess' what the graph would appear like and was keen to see if her predictions would be correct. (Maths - Tina)

Teacher problems fell into two main categories: planning (6) and teaching, the latter being made of two main concerns classroom management (5) and differentiation (4), issues that perhaps were felt even more acutely in an ICT environment. It was refreshing to read that student teachers were now more aware of what they might have done to make the lesson more successful:

> Although the mathematical ability of the pupils was similar, within the class there was a much wider range of ICT abilities. This meant that there were some pupils such as Sam, Peter, Lewis, and Adelka who were very able students and could start to manipulate their spreadsheets very quickly. Yet, there were pupils such as Kate, Samantha and William within the class who were much slower to start and required help and guidance to enable them to progress with the task. (ICT – Leon)

> I was too ambitious trying to get such a lot of work done in the lesson. I went though the examples using a laptop and projector. Gemma struggled to keep up with my demonstration using the projector but Kelly was getting impatient that I was not going fast enough for her. I think that the lesson would have gone better if I had made a worksheet for pupils to work through at their own pace. (ICT – Tim)

The benefits for teachers, planning (2), teaching (1) and differentiation (2), were somewhat ambivalent with Tina's observation being typical:

> It was interesting to see how the dynamics of the group changed. The classroom ability boundaries appeared to have disappeared – those high achievers of the group such as Daniel, were not necessarily better at the set activity as his IT capabilities were quite poor. (Maths – Tina)

DISCUSSION

Becta (op cit) categorise ICT barriers in terms of whether they were at the school level or at the teacher level, and they suggest that further research is needed in terms of individual subject areas. This paper has gone beyond that suggestion by looking at the problems in terms of one application - spreadsheets - within the subject area of mathematics. It has further located these problems in terms of the triad: teachers, computers, and children. The results suggest that, although the process of locating problems and benefits, is one of approximation rather than exactitude, it is a useful means for seeing where the problems lie and to whom the benefits accrue. In the first case, it suggests that knowing where the problems occur may help student teachers to be better able to forestall them. In the second case, this process indicates that student teachers incur additional costs through using spreadsheets: in terms of planning and teaching. The benefits accrue to the children in terms of better understanding and attitudes towards learning - and ultimately to the teacher – in achieving these goals.

REFERENCES

Becta (2004a). *A review of the Research Literature on the Barriers to the Uptake of ICT by Teachers*. Retrieved March 5, 2005 from: http://www.becta.org.uk/page_documents/research/barriers.pdf

Cohen, L., Manion, L & Morrison, K. (2001). Research Methods in Education, London: Routledge Falmer.

DfEE – QCA (1999) *Mathematics in the National Curriculum.* London: HMSO.

O'Reilly, D. (2003). Making Information and Communications Technology Work. *Technology, Pedagogy and Education*, 12, 3, 417-446.