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Abstract

In this paper we examine the barriers to using ICT of secondary mathematics teachers in the classroom. The sample contained 114 mathematics teachers from public secondary schools in New South Wales (Australia). The instrument used in this study was a survey questionnaire mailed to secondary schools in the New South Wales Department of Education and Training. The questionnaire design is a closed-response with five open-ended questions. Results of the study showed that lack of access to computer labs is the number one barrier to using ICT in the classroom. But when a second analysis using a logistic regression analysis modeling was used, the non-users of computers paint a different picture. The number of teachers indicating lack of lesson plans as a barrier was significantly higher for teachers who do not use technology than teachers who do use technology in the classroom.

Keywords

Barriers, using, ICT, mathematics, teaching, issues, methodology

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Barriers to Using ICT in Mathematics Teaching: Issues in Methodology

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Abstract: In this paper we examine the barriers to using ICT of secondary mathematics teachers in the classroom. The sample contained 114 mathematics teachers from public secondary schools in New South Wales (Australia). The instrument used in this study was a survey questionnaire mailed to secondary schools in the New South Wales Department of Education and Training. The questionnaire design is a closed-response with five open-ended questions. Results of the study showed that lack of access to computer labs is the number one barrier to using ICT in the classroom. But when a second analysis using a logistic regression analysis modeling was used, the non-users of computers paint a different picture. The number of teachers indicating lack of lesson plans as a barrier was significantly higher for teachers who do not use technology than teachers who do use technology in the classroom.

The new math reform period brought some notable changes to the secondary school curriculum in many countries and proposals to revamp the mathematics curriculum met resistance from teachers (Keitel and Ruthven, 1993). Some educators (both new and experienced) may be reluctant to integrate technology because it is new and different (Newby et al., 2006). The reluctance of mathematics teachers to use technology in their teaching is thought to reflect the barriers encountered by them when implementing the use of technology in the classroom. Examination of several studies regarding the barriers to computer use in the mathematics classroom over the years since 1998 onwards across the continent reveals similar patterns. Several past and current researches across continents address the barriers to technology use.

The purpose of this paper is to discover the barriers to technology use in teaching mathematics in the secondary schools. Teachers were asked 10 questions listed in Table 2.

Previous Research

Less than a decade ago, in the USA, Sulia (1998) and Donald (1998) found that teachers' resistance to technology use is more about "change". It was also revealed that some of the barriers reflected in the lack of adequate professional activities, preparation and resources. Teachers also felt that they are insufficiently trained and lack of technical support is minimal. Studies in New Zealand and Australia have led to similar conclusions. Mawson's (1999) study in New Zealand revealed that teachers lacked the familiarity with technological language and terms, limited knowledge of technology curriculum statement and lack of professional development. Richards (1997), D'Sousa, Sabita & Woods (2003) and Palmer (2002) in Australian studies all identified the common barrier to technology use in the classroom as a lack of professional development and lack of access to computers.

Richard's (1997) findings revealed that teachers felt powerless to change their attitudes and perceptions on their present practices to shift to technology use in the classroom and further that teachers' preferred method of teaching is the traditional method rather than using technology.

There have also been several studies specifically focused on secondary mathematics teaching. Manoucherhi (1999) in a US study conducted in 1996 on the extent in which computers are being used by middle and high school mathematics teachers urban, suburban and rural areas concluded the lack of computer use is due to:

- lack of experience and access to educational software;
- lack of the appropriate knowledge-base about using computers;
- lack of knowledge about the nature and purpose of exploratory activities in mathematics and ways to enhance instruction and
- lack of adequate professional training and professional support as it relates to the use of computers in mathematics instruction.

The most recent Australian study by Forgaz (2006) revealed a number of barriers or inhibiting factors to technology use in the secondary mathematics schools in Victoria, Australia. This study has similarities to the research undertaken by the author. Table 1 presents the results of the data.

Table 1

Factors Inhibiting Teachers from Using Computers: 2003, (N=54), Rank Order and Frequency and Percentage Response (Forgaz, 2006)

Discouraging Factors	Rank	N	(%)
Access to computer and /or computer labs	1	46	67%
Need professional development and time For professional development	=2	12	22%
Time: students to cover syllabus, acquire basic skills; Teachers to prepare lesson plans	=2	12	22%
Lack of experience, confidence, skills	4	10	19%
Technical problems, lack of technical support, old equipment	5	8	15%
Software: availability, appropriate, relevant	=6	7	13%
Student discipline, attitudes, behaviours	=6	7	13%
Not part of math courses	8	5	9%
Graphics calculators	=9	1	2%
Students lack keyboard skills	=9	1	2%
Other categories with less than 4% response rate	11	1	2%

Source: Forgaz (2006), *Journal of Computers in Mathematics and Science Teaching* (2006) 25(1), 77-93

After making comparisons of the researchers in the barriers of technology use in the classroom in general and the mathematics classroom in particular, similar patterns emerged in Sulia (1998); Donald (1998); Mawson (1999); Richards (1997); D'Sousa et al. (2003); Palmer (2002); Forgaz (2006) and Manoucherhi (1999). These have common theme in the need for professional development, access to computer use, technical support and teacher's beliefs in teaching and learning using and not using technology.

The Present Study

Aims

The aim of this study is to investigate the barriers to using ICT in mathematics teaching. The teachers involved are Australian secondary mathematics teachers.

The Sample

Twenty six public secondary schools in NSW were included in the study. These secondary schools were located in 10 regional areas of New South Wales (Australia) namely: Hunter/Central Coast, Illawarra and South Coast, New England, North Coast, North Sydney, Riverina, South Western Sydney, Sydney, Western New South Wales and Western Sydney. The sample included 114 secondary mathematics teachers who consented to participate in the survey.

The Instrument and Procedure

The instrument used in this study was a survey questionnaire developed and piloted by the researcher and mailed to secondary schools in the New South Wales Department of Education and Training. The questionnaire design is a closed-response with five open-ended questions. It is composed of four Parts. Section 1: Professional Development for Using Technology in Mathematics Section 2: Your beliefs/Conceptions in Mathematics Teaching and Learning and Using Technology-Computers, Section 3: Technology Used and Instructional Practices and Section 4: Questionnaire for Mathematics Head Teachers, About Your School in Using Technology.

The participating schools were sent letters through the post with prior approval from the NSWDET (New South Wales Department of Education and Training). These letters were mailed during the first week of November, 2005. A follow-up letter was sent to schools who did not respond to the initial survey questionnaires in February 2006.

Sources of Data

The instrument used in this paper is Question number 10 from Section 1 of the survey. These questions are shown in Table 2.

Table 2

Question 10. In the table below, please mark a tick on the space provided to answer the questions.

SA (Strongly Agree); A (Agree); U (Undecided); D (Disagree); SD (Strongly Disagree)

The following prevent me from using computers in the classroom.

	Items	5 SA	4 A	3 U	2 D	1 SD
a.	access to computers					
b.	access to computer labs					
c.	classroom management in using computers					
d.	technology support					
e.	lack of time to undergo training					
f.	compatibility of software and hardware					
g.	not confident in using the software					
h.	lack of knowledge of teaching strategies using computers					
i.	inability to trouble-shoot problems with computers					
j.	lack of lesson plans using computers in Mathematics					

k. If there are any others, please specify_____

Results and Discussion

From the responses of the 114 participants in the present study, striking but perceived revelations as to the barriers to technology use in the classroom emerged.

As shown in Table 2, the participating teachers were asked to mark a tick on the space provided to answer to the items on Question 10. The ranking and percentage of the answers to Question 10 is shown in Table 3.

First Analysis:

The first analysis involved combining the categories, Agree and Strongly Agree. The percentage of teachers who agreed that the item was a barrier to using technology in the classroom was then determined. The items were then ranked from the most cited barrier to the least cited barrier. The ranking and percentage of the answers to Question 10 is shown in Table 3.

The survey reveals that: 72% of the respondents believed that access to computer labs prevent them from using computers in teaching mathematics; 64% of teachers thought that access to computers hinder them from using in mathematics teaching; 63% believed that lack of lesson plans using computers in Mathematics is a barrier to using computers in teaching and 60% also believed that lack of time to undergo training prevents them from using computers in teaching. The rest of the items and their ranking can be seen in Table 3.

Table 3

Factors that prevent teachers from using computers in mathematics teaching: (N= 114), Rank Order, Frequency and Percentage Response.

	Rank	Percentage (%)
access to computer labs	1	72%
access to computers	2	64%
lack of lesson plans using computers in Maths	3	63%
lack of time to undergo training	4	60%
inability to troubleshoot	5	54%
lack of knowledge of teaching strategies	6	51%
not confident in using software	7	42%
technology support	8	41%
classroom management in using computers	9	33%
compatibility of soft and hardware	10	29%

Second Analysis

The second analysis, a logistic regression analysis modeling whether teachers used computers found only the lack of lesson plans associated with use ($\chi^2 = 6.587$, $df=1$, $p=.01$). The non-users of computers were significantly more likely to indicate that a lack of lesson plans was a barrier to using computers than did the teachers who used computers in the classroom (Wald Statistic=5.386, $df=1$, $p=.02$). None of the remaining items were significantly associated with the use of computers in the classroom. The number of teachers indicating a lack of lesson plans as a barrier, was significantly higher for teachers who do not use technology (78%) than teachers who do use technology in the classroom (60%). The differences for the other items were not significant.

Table 4 contains the percentage of teachers not using and using technology indicating the item to be a barrier.

Table 4

Percentage (%) of teachers using and not using technology indicating the item to be a barrier.

Barriers	Teachers <i>not using</i> Computers (%)	Teachers <i>using</i> Computers (%)
access to computer labs	62%	76%
access to computers	73%	73%
lack of lesson plans using computers in Maths	78%	60%
lack of time to undergo training	65%	60%
inability to troubleshoot	58%	54%
lack of knowledge of teaching strategies	65%	47%
not confident in using software	58%	39%
technology support	47%	40%
classroom management in using computers	42%	31%
compatibility of soft and hardware	39%	27%

What does the literature and the data of the current study tell us?

The analyses raise issues regarding the identification of barriers to using computers in the classroom. A review of other studies in the literature, Sulia (1998); Donald (1998); Mawson (1999); Richards (1997); D'Sousa et al. (2003); Palmer (2002); Forgaz (2006) and Manoucherhi (1999) identified a common finding that access to computers/computer labs were a barrier to computer use by teachers. This is consistent with the present findings, when teachers are asked to identify barriers to use when a simple ranking of teachers cited barriers is examined. However, an examination of Table 4 reveals teachers who use computers are just as likely to indicate the lack of computer access is a barrier to those who do not use computers. The *lack of lesson plans using computers in mathematics* is the only item that distinguishes between those who use and those who do not use computers in the classroom. What precisely a barrier is, is called into question in this study. Barriers may be seen as circumstances that make the use of computers more difficult, not necessarily as circumstances which prevent teachers from using computers in the mathematics classroom. Seventy six per cent of teachers overcome the perceived barriers of lack of access and use computers in their teaching. Perhaps the question to ask is why some teachers manage to overcome perceived barriers to use computers while others do not.

In the present study, it seems that the non-users of technology need some help in their pedagogy with the aid of computers. Maybe, to remedy this problem is for the school to include in their school plans the training of teachers using technology with emphasis on lesson planning. Lesson preparation is paramount to teaching and learning and most teachers want to see lessons that work for the students they teach. A study that will specifically address on training teachers to create and design lessons integrating technology in the mathematics subjects must be explored. Education departments, district office/regional office and secondary schools should consider training mathematics teachers incorporating technology in lesson preparation and not left to individual teachers to fend for themselves. The training or professional development programs should be an on-going one with time-lines, and evaluated after two or three years of implementation.

Conclusions

Results of the survey revealed the teachers felt that access to computers/computer labs as the prevalent barriers to the integration of technology in their teaching. This is similar to those reported in earlier research studies on computer use in education in general: in the US, Sulia (1998) and Donald (1998); in New Zealand, Mawson (1999); in Australia, Richards (1997); D'Sousa et al. (2003) and Palmer (2002). In studies of secondary mathematics schools, Forgaz (2006) in Australia and Manoucherhi (1999) in the USA appeared to have striking similarities as to the barriers to technology use in the mathematics classroom. Similar conclusions could be drawn in this study when simply ranking the percentage of teachers citing

these as barriers. However, when a logistic regression analysis modeling who uses computers in the mathematics classroom was undertaken in the current research a different story emerged.

The question as to what are the barriers to using technology in the classroom appears to be methodologically bound. Studies which rank items that teachers suggest are barriers to use do not necessarily identify the factors that prevent teachers from using technology in the classroom.

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