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for adult literacy and numeracy

Research Report

Greater than the sum...

Report of the action research project: The Use of ICT in Adult Numeracy Teaching in Scotland, Phase 2

Diana Coben, Jim Crowther, Maria Kambouri, Harvey Mellar, Nora Mogey, Sheena Morrison and Ian Stevenson

Spring 2007

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Authors' dedication

For tutors of adult literacies everywhere and with special thanks to all the tutors and learners in Phases 1 and 2 of the project titled:
The Use of ICT in Adult Numeracy Teaching in Scotland.

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Foreword

The Scottish Executive's strategy for raising literacy and numeracy levels across Scotland was set out in *Adult Literacy and Numeracy in Scotland* (ALNIS), 2001. This report noted the need 'to put right the low priority given to numeracy in programmes'.

Learning Connections' first step to address this issue was to commission *Adult Numeracy: Shifting the focus – A Report and Recommendations on Adult Numeracy in Scotland* (Communities Scotland, 2005). Its author, Diana Coben, highlighted the role of information and communications technology (ICT) in promoting adult numeracy within the Scottish literacies strategy, calling for 'the integration of ICT into adult numeracy teaching' and 'intervention studies in the use of ICT in teaching numeracy'. Diana's recommendations echoed the suggestion in ALNIS that one of the strategy's critical success factors was to maximise 'the potential of information and communications technology'. Indeed, one of ALNIS's main goals, 'to achieve a quality learning experience', relied in part on 'a strong emphasis on the role of ICT'.

Phase 2 of The Use of ICT in Adult Numeracy Teaching in Scotland project has aimed to broaden and explore more deeply the work begun in Phase 1. The project lasted from November 2005 until December 2006, when the action researchers presented their learning and teaching projects to their peers at the Third National Adult Numeracy Seminar in Stirling, Focus on ICT and Numeracy. We acknowledge the useful lessons for the field of Scottish adult literacies that the report offers, and will consider its recommendations carefully.

Annexed to the electronic version of the report – available on Adult Literacies Online (www.aloscotland.com), Learning Connections' online resource bank – are detailed reports of each project, with links to learning resources created by the action researchers. We hope that tutors will enjoy using these resources with their own learners, and be inspired by the researchers' innovative applications of ICT in adult numeracy teaching.

We have been delighted by the energy and enthusiasm of the tutors, many of whom engaged with the project in their own time – a true sign of their dedication to their learners. We thank them for their important contribution to the project.

We believe that this project has significantly enhanced the action researchers' knowledge, skills and understanding, as well as providing the Scottish adult literacies field with 16 fascinating case studies of how ICT can be integrated with numeracy to provide stimulating and high-quality learning experiences.

LEARNING CONNECTIONS
Spring 2007

Executive summary

The Use of ICT in Adult Numeracy Teaching in Scotland was an action research[1] and staff development project with adult literacies tutors who designed and undertook action research projects with learners in various settings across Scotland. These settings spanned community-based provision, the voluntary sector, Scotland's Colleges, the workplace, university outreach and a prison.

The aim of the project was to explore, extend and improve the use of information and communication technology (ICT) in adult numeracy teaching in Scotland in keeping with *Adult Literacy and Numeracy in Scotland* (Scottish Executive, 2001) and *Adult Numeracy: Shifting the Focus* (Coben, 2005).

The project ran in two phases: Phase 1, January–March 2005[2] and Phase 2, November 2005–December 2006; this report is on Phase 2.

Tutors were supported by seven one-day workshops at the University of Edinburgh, together with online activity and face-to-face support from the project team. The project culminated in presentations by the tutors and the research team at the Learning Connections' Third National Adult Numeracy Seminar, held at the Stirling Management Centre on 6 December 2006.

Research questions

Alongside staff development, the project explored the following research questions:

- What uses of ICT can we identify and demonstrate to support adult numeracy learning?
- Do adult learners learn using ICT to support numeracy learning – if so, are there particular operations or technologies that are more conducive to an integrated approach?
- What are the contexts in which the learners live and work and how can these best be reflected in their numeracy programme?
- Does ICT add to the motivation, concentration and persistence of learners?
- Does ICT help us reach the 'harder to reach' learners?
- How should numeracy learning be assessed? Are current methods – e.g., through individual learning plans (ILPs) or through Scottish Qualification Authority (SQA) routes – effective, or are changes in the structure of assessments needed? Should ICT skills developed in a numeracy context be assessed – and if so, how?
- How may the training and support offered on this project best be extended to other numeracy tutors across Scotland to promote the effective use of ICT?

1 For a full description of action research, see Chapter 3, The design of the project.
2 The report on Phase 1 is on the Adult Literacies Online website at www.aloscotland.com (Coben, Stevenson, Mellar, Kambouri and Mogey, 2005).

We addressed these questions by:

- supporting tutors to develop action research projects with and for adult learners, exploring the use of a wide variety of ICT
- promoting self-reflection
- sharing ideas and expertise through face-to-face meetings and online discussion
- providing staff development in the use of a range of technologies and their application to adult numeracy
- developing online and electronic media-based teaching and learning materials and guidance for tutors on using ICT in adult numeracy, based on their action research projects, for use in the wider adult numeracy field.

Action research in the project

The tutors tailored the use of ICT in their numeracy teaching to the perceived needs and interests of the learners with whom they worked through their action research projects, as follows:

- ***Using Numbers in an Office***, **Dot Butler, West Fife Enterprise Ltd**. This project aimed to enable learners to perform administrative office tasks involving numbers, and to follow written and verbal instructions using technology, especially sound.
- ***Home Energy Saving and Adult Literacy and Numeracy***, **Ana Calixto, Edinburgh University Settlement Community Learning Centre**. This project aimed to: increase the numeracy and literacy skills of the participants while raising awareness about energy efficiency and affordable warmth; co-develop, with the learners, numeracy and literacy resources to aid understanding; and gain practical skills in the area of energy saving in the home. Learners' self-stated goals included 'learning how to save energy at home', 'understanding how to read a gas/electricity bill' and 'revising and learning new numeracy skills'.
- ***Everyday Numeracy***, **John Cameron, Adult Literacy and Numeracy Team, South Lanarkshire**. The main focus of this project was to introduce everyday numeracy, through ICT, to learners who had little or no previous experience of using ICT as a medium for learning. The intention was to renew enthusiasm for the learning process and show the importance of numeracy in everyday life. Learners were encouraged to use spreadsheets, word-processed documents, digital images and presentation software to interpret what numeracy meant to them. The project was intended to show the practical application of numeracy and ICT for learners, particularly those with previous bad experiences of numeracy teaching.
- ***Cooking and Numbers,*** **Nancy Craig, Dundee Council**. The aim of the project was to engage with learners and raise their awareness of links between numeracy, ICT and life skills and to encourage them to identify any numeracy skills they would like to improve.
- ***ICT and Numeracy Tutor Training***, **Nancy Craig, Dundee Council**. This project aimed to provide literacy and numeracy tutors with access to a range of ICT numeracy materials appropriate for use with adult learners to help them improve their numeracy skills.
- ***Financial Inclusion – An Intermediate One Numeracy Accreditation?*** **Marjorie Drew, Midlothian Adult Literacy and Numeracy Initiative (MALANI) in partnership with Jewel and Esk Valley College**. This project aimed to produce a contextualised ICT resource on financial inclusion that would both attract and retain adult numeracy learners. The project explored the following questions:
  - Can ICT be used to attract learners to numeracy courses on financial inclusion that historically have been badly attended, despite research showing a need for and an interest in these?

  - Can an ICT-based numeracy course on financial inclusion be used for SQA accreditation?
  - Will a contextualised ICT-based course on financial inclusion enhance the learning of numeracy?

- ***Politics and Numbers***, **Suzi Gibb and Louise Clark, Bethany Christian Trust, Edinburgh**. This project aimed to produce ICT and numeracy resources for 'hard to reach' learners. This included identifying political issues in the community which affect learners and basing numeracy and ICT tasks around these topics. In the past, learners tended to focus on improving their reading and writing and often did not see the relevance of numeracy work. The tutors described this as an 'invisible need' because learners may not realise the impact that numeracy has on their lives. They tried to overcome any lack of interest and fear of working with numbers by using numbers in a meaningful way.
- ***Blogging for Numeracy***, **Carol Gibbons, Clydebank College**. This project aimed to investigate the use of blogs in the teaching of core skills numeracy in a college setting. It was hoped that blogging would motivate the students and enable them to see the relevance of numeracy to their vocational interests.
- ***Sums for Fun***, **Shirley Jones, Shetland College**. This project aimed to encourage the use of ICT in delivering numeracy through family learning, while giving families the confidence to work together. The researcher accessed resources to help children with numeracy homework using computers and helped parents to do the same.
- ***Show Garden***, **Zoe Kennedy and Joe Lennon, British Trust for Conservation Volunteers (BTCV), Scotland, Ayr**. This project aimed to explore the use of ICT and numeracy in garden design, encourage group discussion in numeracy learning inspired by ICT, and create a show garden for public display.
- ***Using ICT to Embed Numeracy into Workplace Learning,*** **Sheila Maher, Workers' Educational Association (WEA), Inverness**. This project aimed to develop and deliver a new non-accredited numeracy course to workplace learners who have recently completed a ten-week basic ICT course.
- ***Introducing Vocationally Relevant Numeracy Blogs to the Classroom,*** **Kirsty Paterson, Angus College, Arbroath**. This project aimed to make numeracy learning more fun and to show learners that numeracy can be related to their vocational course and outside interests. It also set out to allow the tutor to demonstrate that ICT and numeracy can be used successfully together, making the ICT learning more directed to learners' vocational interests but also directly related to the numeracy performance criteria to be delivered. Finally, it aimed to provide independent opportunities for learners to take more responsibility for their own learning.
- ***Can ICT Help to Make the Teaching of Numeracy More Vocationally Orientated?*** **Angela Smith, Dumfries and Galloway College**. This project aimed to discover whether ICT would make numeracy a more palatable subject for poorly motivated students and to develop vocationally-orientated ICT numeracy work through using WebQuests. It also aimed to develop a format that would increase learner-tutor interaction (as opposed to a self-teaching method for learners).
- ***Teleporting a Tutor***, **Owen Smith, Inverness College**. This project aimed to investigate the teaching of numeracy at a distance using videoconferencing. The key problem addressed was the lack of a teacher at Intermediate 2 numeracy as well as the lack of a learning support workshop for basic numeracy in Fort William. Technology was used to bridge the distance, adapting teaching methods where necessary.
- ***Understanding Electricity and Gas Bills,*** **Neil Sutherland, Fife Council**. This project aimed to give community adult learners both an understanding of all aspects of bills for checking purposes and confidence in selecting or changing suppliers.
- ***Money Matters Behind Bars***, **Trisha Tilly, Stirling Council/Cortonvale Prison**. This project aimed to produce a course of material for prisoners about handling money in real life situations while introducing as much ICT input as possible to provide variation and challenge, and to support motivation.

The tutors' reports of these projects, together with the teaching materials they produced, are available on the Adult Literacies Online (ALO) website (www.aloscotland.com).

Key points arising from the project

This project needs to be seen not only as a research project (what do we now know that we did not know before?) but also as a capacity enhancement project (what skills, knowledge and understanding do tutors have that they did not have before?). These aspects are identified and discussed separately below but in reality they were integrated throughout the project. It should also be borne in mind that what is referred to here as 'the project' consisted of an overall project within which were nested the tutors' individual action research projects, listed above.

Enhancing teaching capacity through action research

The quality and diversity of the work developed through the tutors' action research projects and the tutors' increased skills and confidence in using ICT in their numeracy teaching amply demonstrate the benefits of an approach tailored to local circumstances and geared to enhancing tutors' capacity to use ICT to teach numeracy.

The tutors' experience and training with respect to both numeracy and ICT varied greatly at the outset of the project. By the end of the project, all the tutors reported that ICT had enhanced their numeracy teaching. Their action research projects reflected a wide range of topics geared to learners' interests and demonstrated a range of uses of ICT.

Innovative uses of ICT in numeracy teaching on the project included incorporating sound into worksheets (particularly valuable for ESOL[3] and literacy learners), WebQuests, mind mapping and blogging, with imaginative use of software such as word-processing and spreadsheet programs to make numeracy more meaningful, accessible and attractive to learners. Personal USB sticks for learners gave them a sense of personal control and enabled them to share ideas easily with their fellow students and to transfer their work onto other computers if they wished.

The project also sought to establish an online community of practice in using ICT for adult numeracy teaching through the virtual learning environment (VLE) WebCT (see Glossary). This had limited success. However, for some things, such as acting as a shared repository of materials and work in progress, and disseminating expert advice (e.g., a legal expert fielded questions on the copyright issues around producing materials arising from the project), WebCT worked well.

Reflection and analysis

Tutors' uses of technology in their action research projects were mapped onto the framework developed by Diana Laurillard (2002)[4]. The main types of technologies used were 'narrative'

3 English for speakers of other languages.
4 For a detailed account of Laurillard's classification of media see Appendix 6.

(for attending and apprehending) and 'interactive' (for investigating and exploring). The use of narrative media included the use of ICT as a motivator, to hold the learners' interest while they practised their skills. The use of interactive media included the use of websites with numeracy activities put into meaningful contexts (e.g., gardening) for learners.

ICT was used to 'see' numeracy in a modern real-world context. This is the start of a process that could lead to rethinking what numeracy involves in the information age, e.g., seeing what the ICT/numeracy demands are in ordering a train ticket online rather than buying it at the station.

Several of the action research projects adopted a critical perspective on numeracy, seeing numeracy as knowledge that empowers people for life in their societies, beyond the skills of daily life.

ICT was also used for communication (e.g., a video link for a tutor based far from his learners).

There was little use of what Laurillard calls 'adaptive' or 'productive' media. Adaptive media (which involve supporting experimentation and practice) include software such as games and simulations. Productive media (for articulating and expressing) are those in which the learner builds something; this could include modelling and creating hypermedia[5].

It should be noted that the uses of adaptive and productive media require more complex pedagogies, not necessarily more complex technologies (although these may be more complex). For example, the tutor might use a word-processing program to create interactive exercises for the learner so that the learner's activity is 'interactive'. Learners using a word-processing program to create their own hypermedia materials could be seen as using 'productive' media in Laurillard's terms.

The absence of such approaches in this project is perhaps not surprising given the relative paucity of examples of the use of these strategies in literacies work outside the project. Neither is this situation unique to the literacies context: Laurillard comments on the lack of exploitation of the productive capabilities of electronic media in teaching and learning generally.

Overall, the use of ICT appeared to be dominated by tutors' existing approaches to teaching numeracy, which were extended into new areas rather than fundamentally changed: in that sense ICT failed to dent the mould.

The outcomes of our project should be understood as the result of tutors in very diverse contexts adapting ICT to suit their particular contexts, abilities and experience, and balancing the use of ICT against other pressures, in particular, those of time and money and their own capabilities with respect to using ICT in their numeracy teaching.

While there is general agreement that the development of the use of adaptive and productive media geared to adult literacies learners would be very useful, existing ICT resources are mainly either aimed at children (i.e., the content is appropriate but the presentation is not) or undergraduates (i.e., the presentation may be appropriate but the content is too complex).

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5 Hypermedia denotes the linking of graphics, sound, text and video elements in ICT.

New forms of games, simulations and modelling tools are needed for adult literacies learners, taking account of any literacy or language needs they may have. ICT offers exciting opportunities to take such approaches to teaching adult numeracy further into the territory of Laurillard's communicative and adaptive media. This project has laid the groundwork for such interventions. It has made an impressive start, demonstrating that together, ICT and numeracy can and do make a whole that is greater than the sum of their parts, but more remains to be done.

Recommendations

Our aim in this report is to document and build on the progress made in the project. Accordingly, a range of strategies is suggested here to carry forward work begun in the project, some of which are already underway. These recommendations are addressed to Learning Connections, to adult literacies partnerships and their co-ordinators and to literacies tutors. The recommendations will need to be refined and updated as new technologies evolve (such as, for example, Web 2.0) which have the potential to change literacies practices, as well as the way learners learn.

We recommend that the use of ICT in numeracy learning and teaching should be promoted in Scotland through: training and continuing professional development (CPD); policy; networking; resources and materials; and research, as follows:

1 Training and continuing professional development

- *Provide training and CPD in a variety of formats,* including: road shows; local, practical workshops geared to different levels of ability, varied to suit local contexts; regular face-to-face meetings; project participants 'cascading' experiences in their own area; mentors to support tutors.
- *Provide institutional and financial support for tutors providing and undertaking professional development.* Both release time and additional payment were mentioned by tutors as important ways of supporting professional development.
- *Encourage the appointment of ICT and Numeracy Champions* to promote tutors' confidence and provide support within partnerships for literacies tutors to develop their use of ICT in numeracy, including email and telephone support, since ICT coaching can be undertaken remotely.
- *Encourage collaborative numeracy learning*, e.g., through dissemination in Scotland of the findings of the Thinking Through Mathematics project in Maths4Life (www.maths4life.org) in England.
- *Showcase and cascade the work of the action research projects* at national literacies conferences and locally, through partnerships, including hands-on learning using ICT.

2 Planning

- *Encourage partnership co-ordinators to consider the findings of this report in relation to how this work might be included in partnership planning.*
- *Specify numeracy clearly in reporting mechanisms:* Partnerships should be asked to tell the Scottish Executive's Enterprise, Transport and Lifelong Learning Department (ETLLD) how they are promoting numeracy to their tutors, including through the use of ICT.

3 Networking

We hope that this project will prove to have contributed to the development of a community of practice in adult numeracy alongside and complementary to existing local, regional and national networks. We recommend that Learning Connections should:

- *Continue the support and development of national and local networks and meetings,* such as the Adult Numeracy Network and the ICT and Literacies Network run by Learning Connections and an online adult numeracy forum. These networks provide support and enable tutors to share ideas and learn from one another. The tutors in this project should continue to be fully involved in these networks and supported to continue developing their knowledge and cascading it to colleagues in order to keep the momentum and energy for using ICT in adult numeracy teaching going.

4 Resources and materials

- *Create numeracy case studies* based on the action research tutors' programmes of study and build them into resources held on the ALO website to inspire and inform literacies tutors.
- *Produce a series of guides to good practice in using ICT in adult numeracy education in Scotland, featuring a variety of different approaches*, such as WebQuests, blogging, videoconferencing, mind mapping, using sound, spreadsheets, etc. written by project tutors and posted on the ALO website. Lessons learnt in the project can thereby be passed on to the wider adult literacies field.
- *A numeracy resource or teaching idea of the month* should be produced and publicised on the ALO website. This would raise the profile of numeracy and encourage the sharing of resources and ideas.
- *Make materials and activities developed in the project available in a variety of formats* (e.g., CD-ROMs as well as online posting on the ALO website, since not all literacies tutors are routinely able to go online).
- *Develop more freely available materials* using ICT for adult numeracy teaching, e.g., games and simulations.
- The Scottish Further Education Unit (SFEU) and Learning Connections should together explore the potential for greater collaboration with respect to planning, resources and training/CPD, including web forums and resource banks.
- *Develop an online community of literacies tutors and continue to disseminate information and resources* via the ALO website and the Learning Connections' e-newsletter and Adult Numeracy Network updates.

5 Research

- *Further action research at local level* should be facilitated through tutors cascading their work on this project to their colleagues, with support from partnerships.
- *Further ongoing research and development is needed on the use of new technologies with numeracy teaching* (this project does not claim to have covered the full range of what is available). Such technologies would include popular technologies such as games and simulations, new personal and home technologies, such as multi-functional mobile/handheld devices (for m-learning), interactive TV and emerging social software (Web 2.0). Research on these is needed not only in creating and updating materials for use in classrooms but also in developing the skills of tutors and learners to create their own artefacts to enhance learning.
- ICT offers exciting opportunities to take approaches to teaching adult numeracy further into the territory of Laurillard's categories of communicative, adaptive and productive media in interventions with learners. This project has laid the groundwork for such interventions. In particular, design research should be undertaken on:
  - effective models of the use of m-learning, digital TV and other new technologies
  - use of games and simulations in numeracy teaching and the possible development of new games suitable for adult numeracy learners
  - expressing numeracy: an investigation of the tools learners need to express their understanding of mathematics (through what Laurillard calls 'productive media').

1 Introduction

This is the final report of the action research and staff development project with adult literacies tutors entitled The Use of ICT in Adult Numeracy Teaching in Scotland, Phase 2. The project aimed to explore, extend and improve the use of ICT in adult numeracy teaching in Scotland in keeping with *Adult Literacy and Numeracy in Scotland* (ALNIS) (Scottish Executive, 2001) and *Adult Numeracy: Shifting the Focus* (Coben, 2005). The project was commissioned by Learning Connections, Communities Scotland[1] (henceforth Learning Connections). It was a collaboration between researchers in the Universities of London[2] and Edinburgh[3] working with adult literacies tutors with an interest and/or experience in using information and communication technology (ICT) for numeracy teaching; the project Development Officer was Sheena Morrison of Sheerface Ltd, a specialist education consultancy in Scotland[4]. The project was inspired by NRDC's Study of Effective Practice in ICT and Adult Literacy project in England (Mellar et al., 2007)[5] and ran in two phases: Phase 1, January–March 2005[6] and Phase 2, November 2005–December 2006; this report covers Phase 2.

Twenty-two tutors were recruited by Learning Connections and participated in Phase 2 of the project, designing and undertaking action research projects with learners in their groups or classes[7]. They worked in a range of community, voluntary sector, workplace and prison settings and in Scotland's Colleges. They varied greatly in the extent of their prior experience of using ICT in teaching. Some were using it for the first time in their teaching. Four tutors had participated in Phase 1 of the project and hence had some experience of the approach we were developing and of the possibilities of using ICT in adult numeracy teaching. This report should be read in conjunction with participating tutors' reports of their action research projects, available on the Adult Literacies Online (ALO)[8] website.

Alongside professional development, the project explored the following research questions:

- What uses of ICT can we identify and demonstrate to support adult numeracy learning?
- Do learners learn using ICT to support numeracy learning – if so are there particular operations or technologies that are more conducive to an integrated approach?

1 The Learning Connections website is at: www.lc.communitiesscotland.gov.uk. The project was run under the auspices of Prue Pullen, Daniel Sellers and Cath Smith of Learning Connections.
2 Professor Diana Coben and Dr Ian Stevenson of King's College London (www.kcl.ac.uk); Dr Harvey Mellar and Dr Maria Kambouri of the Institute of Education, University of London (www.ioe.ac.uk).
3 Dr Jim Crowther of the Department of Community Education and Nora Mogey of the Media and Learning Technology Service (MALTS), University of Edinburgh (www.ed.ac.uk).
4 Sheerface Ltd. (www.sheerface.co.uk).
5 One of five linked studies on effective teaching and learning carried out by the National Research and Development Centre for Adult Literacy and Numeracy (NRDC) in England between 2003–6. For more information on NRDC, see Glossary.
6 The report of Phase 1 is on the Learning Connections website at www.lc.communitiesscotland.gov.uk
7 The complete list of tutors who participated in all or part of the project, and their organisations, is given in Appendix 1.
8 Adult Literacies Online is a national online databank developed by Learning Connections. It is a single point of access for available resources, training and development, research and networking. There are three main sections: Learning Resources; Teacher Training; Research and Reports. The URL is www.aloscotland.com

- What are the contexts in which the learners live and work and how can these best be reflected in their numeracy programme?
- Does ICT add to the motivation, concentration and persistence of learners?
- Does it help us reach the 'harder to reach' learners?
- How should numeracy learning be assessed? Are current methods, e.g., through individual learning plans (ILPs) or through Scottish Qualification Authority (SQA) routes, effective, or are changes in the structure of assessments needed? Should ICT skills developed in a numeracy context be assessed – and if so, how?
- How may the training and support offered on this project best be extended to other numeracy tutors across Scotland to promote the effective use of ICT?

We addressed these questions by:

- supporting tutors to develop action research projects with and for adult learners, exploring the use of a wide variety of ICT
- promoting self-reflection
- sharing ideas and expertise through face-to-face meetings and online discussion
- providing staff development in the use of a range of technologies and their application to adult numeracy
- developing online and electronic media-based teaching and learning materials and guidance for tutors on using ICT in adult numeracy, based on their action research projects, for use in the wider adult numeracy field.

The project was interactive and practical and involved tutors developing and trying out new activities and approaches and reflecting on their use of ICT in numeracy. Work to develop their action research projects was negotiated with tutors, linked to their past experience, current practice and future possibilities.

At the start of the project each tutor completed a questionnaire (see Appendix 2). They then came together at seven one-day workshops held at the University of Edinburgh[9] to plan and report on work in progress on their action research projects and explore new approaches.

Between workshops, the tutors undertook action research in their workplaces with the support of the research team. They were encouraged to keep reflective diaries about their work in progress. Sheena Morrison, Development Officer for the project, visited tutors in their workplaces and met learners. She helped tutors to solve their ICT problems, provided one-to-one training and acted as a sounding board for tutors as they developed their ideas and planned their projects. She also helped tutors to access grants or other resources and collected evidence such as pictures and learning material from the action research projects, and interviewed learners during her visits.

In addition to the workshops, the tutors and the team also communicated online using WebCT[10], as well as by telephone and email. The tutors reflected on their experience and shared examples of ICT use in adult numeracy teaching. The project team also demonstrated ways in which ICT could be used with learners at a range of levels. All this material was available online on WebCT between the workshops, together with relevant articles and

9 The workshops were facilitated by Nora Mogey of MALTS, University of Edinburgh. They took place on 11 November and 2 December 2005, and 27 January, 3 March, 26 May, 18 August and 27 October 2006.
10 The project used WebCT Campus Edition 4, co-ordinated by MALTS, University of Edinburgh.

guidance on doing action research (see Appendix 3).

Work on the project was disseminated in various ways, including the publication of tutors' individual reports of their action research projects and the materials they produced on the ALO website, the publication of the project final report (this document) and presentations by tutors and the project team at various conferences in Scotland and further afield, including ALM13[11], SETT 2006[12], the 2006 International Literacy Day conference[13] and the Third National Adult Numeracy Seminar[14]. In addition, work on the project was disseminated through the Adult Numeracy Network, which includes a number of the tutors in this project. The Adult Numeracy Network meets regularly and contributes to the annual Learning Connections Numeracy Seminar. Also, a number of adult literacies partnerships have asked the Development Officer and the action researchers to present at their Literacies Conferences, thus cascading the work of the project to the wider adult literacies field.

11 ALM13 was the 13th international conference of Adults Learning Mathematics – A Research Forum (ALM), held at Queen's University Belfast in July 2006, see www.alm-online.org

12 The Scottish Learning Festival is the annual national educational conference and exhibition presented by Learning and Teaching Scotland and Emap, www.ltscotland.org.uk/sett. Previously known as the Scottish Education and Teaching with Technology (SETT) Conference.

13 The fourth national conference to mark International Literacy Day was held at the SECC in Glasgow on 8 September 2006. www.communitiesscotland.gov.uk

14 The Learning Connections Third National Numeracy Seminar was held at Stirling Management Centre on 6 December 2006.

2 Background

2.1 Why use ICT in adult numeracy teaching?

The case for using ICT to support adult learners in becoming more numerate has been summarised as follows in the Report of the Committee headed by Sir Claus Moser, *A Fresh Start: Improving literacy and numeracy*:

- ICT is a powerful tool to raise levels of literacy and numeracy
- Computers and multimedia software provide attractive ways of learning
- The web enables access to the best materials and the most exciting learning opportunities
- ICT offers a new start for adults returning to learning
- The internet and digital TV technology can reach into the home
- Learners who use ICT for basic skills double the value of their study time by acquiring two sets of skills at the same time.

(DfEE, 1999:7)

However, research in adult numeracy and ICT in England by Harvey Mellar and colleagues found very little effective ICT use in adult numeracy provision (Mellar, Kambouri, Sanderson, and Pavlou, 2004)[1]. They mapped teaching against a typology of approaches to integrating technology into adult basic education (Ginsburg, 1998)[2] and found that technology was most commonly used as a complement to instruction. A few classes taught applications such as spreadsheets, word-processing program or databases, regardless of learners' numeracy or literacy needs. A few encouraged group work and used a number of ICT tools to achieve language learning and communicative goals. ICT tended to be used either in the form of practice CD-ROMs or for highly individualised teaching, leaving learners waiting for help for protracted periods. From preliminary soundings for Phase 1 of the project, a similar situation pertained in Scotland.

In Phase 1 we found a great deal of interest amongst literacies tutors in using ICT in adult numeracy teaching and a strong commitment to developing resources and approaches but anxiety about the time and other resource implications of doing so. At the outset, most tutors reported using ICT in teaching numeracy as a delivery mechanism and as a complement to instruction. There was some evidence of movement towards using technology as an instructional tool. One of the most exciting benefits of the project lay in its providing tutors with the opportunity to exchange ideas with each other and develop their skills, both face-to-face at workshop meetings, but also through ongoing activity in emails and WebCT.

This was the starting point for our exploration of the possibilities for adult numeracy teaching and learning using ICT in Phase 2 of the project.

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1 This should not surprise us. A recent study in schools found that 'Although there has long been interest in the potential of computer-based tools and resources in school mathematics, their use has only recently become more established in mainstream practice' (Ruthven and Hennessy, 2002:47).

2 An account of Ginsburg's typology is given in Appendix 5.

Both phases of the project took place against the background of contemporary policy and practice in adult literacies in Scotland, so we turn next to a brief overview of this context.

2.2 The policy and practice context

The Scottish approach to adult literacies is set out in the ALNIS report (Scottish Executive, 2001)[3] and progress has been reported on in successive reports (Learning Connections, 2004, 2005b, 2006). The approach values the plurality of adult literacies, seeing them as rooted in social contexts, and builds on people's own literacies, relating to their lives and promoting the development of knowledge, skills and understanding of literacies. Literacies are defined in ALNIS as:

> The ability to read, write and use numeracy, to handle information, to express ideas and opinions, to make decisions and solve problems, as family members, workers, citizens and lifelong learners.
>
> (Scottish Executive, 2001)

The ALNIS report emphasised the need to maximise the potential of ICT in adult literacies provision in Scotland and called for 'a quality learning experience with strong emphasis on the role of ICT'. This was identified as one of the critical factors in the strategy's success.

Learning Connections was charged in ALNIS with undertaking the following tasks:

- to lead the development of e-learning in support of literacy and numeracy
- to explore new ways of learning and new modes of communication such as electronic mail, websites and interactive television
- to consider how to harness the fact that some people learn best online at times that suit them and to therefore encourage the use of this medium where appropriate for such learners
- to identify and disseminate information about online materials which develop literacies, including the creation of new materials where appropriate
- to look at how ICT can be used to make learning plans accessible, informative and easy to update for learners, practitioners and providers
- to explore the potential of e-learning as a means of widening access
- to include in the national training strategy, awareness of tutoring in an online environment.

(Scottish Executive, 2001:20)

Learning Connections (quoted in Coben, et al., 2005:6) identified a number of issues that needed to be addressed for this vision to be realised:

1 Access to ICT facilities is not uniform throughout the country.
2 Staff skills in using computers and other technological devices vary.
3 The quality of ICT software and resources vary.
4 Cost and organisational factors can sometimes restrict the use of ICT.

Learning Connections also suggested that ICT might be used as a tool to help adult learners

3 The Scottish Executive's Enterprise, Transport and Lifelong Learning Department (ETLLD) is refreshing ALNIS. Following consultation with stakeholders, a report containing recommendations and targets to drive forward the strategy to 2011 will be launched in early 2007.

in their literacy and numeracy learning and to help practitioners organise and support their learners, stating that:

> As the term 'ICT' highlights, using technology in learning is not simply about letting learners get the information they need electronically. It is also an effective way for them to communicate with other learners, with their tutor and with other people in their day-to-day lives. The term ICT embraces the concepts of 'e-learning' (electronic learning) and, a more recent development, 'm-learning[4]' (mobile learning).

A subsequent report for Learning Connections, *Adult Numeracy: Shifting the Focus* (Coben, 2005), sought to increase the emphasis on numeracy, since literacy tended to predominate within literacies. The report offered a working definition of adult numeracy to augment the ALNIS definition of literacies by indicating what it means to be numerate (to 'use numeracy', as ALNIS put it):

> To be numerate means to be competent, confident, and comfortable with one's judgements on *whether* to use mathematics in a particular situation and if so, *what* mathematics to use, *how* to do it, what *degree of accuracy* is appropriate, and *what the answer means* in relation to the context.
>
> (Coben, 2005:7)

This definition was adopted by the project team.

The *Shifting the Focus* report also noted 'The growing need and demand for numeracy skills, often involving ICT, in the workplace and elsewhere' (Coben, 2005:12) and recommended:

- guidance for tutors about adult numeracy resources (including ICT)
- encouragement of the integration of ICT into adult numeracy teaching, e.g., through the use of spreadsheets
- intervention studies in the use of ICT in teaching numeracy
- development of innovative tools to move closer to some of the fun of ICT in action.

The new Adult Literacy and Numeracy Curriculum Framework for Scotland, published in June 2005 and distributed through the partnerships, promotes the Scottish approach to adult literacies learning and teaching. It provides a broad national framework within which local literacies providers can offer a curriculum to meet particular needs. Learning Connections has led a systematic roll-out of the framework during 2005–06, aiming to embed the framework into local literacies training and practice across Scotland (Learning Connections, 2005a).

Other current initiatives in Scotland to encourage the development and maintenance of a community of practice of tutors using ICT in literacies learning and teaching include:

- An ICT and Adult Literacies Network for tutors and other practitioners in Scotland who are interested in using ICT with literacies learners. The Network communicates through an online

4 The Learning Connections website states that: 'After e-learning, m-learning is the next generation of information technology to be utilised in the learning process. It will allow learning to take place anytime, anywhere, according to the learner's needs, and in privacy. Using a mixture of text and audio, m-learning is delivered through hand-held devices such as palmtop computers and mobile phones.' See: www.lc.communitiesscotland.gov.uk, accessed 6 February 2007. See also Savill-Smith, Attewell and Stead (2006) *Mobile Learning in Practice. Piloting a mobile learning teachers' toolkit in further education colleges* (LSN).

discussion forum and four meetings per year.

- An Adult Numeracy Network, with meetings across Scotland.
- The 'Laptops and Literacies Learners' initiative – Learning Connections has provided each literacies partnership with a laptop computer and printer to help partnerships to explore and develop their use of ICT with adult literacies learners[5].
- The Innovations in ICT and Literacies project aimed to investigate and encourage the use of ICT with literacies learners (Learning Connections, 2005c)[6]. A conference to disseminate work from the third round of projects will be held in June 2007 at Stirling Management Centre.
- The 'ICT toolkit'[7], a collection of ideas, examples and approaches to help practitioners think through how they use ICT in the structure and delivery of their adult literacies programmes.
- The ICT training programme: a programme of workshops for tutors aimed at developing tutor skills and exploring ideas for using a range of ICT options with adult literacies learners. There are currently six workshops in the series:
  - Using digital cameras in adult literacies learning
  - Writing with computers
  - Using the internet in adult literacies learning
  - Creating electronic resources
  - Using ICT in adult numeracy
  - Using video with adult literacies learners.
- Adult Literacies Online (ALO) is building up an online Scottish resource which contributors can use and adapt and submit adapted resources so the collection grows and develops – sharing is key to its success. Materials from all the workshops mentioned above are in the training section of the ALO website.
- Numeracy is an equal part of the Curriculum Framework and the introduction of the interactive curriculum wheel (see Figure 1) on CD-ROM offers the chance for learners and tutors to use ICT while planning and reviewing their goals for numeracy learning.
- Numeracy energiser training, designed for experienced literacy tutors who feel less confident and competent in working on numeracy[8].
- Teaching qualification in adult literacies (TQAL), currently being piloted by a consortium of higher education institutions (HEIs)[9] in Scotland, has an equal focus on numeracy.
- ICT and adult numeracy – including the workshop 'Using ICT in adult numeracy' listed above and the project reported on here.
- New developments in 2007 include:
  - Numeracy for speakers of other languages (NSOL)[10]
  - Numeracy Skills Up Front[11], a healthcare numeracy project.

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5 See the Learning Connections website (www.lc.communitiesscotland.gov.uk) and also a handbook for practitioners on *Using Laptop Computers to Develop Basic Skills* (NRDC, 2003).

6 See: www.lc.communitiesscotland.gov.uk

7 The ICT toolkit: see the Learning Connections' website: www.lc.communitiesscotland.gov.uk

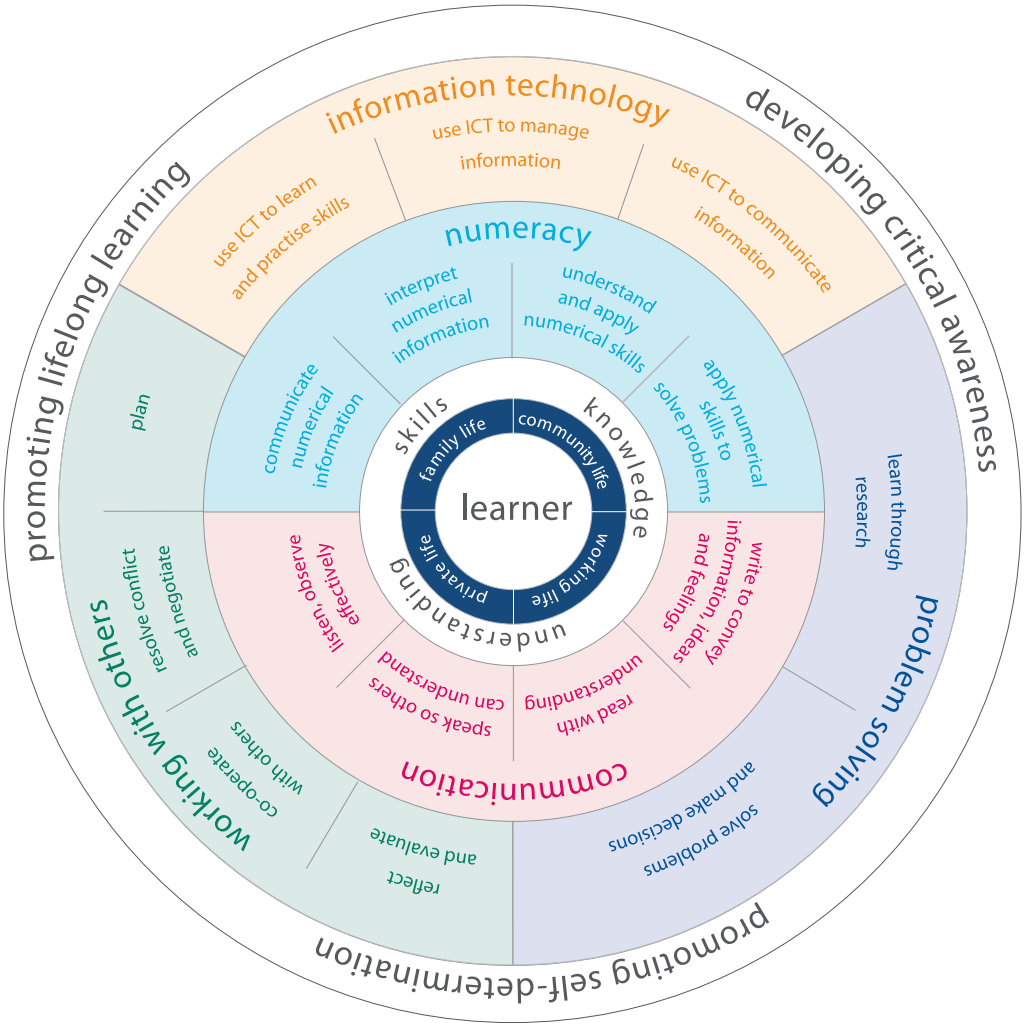
8 Numeracy energiser materials are online on www.aloscotland.com

9 The Pilot TQAL started in autumn 2006. It is run by the Scottish Consortium, led by Strathclyde University www.strath.ac.uk/Departments/CommunEdu/tqal/index.html

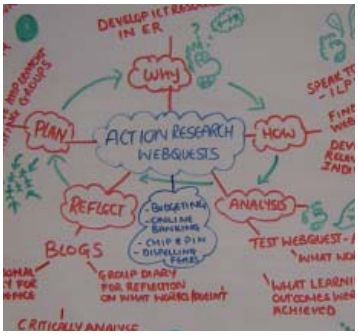
10 Learning Connections sent electronic questionnaires in August/September 2006 to members of the numeracy and English for speakers of other languages (ESOL) networks to ask how they perceive numeracy existing within ESOL and vice versa.

11 Numeracy Skills Up Front aims to enhance the numeracy skills of NHS Scotland staff, see www.nes.scot.nhs.uk/news/items/default.asp?id=298 (jointly funded by NHS Education Scotland and Learning Connections).

Figure 1 The adult literacies curriculum wheel (Learning Connections, 2005a:29)



3 The design of the project



Phase 2 of the project built on the foundations laid in Phase 1 in using a practitioner action research and staff development approach. Action research pursues action and research outcomes at the same time. Therefore, it has some components that resemble consultancy and some which resemble empirical research (Dick, 2000). In practitioner action research the identification of the problems and the solutions is essentially in the hands of the practitioners. Given the diversity of the literacies field, we felt that the practitioners – in this case, the literacies tutors – were best placed to develop projects geared to the needs and interests of the learners with whom they worked, and to develop their practice with guidance and support from the project team. This approach fits a tried and tested pattern of action research and staff development used with both child and adult learners. For example, the Computer-Based Modelling Across the Curriculum (CBMAC) project[1] and the Pupil Autonomy in Learning with Microcomputers (PALM) project[2] (Somekh, 1997) both used this approach.

The CBMAC project aimed to create resources and training materials to support the introduction of computer-based modelling in secondary school teaching (Stevenson and Hassell, 1994). As with this project, teachers were supported in developing activities and materials by a visiting project officer who worked with them in their own contexts. There were regular workshop meetings of all teachers to write materials and discuss issues that emerged. Two distinct types of training were undertaken: personal and professional. The teachers were keen to develop their personal skills in order to produce better teaching materials, which they did with support from the Development Officer. The acquisition of professional skills, which involved the integration of ICT into existing pedagogical practices, was more problematic. This involved modifying existing and often successful ways of teaching. It took a long time to accomplish – typically years rather than months – and had variable outcomes. As we shall see, a similar pattern was observed in this project, with tutors adapting their practice in a variety of ways to balance their personal circumstances, project priorities, belief in ICT and the need for change, institutional pressures, and numeracy and other curriculum requirements, while at the same time being very keen to acquire personal ICT skills.

Action research as a method of teacher development was also employed in the PALM project. PALM was a collaboration between secondary schools and higher education institutions (HEIs) in which pairs of teachers, supported by researchers from HEIs, used action research to identify issues in improving pupils' learning with digital technology. With a clear focus on pupils, teachers and researchers observed each others' practice and focused on changing their practice to maintain consistency and support learner autonomy with digital technologies

1 CBMAC was funded by the Technical and Vocational Educational Initiative (TVEI) 1989–92.
2 PALM was an action research project involving teachers in 30 schools, funded by the National Council for Educational Technology (NCET) in conjunction with Cambridgeshire, Essex and Norfolk Education Committees (1988–90). PALM aimed to test claims made for the role of computers in learning. See www.uea.ac.uk/care/research/palm.html

through collecting data, reflecting on the data and designing new approaches to teaching (Somekh, 1997; Stevenson and Hassell, 1994).

Recent NRDC[3] projects have used an action research approach with adult literacies learners, especially the Practitioner-Led Research Initiative (PLRI)[4] (Hamilton and Wilson, 2005) and the Study of Effective Practice in ICT and Adult Literacy[5] (Mellar et al., 2007).

The PLRI was a nationally co-ordinated series of small-scale practitioner-led research projects, running from 2004 until 2006, which aimed to: build research capacity in the field; embed the activities of NRDC in practice; undertake small-scale research projects which would contribute to NRDC's overall programmes; strengthen research networks linking practitioners, researchers and policy agencies. In her Afterword to the report on the first round of PLRI projects, Marina Niks remarks on the importance of practitioner research initiatives such as the PLRI in England and a similar initiative in Canada (Niks, Allan, Davies, McRae, and Nonesuch, 2003) in raising literacy practitioners' confidence and breaking down the isolation that many feel in their work (Hamilton and Wilson, 2005:108).

The Study of Effective Practice in ICT and Adult Literacy aimed to develop effective ICT-based teaching strategies through a series of trials using ICT with adult literacy, numeracy and ESOL learners with theoretically-grounded ICT task designs targeted at specific learning objectives. By generalisation from these effective teaching strategies the project also aimed to identify effective design guidelines for ICT-based teaching for adult literacy, numeracy and ESOL. The encouraging findings from the development phase of the project were that:

- tutors successfully modified their pedagogic skills, moving from a didactic style to a more participatory and collaborative model
- tutors became more adept at integrating ICT skills with specific literacy, numeracy and ESOL teaching
- tutors became more adept at recognising specific ICT and Skills for Life[6] learning outcomes
- the development process for the tutors, though time-consuming and resource-intensive, yielded sustainable changes in their practice.

These findings encouraged us to pursue similar aims for adult numeracy tutors in Scotland in this project. We were fortunate in being able to run a short pilot study (Phase 1) in January–March 2005 in which we tried out an action research and staff development approach with literacies tutors (Coben, Stevenson, Mellar, Kambouri, and Mogey, 2005). We subsequently adapted and refined our approach with a larger number of tutors in Phase 2.

3 NRDC was established by the Department for Education and Skills (DfES) as part of Skills for Life: the national strategy in England for improving adult literacy and numeracy skills; see www.nrdc.org.uk
4 The PLRI was a nationally co-ordinated series of small-scale practitioner-led research projects in three rounds, led by NRDC in England, 2004–06; see www.nrdc.org.uk/content.asp?CategoryID=512
5 See www.nrdc.org.uk/projects_details.asp?ProjectID=27&ProjectCategoryID=6
6 Information on Skills for Life can be found on www.dfes.gov.uk/readwriteplus

4 What happened in Phase 2?

Learning Connections advertised for adult literacies tutors to take part in Phase 2 and selected tutors on the basis of their enthusiasm, commitment and potential scope to develop the use of ICT in their numeracy teaching.

4.1 The tutors

The tutors completed an initial questionnaire (see Appendix 2) at the outset of the project on their current use of ICT in numeracy, how they saw the relationship between ICT and numeracy, what their aims were for using ICT and how ICT related to their work. Their responses revealed that they worked in range of contexts across Scotland, from teaching a set numeracy curriculum in a college environment, to workplace or community-based tutors who designed materials to suit individual learners' needs. Their experience and levels of ability in using ICT in their teaching varied considerably. Some had good desktop publishing skills and most had used the internet. However, few had experience of creating and embedding sound, downloading and using video, using photography or spreadsheets with learners, or creating hyperlinks[1] to images in their work; none had used software such as Hot Potatoes®[2] to create games.

At the outset of the project, thirteen tutors reported using ICT as a support to instruction by employing commercial packages, CD-ROMs or websites. They viewed ICT as having a range of uses, from providing learners with tools to support their own learning to being a means of reinforcing previously learnt material. ICT was also seen as a way of attracting 'hard to reach' learners. Tutors' views on what the project might bring ranged from one tutor who felt the need for 'real training' through to three tutors who felt they were competent in using ICT and teaching numeracy and saw the course as a chance to find out about new developments and technologies. Most wanted a mixture of training and access to resources, and hoped that ICT would provide solutions to their individual challenges in tutoring and teaching. Three tutors felt that the project would give them time to explore new materials and tools. Assessment was viewed in terms of ICT providing online testing with automatic marking and feedback to learners. Both formative and summative modes of assessment were identified in relation to either a formal curriculum such as SQA[3] Core Skills Numeracy, or to help in the diagnosis of individual learners' needs.

The tutors had in common an enthusiasm for using ICT. They were prepared to change their

1 A hyperlink is a reference or navigation element in a document to another section of the same document, another document, or a specified section of another document, that automatically brings the referred information to the user when the navigation element is selected by the user (see http://en.wikipedia.org/wiki/Hyperlink).
2 Hot Potatoes® is produced by Half Baked Software and can be downloaded from their site at www.halfbakedsoftware.com It can be used free of charge by educational establishments.
3 The Scottish Qualifications Authority (SQA) is an executive non-departmental public body (NDPB) sponsored by the Scottish Executive Education Department. It is the national body in Scotland responsible for the development, accreditation, assessment and certification of qualifications other than degrees. Further information is at www.sqa.org.uk

teaching practice by trying out new ways of doing things, reflecting, evaluating, sharing, learning and adapting their approach, and they volunteered their own time to participate in the project.

They differed in that they were from various settings across Scotland, working for a range of funders with different requirements in terms of learning outcomes (some accredited, others not). They also had different target audiences and were supporting different learners' needs. Their working conditions varied greatly: some were supported by a team while others worked in isolation. They had different levels of experience of designing learning programmes and they were delivering programmes of different types and duration, using different versions and qualities of technologies and facilities. They also had different levels of knowledge, experience and confidence in numeracy and research, and varying degrees of skills and confidence in using, manipulating and teaching with ICT.

4.2 The action research projects

With support from the project team, the tutors experimented with various forms of ICT in their numeracy teaching and developed individual action research projects with the learners in their groups. We tried to use technologies that tutors could access easily. Tutors tailored the use of ICT in their numeracy teaching to the perceived needs and interests of the learners with whom they worked. The following action research projects came to fruition[4]:

- ***Using Numbers in an Office*, Dot Butler, West Fife Enterprise Ltd.** This project aimed to enable learners to perform administrative office tasks involving numbers, and to follow written and verbal instructions using technology, especially sound.
- ***Home Energy Saving and Adult Literacy and Numeracy*, Ana Calixto, Edinburgh University Settlement Community Learning Centre**. This project aimed to: increase the numeracy and literacy skills of the participants while raising awareness about energy efficiency and affordable warmth; co-develop with the learners numeracy and literacy resources to aid understanding and gain practical skills in the area of energy saving in the home. Learners' self-stated goals included 'learning how to save energy at home', 'understanding how to read a gas/electricity bill' and 'revising and learning new numeracy skills'.
- ***Everyday Numeracy*, John Cameron, Adult Literacy and Numeracy Team, South Lanarkshire**. The main focus of this project was to introduce everyday numeracy, through ICT, to learners who had little or no previous experience of using ICT as a medium for learning. The intention was to renew enthusiasm for the learning process and show the importance of numeracy in everyday life. Learners were encouraged to use spreadsheets, word-processed documents, digital images and presentation software to interpret what numeracy meant to them. The project was intended to show the practical application of numeracy and ICT for distance learners, particularly those with previous bad experiences of numeracy teaching.
- ***Cooking and Numbers,* Nancy Craig, Dundee Council**. The aim of the project was to engage with learners and raise their awareness of links between numeracy, ICT and life skills and to encourage them to identify any numeracy skills they would like to improve.
- ***ICT and Numeracy Tutor Training*, Nancy Craig, Dundee Council**. This project aimed to provide literacy and numeracy tutors with access to a range of numeracy materials appropriate for use with adult learners to help them improve their numeracy skills.

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4 The tutors' reports on these projects and associated teaching and learning materials are available on the ALO website, www.aloscotland.com

- ***Financial Inclusion – An Intermediate One Numeracy Accreditation?*** **Marjorie Drew, Midlothian Adult Literacy and Numeracy Initiative (MALANI) in partnership with Jewel and Esk Valley College**. This project aimed to produce a contextualised ICT resource on financial inclusion that would both attract and retain adult numeracy learners. The project explored the following questions:
  - Can ICT be used to attract learners to numeracy courses on financial inclusion that historically have been badly attended, despite research showing a need for and an interest in these?
  - Can an ICT-based numeracy course on financial inclusion be used for SQA accreditation?
  - Will a contextualised ICT-based course on financial inclusion enhance the learning of numeracy?
- ***Politics and Numbers*****, Suzi Gibb and Louise Clark, Bethany Christian Trust, Edinburgh**. This project aimed to produce ICT and numeracy resources for 'hard to reach' learners. This included identifying political issues in the community which affect learners and basing numeracy and ICT tasks around these topics. In the past, learners tended to focus on improving their reading and writing and often did not see the relevance of numeracy work. The tutors described this as an 'invisible need' because learners may not realise the impact that numeracy has on their lives. They tried to overcome any lack of interest and fear of working with numbers by using numbers in a meaningful way.
- ***Blogging for Numeracy*****, Carol Gibbons, Clydebank College**. This project aimed to investigate the use of blogs in the teaching of Core Skills Numeracy in a college setting. It was hoped that blogging would motivate the students and enable them to see the relevance of numeracy to their vocational interests.
- ***Sums for Fun*****, Shirley Jones, Shetland College**. This project aimed to encourage the use of ICT in delivering numeracy through Family Learning, while giving families the confidence to work together, accessing resources to help their children with numeracy homework using computers.
- ***Show Garden*****, Zoe Kennedy and Joe Lennon, British Trust for Conservation Volunteers (BTCV), Scotland, Ayr**. This project aimed to explore the use of ICT and numeracy in garden design, encourage group discussion in numeracy learning inspired by ICT, and create a show garden for public display.
- ***Using ICT to Embed Numeracy into Workplace Learning,*** **Sheila Maher, Workers Educational Association (WEA), Inverness.** This project aimed to develop and deliver a new non-accredited numeracy course to workplace learners who have recently completed a ten-week basic ICT course.
- ***Introducing Vocationally Relevant Numeracy Blogs to the Classroom,*** **Kirsty Paterson, Angus College, Arbroath.** This project aimed to make numeracy learning more fun, to show learners that numeracy can be related to their vocational course and outside interests. It also aimed to allow the tutor to demonstrate that ICT and numeracy can be used successfully together, making the ICT learning more directed to learners' vocational interests but also directly related to the numeracy performance criteria to be delivered. Its final aim was to provide independent opportunities for learners to take more responsibility for their own learning.
- ***Can ICT Help to Make the Teaching of Numeracy More Vocationally Orientated?*** **Angela Smith, Dumfries and Galloway College.** This project aimed to discover whether ICT would make numeracy a more palatable subject for poorly motivated students and to develop vocationally-orientated ICT numeracy work through using WebQuests. It also aimed to develop a format which would increase learner-tutor interaction (as opposed to a self-teaching method for learners).
- ***Teleporting a Tutor*****, Owen Smith, Inverness College.** This project aimed to investigate the teaching of Numeracy at a distance using videoconferencing. The key problem being

addressed was the lack of a teacher at Intermediate Two numeracy and the lack of a learning support workshop for basic numeracy in Fort William. Technology was used to bridge the distance, adapting teaching methods where necessary.

- ***Understanding Electricity and Gas Bills,* Neil Sutherland, Fife Council.** This project aimed to create in community adult learners both an understanding of all aspects of bills for checking purposes and confidence in selecting or changing suppliers.
- ***Money Matters Behind Bars*, Trisha Tilly, Stirling Council/Cortonvale Prison**. This project aimed to produce a course of material for prisoners about handling money in real life situations while introducing as much ICT input as possible to provide variation and challenge, and to support motivation.

Several of the action research projects outlined above, including the Bethany Christian Trust project, adopted a critical perspective on numeracy, seeing numeracy as knowledge that empowers people for life in their societies, beyond the skills of daily life. In this perspective, numeracy is culturally based and socially constructed; it has economic, social, and political consequences. The implications for adult numeracy teaching may be summarised as follows: teaching is based on a commitment to social justice and the belief that everyone can do mathematics and everyone uses numeracy practices that may go unrecognised; literacy and numeracy are linked and contextualised; familiar contexts make mathematics more accessible for those who have been alienated from it. Such teaching, it is argued, helps learners to recognise the mathematical characteristics in everyday situations and develop more numerate ways of thinking, thus equipping them with knowledge and tools to examine and criticise the economic, political and social realities of their lives (Kerka, 1995).

4.3 Issues that arose during the project

The action research projects were the core of the project overall; they constituted the main activity of the project, alongside which the research team supported the tutors and analysed and reflected on data from the project in order to answer the research questions. Sometimes it seemed that practical issues to do with ICT were predominating over pedagogical issues to do with using ICT to teach numeracy. We were also concerned that in some instances ICT might be being used for its own sake, rather than because it offered anything particularly useful to the teaching of numeracy, and that the development and production of materials were predominating over the development of teaching approaches. At the project workshop on 26 May, the team attempted to address these concerns by posing the following questions with respect to each action research project under the heading 'Now you see it, now you don't... Where's the numeracy and where's the ICT in your project?':

- What is the learning problem that is being addressed in the action research project?
- How does ICT relate to that learning problem?
- Is ICT the problem?
- Is ICT being used to make numeracy more attractive/palatable, etc.?
- How does numeracy relate to the learning problem?
- How is the project addressing ICT and numeracy learning issues?
- How will anyone know if any learning has occurred as a result of the project?

These questions helped to focus all our minds on some of the complex issues in the relationship between ICT and numeracy teaching and learning that arose during the project. These are elaborated in the discussion of our research findings below, and they informed tutors' reports of their action research projects (see the ALO website).

4.4 Presenting the project to a wider audience

As noted above, work in progress on the project was presented at various conferences: the Scottish Learning Festival in June 2006; the 13th international conference of Adults Learning Mathematics – A Research Forum (ALM13) in Belfast in July 2006; the SETT Conference in September 2006; and the International Literacy Day Conference, also in September 2006.

The project culminated in the Third National Numeracy Seminar in December 2006. At that event, the project team worked with the tutors in presenting their projects to seminar participants and then came together as a panel to present their conclusions and to involve the participants in discussion of the way forward. Much interest was generated in the materials and approaches developed in the project[5].

4.5 Using WebCT to establish an online community of practice

The project attempted to establish an online community of practice in using ICT for adult numeracy teaching through the virtual learning environment (VLE) WebCT. Asynchronous discussion fora and simultaneous online CHAT[6] sessions were offered as a means to get together between meetings. Materials, web links and articles, together with notices of workshops, etc., were posted so that everyone could access them. WebCT thereby offered a virtual forum for the project – a way of keeping in touch and sharing ideas and electronic resources. As an ICT tool, it was appropriate to use it for a project involving the use of ICT. However, it was not the only way participants communicated with each other – for example, emails, faxes or phone calls and visits were all used.

In the event, WebCT had only limited success for a variety of reasons: tutors did not have continuous access to the internet, nor was this the norm in their organisations; the WebCT platform was not familiar to most tutors in the way that, for example, email now is and some actively disliked it (although at least one liked it very much); lack of 'traffic' on WebCT was disheartening to those who tried to use it to communicate with tutors and the team. However, for some things, such as acting as a shared repository of materials and putting experts in the hot seat (e.g., a JISC[7] legal expert on copyright issues), WebCT worked well.

Specific difficulties in using WebCT reported by tutors included:

- **technical** difficulties, such as: difficulty in accessing WebCT CHAT when at work because of firewalls; difficulty in downloading Java[8]; forgetting passwords; not having the ICT skills to enter and use the site – some tutors suggested we should have undertaken a full ICT skills audit at the start of the project, with training implemented as appropriate; instead we tried to meet training needs as they emerged;
- **time** difficulties: some tutors said they were too busy to look in WebCT regularly, they did not realise how much time they were expected to contribute to the project and hence had not planned for time to chat online;
- difficulties to do with the **organisation and content of the WebCT site**: some people could not

5 Materials, reports and other resources produced by the tutors may be found on the ALO website at www.aloscotland.com
6 The WebCT CHAT tool is a real-time communication tool.
7 The Joint Information Systems Committee (JISC) (www.jisc.ac.uk) is funded by higher education (HE)/further education (FE) funding councils and the Learning and Skills Council (LSC) to support the innovative application and use of ICT in UK further and higher education institutions.
8 Java is an object-oriented computer programming language.

find their work plans when they were moved; minutes and agendas did not always appear as expected; there was delay in responding to messages; little new information was added at various times; some people said they found it confusing following the threads of conversations in the discussion area; the CHAT room discussions were not sufficiently numeracy-focused.

The research team responded to these concerns to help tutors get the most out of the project. We recognised that it would be counter-productive if trying to use WebCT and finding it an unrewarding experience led to tutors feeling negative about ICT. We were reassured to be told that tutors felt their concerns had been heard and dealt with.

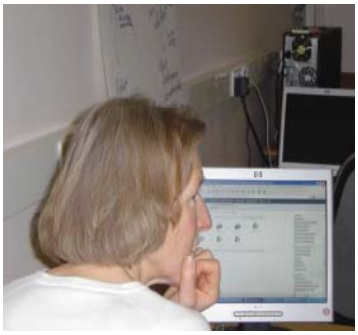
We hope that this project will prove to have contributed to the development of a community of practice in adult numeracy alongside and complementary to existing local, regional and national networks; time will tell.

4.6 Copyright issues

Various copyright issues arose during the project with respect both to the use and proper citation of other authors' work in resources produced on the project and to tutors' right to assert their own (rather than their employer's) authorship over resources produced on the project. The advice on the JISC Legal website[9] was a useful starting point for these discussions and we then invited Jason Campbell of the JISC Legal Department to respond to questions from the tutors in a WebCT discussion forum. The chief questions raised and Jason Campbell's replies are summarised in Appendix 4.

9 The JISC Legal website is at www.jisclegal.ac.uk/ipr/IntellectualProperty.htm

5 Findings and outcomes arising from the project



This project needs to be seen not only as a research project (what do we now know that we did not know before?) but also as a capacity enhancement project (what skills do tutors now have that they did not have before? how have their perspectives and teaching practices changed? what teaching materials do we now have? what organisational infrastructures have been put in place? what networks developed?). Accordingly, the findings and outcomes of the project are identified and discussed separately below, starting with a discussion of capacity enhancement in the project and followed by a reflective analysis of the findings of the project overall. However, in reality these two elements were integrated throughout the project. It should also be borne in mind that what is referred to here as 'the project' consisted of an overall project within which were nested the tutors' individual action research projects. Finally, the implications of work on the project for the wider adult numeracy and ICT research and practice communities, in Scotland and beyond, are considered and recommendations made.

5.1 The tutors: enhancing capacity through action research

The quality and diversity of the work developed through the tutors' action research projects and the tutors' increased skills and confidence in using ICT in their numeracy teaching amply demonstrate the benefits of an approach tailored to local circumstances and geared to enhancing tutors' capacity to use ICT to teach numeracy.

This is especially impressive given that the tutors' experience and training with respect to both numeracy and ICT varied greatly at the outset. Many initially expressed themselves as bound by regulations, rules and forms of assessment in ways which implied some lack of confidence in teaching numeracy, and some had a low level of ICT literacy. By the end of the project, all the tutors had expanded their ability to create new materials and modify existing materials to their local context (thus increasing their meaningfulness for learners) and overcome some of the literacy barriers to numeracy for their learners. All the tutors reported that ICT had enhanced their numeracy teaching and the action research projects reflected a wide range of topics geared to learners' interests. Experienced tutors explored new ways of integrating ICT into their numeracy teaching (including tutor training). Less experienced tutors became not only more skilled at using technology in their numeracy teaching, but more used to thinking in terms of technology and to seeing the technology in the world around them.

The tutors' innovations on the project included incorporating sound into worksheets (particularly valuable for ESOL and literacy learners), WebQuests[1], mind mapping® [2] and

1 See Glossary for a description of WebQuests.
2 The ALO website includes links to mind mapping software, including free, open source applications such as FreeMind. A

blogging[3], with imaginative use of software programs such as spreadsheets and word processing packages. These uses of ICT offered learners accessible, attractive and interactive resources and the opportunity to incorporate meaningful (often local or personal) content into their numeracy learning.

Creating and editing sound was easier than many tutors initially thought and this encouraged a creative approach to numeracy learning, for example, simulating an office administration task given as a message left on the telephone by a colleague, or simulating verbal instructions given on a construction site. By recording sound using free open source Audacity[4] software, downloaded from the internet onto a computer, tutors were able to record and edit sound and embed it into word-processed documents or spreadsheets, so making text available in a familiar accent to learners with limited reading ability.

Incorporating automatic responses such as conditional 'if statements'[5] into a spreadsheet allowed tutors to offer learners immediate feedback and praise, something which is often difficult to achieve in a busy classroom. This motivated learners and allowed them to gauge their progress instantly. It encouraged them to persist with their numeracy calculations and to seek out solutions with their peers if they had not found the correct answer.

Photography and video provoked collaboration and group discussion. Tutors reported that learners became more reflective and critical about numeracy and came up with different ways of recognising and dealing with numerical information displayed visually in their communities. Using images from the local environment helped learners to explore everyday numeracy. The aspects of numeracy featured in the photographs had a direct and often financial impact on their lives. This inspired their learning as they worked out the mathematics involved in, for example: the prohibitively high cost, for those on welfare benefits, of visiting local tourist attractions such as Edinburgh Castle; APR[6] rates on hire purchase deals for buying a TV; the cost of going out for a meal on a date (for instance, deciding whether to order the set meal in order to estimate the cost of the bill more accurately); going on a family holiday: considering what costs are left out of advertisements or what difference it may make whether the Pound Sterling is strong or weak in the destination country.

Using simple hyperlinks in learning or teaching resources created with word-processing, spreadsheets or presentation software programs or in blogs helped learners to get to their numeracy learning quickly. The tutor did not have to repeat the URL[7] for learners to transcribe and learners were able to go straight to the target webpage, thus making them more independent. Blogs provided extended hours of learning in a supportive environment outside the classroom.

Colour, pictures and design were important elements in all the work produced by the tutors. ICT helped to make the materials and activities they produced look professional and appealing. Tutors were able to adapt material created for children quickly and easily to give

list of mind mapping software is at: www.mind-mapping.org. The use of the term 'Mind Maps' is trademarked by The Buzan Organisation, Ltd. in the UK.

3 The term 'blog' is derived from 'Web log', meaning a user-generated journal style website, typically combining text, images and links to other blogs, web pages and other media related to its topic.

4 Audacity is free, open source software for recording and editing sounds. See http://audacity.sourceforge.net

5 See http://pubs.logicalexpressions.com/Pub0009/LPMArticle.asp?ID=225 for more on conditional statements in spreadsheets.

6 Annual Percentage Rate (APR) is an expression of the effective interest rate that will be paid on a loan. It facilitates calculation of the total cost of borrowing and makes it easier to compare lenders and loan options.

7 URL stands for Uniform Resource Locator, the global address of documents and other resources on the world wide web.

it a Scottish adult literacies feel, contextualised in relation to topics in which learners were interested.

Incorporating elements of 'fun numeracy' into sessions worked well. Activities such as playing the logic-based puzzle Sudoku online, completing a diet quiz, etc., energised learners and gave tutors an opportunity to relax and reflect on the learning going on in their classes.

Tutors found Hot Potatoes® software excellent for creating quick and easy interactive numeracy games which were Scottish, contextualised and had an adult rather than childish look. A number of tutors created electronic numeracy crosswords, number searches, multiple choice quizzes, filling the gaps and number matching exercises. These were further enhanced by the ability to link to the internet and to other documents or voice files stored on the computer.

Some last-minute changes to classes and groups caused logistical problems for the tutors concerned, who found it a rush each week to create learning and teaching resources. They had limited opportunity to reflect on their learning and adapt their teaching practice to find out what worked and what did not work with learners. Where tutors had not planned to sustain the learning or to re-run the course, knowledge was not effectively reported or cascaded and improvements were not implemented. However, the process of writing up their diaries and reports for the project encouraged tutors to reflect and take steps to adapt their teaching in response to changes in circumstances.

Marrying the technology with the numeracy was a complex matter. When designing a teaching idea or resource, some tutors started with a topic or issue in which learners had expressed an interest, then contextualised the numeracy to fit and finally looked for suitable ICT to facilitate this. Other tutors looked at a piece of technology and then considered what they could do with it. There were many successes when tutors came up with creative and offbeat numeracy teaching ideas that their learners loved. Using blogs with poorly-motivated learners raised their interest as well as self-esteem in being able not only to achieve numeracy results but also to communicate them to peers. Tutors and learners were creative in using digital cameras to bring into the classroom images of numbers and other numeracy concepts. WebQuests were very helpful in encouraging learners to go on to the internet and skim, scan and search for information and then analyse and manipulate it appropriately. This was particularly effective when the activity was real, e.g., organising travel on the internet, managing a budget wisely, or trying to find the best deal as a consumer of utilities.

Tutors enjoyed using ICT. It helped to energise their numeracy teaching practice, challenging them to apply their numeracy understanding to different situations and circumstances. ICT also allowed tutors to personalise resources in time-effective ways that are not always possible with pre-ICT print technology.

The tutors needed support to create their ideas and they wanted opportunities to discuss and reflect on their ideas and be given feedback on their efforts. Using ICT allowed them to create teaching and learning resources that they could share with their peers. Talking face-to-face and by phone and email with the project Development Officer and with each other and the research team at the workshops gave the tutors ideas and opportunities to share ways of expanding or enhancing their work. The Development Officer found that using the telephone to coach tutors in using ICT with numeracy learners worked well. Working and sending things back and forth by email also helped to make development a collaborative exercise in

which tutors learned to reflect, were challenged and saw evidence of progress. This helped tutors to develop confidence with ICT and numeracy problem-solving in a secure, helpful and constructive way.

Presenting a workshop at a conference was a daunting prospect for some of the tutors who had no experience of this: they had to raise their game and be seen as professionals able to receive praise and criticism. They also benefited from 'learning by teaching' through reflecting on their learning and seeing if their ideas worked. Making presentations to others allowed them to 'road test' their work, receive feedback, appreciate the value of their work and see where further improvements could be made.

The following examples give a flavour of some of the ways in which tutors developed their practice in their action research projects.

Example 1: A WebQuest about visiting local tourist attractions

Suzi Gibb, of Bethany Christian Trust, decided to create an activity on finding out about the costs of local tourist attractions in Edinburgh and whether these were affordable to learners receiving welfare benefits. She initially put together a word-processed document with a list of websites, but wanted to energise the material and make it more interactive and engaging for her learners. The Development Officer, Sheena Morrison, conducted a one-hour telephone coaching session and introduced Suzi to using spreadsheets with hyperlinks and boxes to complete with automatic feedback and to insert images with links to video. Suzi and her manager Louise Clark then worked together to create a vibrant WebQuest which included tasks, a clear process, guidance material and a specific conclusion. The learning and teaching material was emailed back and forth between Suzi and Sheena until the final product was produced and ready for use. Once used in practice, the activity needed further adjustments. For example, initially, when learners completed answer boxes, automated feedback told them if they were wrong before they had finished the calculation; this stopped them in their tracks. Suzi and Louise told Sheena they needed a formula which led the learner forward, something which 'said' 'you need to do this, then this and then this, before you know if it is right'. This entailed creating nested 'if' and 'and' statements on a spreadsheet[8], which Sheena trained the tutors to do. Suzi and Louise then updated the WebQuest and tried it out with other tutors before using it with learners.

Example 2: Bringing the outside into the classroom

John Cameron, of the Adult Literacy and Numeracy Team, South Lanarkshire, wanted to bring the outside world into his classroom. He tried this initially by taking laptops into the classroom but encountered a number of practical barriers: the laptops were not web-enabled; he was not allowed to install any CD-ROMs; and the laptops were all different models and running different software programs. John had limited experience of using ICT in his numeracy teaching so he and Sheena started with some ICT with which he was familiar: a digital camera. They took pictures of everyday numeracy in the community and then worked on learning how to view the pictures and download them so that John could play them as a slideshow. He then built activities around the photographs and used the photographs to stimulate discussion in the classroom around numeracy issues in the community.

Example 3: Working with an employer and employees

Sheila Maher of WEA, Inverness, developed a model of practice in workplace numeracy,

8 See for example, 'Using If Statements in Excel'. www.homeandlearn.co.uk/ME/mes7p1.html, accessed 10 February 2007.

building on the 'Big Plus for Business'[9] campaign, which pointed out the benefits of numeracy learning within the workplace, such as less time spent completing timesheets, better understanding of payslips, more accurate stock control, etc. She conducted a comprehensive training needs analysis with employees in their workplace and then fed back her recommendations to their employer. This opened up a dialogue with the employer about identifying the numeracy skills that would be most useful within the employees' roles. Sheila was then able to develop an effective programme of study to engage and motivate the learners.

Since the learners had no previous experience of formal adult learning activities and no school qualifications, the aims of the action research project were modest. Sheila focused on shapes and patterns, including estimating and sorting. The employees recognised that their numeracy learning needs had been incorporated into the training programme and that their employer had provided the time and space for them to develop. This helped to build trust and respect – a good basis for learning. The employer provided a break-away space within the organisation and this allowed for quick access, embedded a culture of learning within the organisation and ensured that attendance rates were high. Consistent and regular attendance helped the numeracy tutors to build up the knowledge, skills and understanding in a structured and effective manner. The course was non-accredited and Sheila was delighted that the learners participated in an OECD research project on formative assessment (OECD, 2005)[10].

Being part of the Phase 2 project provided Sheila with support for her action research intervention in the form of:

- resources, training and inspiration
- support to develop innovative ways of using ICT to deliver basic skills numeracy in workplaces where there was no internet access
- ideas to engage with groups of new adult learners in an enjoyable way
- group activities – being part of a team.

For Sheila, her learners and their employer the benefits of the project included:

- motivated learners whose numeracy had improved. By the end of the course the learners were working at around Access 2/3 level, e.g., they could add, subtract and estimate by eye reasonably accurately the quantities of goods in the factory. They had learned to use a calculator and how to play Sudoku in their tea break. They all wanted to learn new skills to advance into new areas of the factory's activities.
- better staff morale and improved skills (as identified by workplace managers/employers)
- good learner progression through continued workplace training
- the energy to work towards numeracy accreditation for courses in the Highlands and/or WEA
- the impetus to work towards developing a new numeracy group in the Highlands.

Example 4: Teaching numeracy at a distance using videoconferencing

Owen Smith, of Inverness College, found that videoconferencing worked well as a method of teaching numeracy. Videoconferencing gave students access to his skills and time to help

9 'The Big Plus for Business' offers employers the opportunity to support their employees in developing their skills in order to improve profitability and competitiveness for their businesses. www.thebigplus.com, accessed 10 February 2007.
10 The final report of this OECD project was published in Spring 2007 (Leavey, 2007).

them improve their numeracy. Sometimes their remoteness allowed him to let them 'get on with it' while he could see and hear what they were doing as they did their working out aloud. His experience reinforced his view that sound traditional teaching practice is needed to make good use of videoconferencing for numeracy learning. He found that he needed to plan his class in advance, including emailing worksheets to learners prior to the course date and ensuring that a telephone would be available in the videoconference room for back up if the technology broke down. He used different coloured worksheets to facilitate quick instructions, and arranged for the desks in the room to be positioned so that learners could walk freely around the room and give each other peer support. Owen found that using a document camera was more important than being able to see learners' faces. Learners needed to see worked examples and he needed to see their written work. He invented a type of mind map diagram to help learners to break down mathematical calculations and this greatly helped him, as the remote tutor, to understand the reasoning process each learner had used. He found that embedding quizzes, using tests, adding in assessments and providing an opportunity to practise all worked well. When learners handed in work to be marked, he marked it quickly and comprehensively; this helped to gain their trust and respect. He also found that having a good rapport with his class was important, with or without videoconferencing: he had to do as much to keep learners engaged and motivated as he would do when running a face-to-face class. He recognised that the learners were motivated to pass a mathematics exam within a short timeframe and wondered whether, if this method were used for non-certificated learning, one might not get such a strong commitment to using ICT.

5.2 Tutors' perspectives on the project

A year after the project started, tutors reflected on their experience of working on the project at the final workshop, held on 27 October 2006.

Factors which encouraged the use of ICT in numeracy

The tutors identified three key factors which encourage the use of ICT in adult numeracy, as follows:

Time to develop their skills and knowledge in order to use ICT critically

Many tutors either did not initially have the skills to use ICT or the time to find good software that could be used well. The project gave them much-needed time out from teaching for professional development in this important area. This included developing experience of different software packages, perhaps starting on a small scale with one or two activities. As their confidence grew, tutors wanted to use ICT more, and they valued the opportunity to swap information about interesting websites and activities between themselves. They recognised that they needed time to experience and play with ICT and felt they should be encouraged to widen their experience through demonstrations of uses of ICT, with time for exploration and practice. Management attitudes could either help or hinder this. Many tutors were employed on a sessional basis with no paid time for the development of teaching materials and skills. They had to manage their time to provide space for research and development, which 'usually means working after 10pm', as one tutor put it. The tutors felt that payment to engage in this kind of professional development work was vital.

Systematic training in personal ICT skills with examples of good practice

The tutors felt the need to be confident in using ICT: they said there was nothing worse

than standing in front of a class if you did not know what you were doing. They insisted that they must be trained in order to become confident and competent users of ICT. Most felt they did not normally have sufficient opportunity to undertake training and continuing professional development in the ICT skills and experience of software required to integrate ICT into numeracy teaching. They recognised that the process of professional change and development is long, complex and challenging, often involving tutors changing their basic philosophy and approach to teaching. They felt they needed personal support and guidance in learning new applications and teaching approaches and they welcomed the chance to learn from one another by example. They found that discussions and sharing ideas with colleagues encouraged them to try using ICT in their numeracy teaching. They stressed that training should be high quality and accessible locally, with effective support networks.

A variety of ICT resources with the opportunity to see what works and what does not
Rather than using ICT 'for the sake of it', tutors felt they needed a range of resources to respond to learners' interests and encourage them to make decisions on their own learning. They needed easy access to ICT resources and they recognised that they might need to modify materials to suit their learners' needs. Having resources and money available to buy new software was seen as important but tutors were often in cash-limited situations. Being able to borrow equipment or access a fund for numeracy resources[11] was useful, and knowing what to buy was important, so that money was not wasted.

What worked well for tutors in the project?
Two interconnected features of the project were mentioned by tutors as important: effective support and the opportunity to discover new topics, equipment and approaches. Many spoke of the vital role played by the Development Officer as a mentor and guide, motivating, providing resources, and helping to solve individual problems and enabling tutors to make changes to their teaching practices. Maintaining contact in between the workshop meetings in Edinburgh was an ongoing concern – both in terms of the research team keeping in touch with the tutors, and tutors keeping in touch with each other, given that they came from all over Scotland and only met face-to-face in the workshops. As discussed below, WebCT was one of the means by which we attempted to maintain contact, but while that met with mixed success, support from the project team, including having a Development Officer, was greatly appreciated. The tutors spoke very highly of the support they received from Sheena Morrison: one spoke for many when she said 'Without Sheena I would have fallen by the wayside a long time ago. She has been inspirational both with her support and all the resources she has found'.

The tutors also appreciated the fact that the workshops gave them the necessary time out from their everyday commitments to meet with others and learn about new applications and approaches. The collaboration this engendered between, for example, tutors in workplace learning and further education, worked very well, producing resources that could be used in either environment. Many tutors found the workshops, interaction with other tutors, and support from the Development Officer to be very useful for improving their skills at using ICT in adult numeracy teaching and giving them the opportunity to develop personal confidence and competence.

They were also looking for good teaching and learning material. For example, Shirley

11 Grants of £500 have recently been awarded by Learning Connections to 55 organisations to buy numeracy resources such as interactive games or electronic weighing scales.

Jones used her 'number boxes' containing a range of numeracy activities, WebQuests and mathematics puzzles with a group of adults with severe learning disabilities in Shetland. This went very well and she felt that the session moved the learners on, in particular, because the activity involved learners working individually instead of in a group, where she had found some would not participate until they were directly asked a question. Shirley had been inspired by materials produced by other tutors in the project, which she said had given her ideas about how to engage learners to address problems and gain some certification of their learning; she felt this encouraged them to progress. Another tutor, reflecting on her work on the project, thought she had concentrated too much on producing materials because she had to have a course up and running by the end of the project. She would have liked more opportunity to try out different hardware and software 'hands-on', rather than overviews of what was available.

5.3 Research findings – answers to the project research questions

What uses of ICT can we identify and demonstrate to support adult numeracy learning?
The uses of technology in tutors' action research projects included its motivational use to hold the learners' interest (in fact, many kinds of interactivity will help to do this, not only those involving the use of ICT) while they practise their skills. Some websites were identified which had interesting numeracy activities and many more put numeracy activities into a meaningful context (e.g., gardening or checking utility bills) for particular groups of learners. ICT was also used to 'see' numeracy in a modern real-world context (this is the start of a process that could lead to rethinking what numeracy is in the information age), e.g., seeing what the ICT and numeracy demands are in ordering a train ticket online rather than in buying it at the station. ICT was also used for communication and enabled remote teaching (e.g., a video link for a tutor based far from his learners).

The tutors relished the opportunity to discover new topics, equipment and approaches and they identified a range of activities and technologies that they found useful to support numeracy learning. They experimented with sound and graphics in their materials and used mobile phones, iPods and digital cameras to support their teaching. They developed games and quizzes and used commonly available applications such as word-processing programs, spreadsheets, online shopping, blogs, WebQuests and topic-specific websites. Tutors developed interactive worksheets using sound and speech to text facilities and learners accessed websites to obtain and compare information, or practise skills online.

Blogging, mind mapping software, personal USB sticks for learners and WebQuests were all new to the tutors in terms of their application to numeracy teaching. Blogging was popular because it saved time in linking directly to suitable websites and, importantly, the relevant point within the website. USB sticks gave learners a sense of personal control and enabled them to share ideas easily with their fellow students and to transfer work onto other computers if they wished. WebQuests enabled learners to engage in structured activities that made use of ICT in a new and interesting way. All these helped tutors to tailor the numeracy work to learners' needs and enabled more learner-centred approaches to be developed. ICT helped to build learners' confidence since they were engaged and could work at their own pace in a private manner.

In some projects, such as those run by Neil Sutherland and Suzi Gibb, learners responded well to automated responses created by inputting simple 'if' statements into a spreadsheet,

giving them the encouragement and confidence required to go on to the next question. Learners were keen to find the solution and often worked with their peers voluntarily to correct numeracy work. Other projects, such as that by Trisha Tilly, created games using Hot Potatoes® software to provide variety to the learning experience and reinforce numeracy covered in conventional 'chalk and talk' teaching. These gave an added sparkle to the learning experience in a prison environment where the internet was not available.

Digital photographs taken in the local community (e.g., of sale prices in shop windows, deals in local restaurants, opening times of public buildings, the cost of entry to local amenities) provided visually stimulating material for learning which was familiar to learners, and put it in context with a financial or other impact on their community, public or private life.

Learners' awareness of energy consumption developed through learning how to read meters and keep an energy diary (in Neil Sutherland's project). Others discovered how expensive it was to visit local tourist attractions (in Suzi Gibb's project). Ana Calixto took learners with low levels of literacies 'by the hand', showing them how to create their own materials for the classroom and giving them confidence in their ability to gain numeracy skills.

Two tutors who developed projects using sound, Dot Butler and Angela Smith, felt that this added an important new dimension to their work. Dot and Angela took only a couple of hours to master the mechanics of Audacity, a simple resource downloaded from the web which adds sound to a file. They then experimented in their own separate contexts with the resource. Sound provided an additional way to provide instructions to learners struggling with reading. Oral instructions also simulated the way instructions were communicated in real life situations, especially in the work environment.

Although the tutors recognised that ICT is more than just computers, almost all the action research projects involved desktop or laptop computers[12]. It would be useful to explore further the use of games machines, interactive television and mobile learning. So-called 'serious games' may be worth exploring for possible application in adult numeracy[13].

Do adult learners learn using ICT to support numeracy learning – if so, are there particular operations or technologies that are more conducive to an integrated (ICT and numeracy) approach?

Evidence from the projects suggests that learners do learn using ICT to support numeracy teaching. Different learners need different approaches and ICT gave tutors the flexibility to adapt materials to suit their learners. Tutors said that learners valued the instant responses and feedback that ICT applications gave and that this helped them to develop transferable skills. They believed the success of their action research projects lay in their ability to develop their teaching approaches. ICT also helped to put numeracy in context for learners, particularly on vocational courses, and in some cases tutors thought ICT had improved learner retention and attendance rates. Tutors also valued the flexibility that ICT gave them to adapt materials to the needs of individual learners. An integrated approach, with technologies and numeracy combined, seemed to work well. It is also important to remember that learning happens when we do not do things, as well as when we do: constant stimulus can impede learning; quiet times are also necessary. Tutors need to choose when, whether and how to

12 This finding should be compared with that of the NRDC effective practice in ICT project (Mellar et al, 2007). A guide for practitioners, following on from that project, will be published later in 2007.

13 'Serious games' are video and computer games whose primary purpose is other than entertainment. See www.socialimpactgames.com/index.php

use ICT to support learning and there was evidence of this happening in the project.

What are the contexts in which the learners live and work and how can these best be reflected in their numeracy programme?

A striking feature of the tutors who participated in the project was the wide variety of work contexts and types of numeracy that they engaged in and the variety of different types of learners with whom they worked. Learners included: young adults studying full-time and part-time in Scotland's Colleges; employees in the workplace; prisoners about to be released into the community; low income earners, many working part-time; unemployed people; homeless people; primary carers; and those incapacitated in some way. Many wanted to develop their basic numeracy to help children with their homework, while others were learning in or for the workplace, or simply out of interest.

The contexts in which the learners lived and worked were represented by the wide range of topics through which tutors used ICT to support numeracy. These included: staying healthy; reading and understanding bills; numeracy for 'life skills'; and budgeting on low incomes. In prison 'Money matters to me' software was useable in a context where few materials were available, since learners in prisons in Scotland are not allowed internet access. Numeracy is also defined in different ways in different settings depending on the learner's context and purpose for learning, ranging from those skills specified in a formal curriculum (e.g., SQA Core Skills Numeracy), through learners' personal needs, to those skills needed in a workplace and specified by an employer.

Does ICT add to the motivation, concentration and persistence of learners?

There is some evidence from the project that ICT does add to the motivation, concentration and persistence of learners, mainly through aligning examples of use with learners' interests, but also through the support that judicious use of ICT offers for practice and giving feedback. Several tutors reported that ICT helped learners' motivation, concentration and persistence. Their students continued their work at home and asked for website addresses so that they could continue their web searches on their own. Self-directed learning proved to be invaluable to adult learners who had returned to education with low self-esteem and low confidence in their ability to learn new things.

Does ICT help us reach the 'harder to reach' learners?

Tutors interpreted the term 'harder to reach' in different ways and this shaped the way that they viewed the role of ICT. For example, some differentiated between young learners, learners lacking in self-confidence and those turned off by school numeracy. Young learners included some who may not have found numeracy interesting in school, but who were attracted by the chance to use ICT. Lack of self-confidence or fear prevents some people from starting courses, since numeracy may invoke strong reactions of avoidance. Using ICT to teach numeracy can help to motivate learners since they are interested in the new skills which ICT brings, and may find it easier to say they are going to learn about computers rather than that they lack numeracy skills. This was the case for one learner who when asked why he was attending the Centre replied it was 'for computing' as he did not want to be thought of as stupid. Different formats offered by ICT helped those turned off by school numeracy; for example, quizzes, games and simulations were attractive to learners less inclined to study using worksheets or books. ICT can reduce the reading content so that it is attractive to those who prefer a more pictorial approach or who find reading difficult. However, some 'harder to reach' learners want personal attention. They need to feel welcome and valued. ICT can be a barrier to personal interaction and the tutor needs to be careful that this does not happen.

Although a number of tutors stated that ICT was a 'hook' by which they attracted learners, there was little firm evidence in the project that ICT really helped to engage the 'harder to reach' learners, or that it encouraged people who would not otherwise have attended a course to do so, or that technology made courses available to learners who could not physically access centres. However, Owen Smith's action research project showed that ICT can bring a tutor to learners in remote rural areas, and the blogs in Carol Gibbons' and Kirsty Paterson's projects provided out-of-hours learning and access outwith the classroom.

Using ICT to teach numeracy was seen by some tutors as a way of bridging the 'digital divide': the gap between those with regular, effective access to digital technologies and those without (DTI, 2000; EC, 2000; Scottish Executive, 2006). The digital divide runs along generational, class and economic lines: younger and more affluent people are likely to have grown up using, trusting and relying upon certain kinds of technology; ICT is part of their culture (Oblinger and Oblinger, 2005). Older and poorer people are less likely to be immersed in ICT in their daily lives and also more likely to be in need of the support offered by adult literacies classes. Learners and tutors with different degrees and kinds of ICT experience responded in different ways to the challenge of using ICT in numeracy teaching and learning. Some tutors were inexperienced in the use of ICT, not only in their teaching but in their daily lives, while others were quite at home with ICT, even if they were not accustomed to using it in their numeracy teaching. The same was true for learners: some were familiar with various kinds of ICT (including some who were sophisticated users, multitasking between ICT activities), others were not; none were accustomed to using ICT to learn numeracy. Recent research on brain function has shown that different kinds of experience condition the brain in different ways: learning specific tasks brings about localised changes in the areas of the brain appropriate to the task (Bransford, Brown, and Cocking, 1999; OECD, 2002; Prensky, 2001). Those with experience of ICT may learn better using ICT for exploration and interaction, as a study of university students in the USA found (Hartman, Moskal, and Dziuban, 2005).

Tutors in our study aimed to democratise the use of ICT through their numeracy teaching, making both numeracy and ICT learning available to mixed groups of learners, including those on the 'wrong' side of the digital divide. Creating interesting, stimulating and authentic learning tasks suitable for such heterogeneous groups of learners is extremely challenging, especially when tutors themselves may be inexperienced in using ICT.

How should numeracy learning be assessed? Are current methods – e.g., through ILPs or through SQA routes – effective, or are changes in the structure of assessments needed? Should ICT skills developed in a numeracy context be assessed – and if so, how?

The diverse purposes for which learners were studying and the requirements of funders both had a major bearing on the nature of the assessment of their learning, including whether it was formally assessed at all. Some learners were developing their skills in or for the workplace and needed a certificate to prove that they had reached a certain standard. Others were studying for personal reasons, such as to improve their ability to handle a household budget. Whether they wanted or needed accreditation varied accordingly.

There was a range of views on the relationship between assessment of ICT and numeracy skills amongst tutors. Some wanted integrated assessment of numeracy and ICT, while others wanted to separate the assessment of the two. This tended to reflect tutors' perceptions of the different needs of their learners and the formal or informal nature of tuition. Some tutors had developed programmes around the needs of individual learners or those of stakeholders such as employers and felt that formal assessment was not appropriate.

Marjorie Drew led the way in getting her material accredited by the SQA. This encouraged a number of other tutors in their action research projects, such as Money Matters to Me (Trisha Tilly), Sheila Maher's workplace project and Neil Sutherland's project on Understanding Electricity and Gas Bills, to consider this route for the future.

Opinions on *how* ICT and numeracy should be assessed also varied, with tutors finding ILPs useful for numeracy if they were regularly reviewed. They recognised that since, for a variety of reasons, learners often attend classes irregularly, ILPs may be neglected. An electronic ILP (EILP) has been developed by Sharon McNamara at North Ayrshire Adult Literacies Partnership. This includes the capacity to personalise the EILP, by, for example, embedding a learner's favourite song so that it plays while they update their EILP. The EILP also includes sound files created by the learners reflecting on their learning with photographs and links to their work, unlike a conventional paper-based ILP. Checklists for ICT were also suggested, coupled with learners' self-assessments. The introduction of the CD-ROM-based Interactive Curriculum Wheel[14] may also encourage numeracy tutors to plan their work with learners in a more dynamic and interactive way.

How may the training and support offered on this project best be extended to other numeracy tutors across Scotland to promote the effective use of ICT?

The model of support developed in this project worked well on the whole but would clearly be too expensive to be continued indefinitely. Tutors particularly valued having a Development Officer visiting and helping them to extend and develop their ICT skills and numeracy teaching approaches and to create new numeracy materials. With respect to the workshops, some tutors wanted more overviews of what ICT was available and some wanted more training on specific ICT packages and their uses for teaching numeracy. It would seem that a judicious mix of training, support and networking at local and national levels would offer the most effective and cost-efficient way forward and such an approach is outlined in Chapter 6, Issues and recommendations. Its success should be measured in terms of any longer-term changes in adult numeracy practice and learner achievement in Scotland which may stem from the project.

5.4 Reflections and analysis

The project was intended to give tutors the chance to explore issues and approaches in using ICT in teaching numeracy, as well as enabling them to produce some exciting new materials. As noted above, the research team often wondered if we had got the balance right – were materials predominating over teaching approaches and was ICT predominating over numeracy?

In order to explore these issues, we mapped the uses of technology in tutors' action research projects against relevant analytic frameworks.

As in Phase 1, we found some evidence of tutors moving from using ICT primarily as a complement to instruction, as a delivery mechanism and a means of achieving language learning and communicative goals, towards also using technology as an instructional tool (Ginsburg, 1998)[15].

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14 The interactive (CD-based) Curriculum Framework Interactive Wheel was piloted by Learning Connections with literacies tutors in autumn 2006. It will be evaluated and amended for distribution in 2007. See: www.lc.communitiesscotland.gov.uk

15 For an account of Ginsburg's typology of technology use in adult basic skills, see Appendix 5.

In analysing the outcomes of Phase 2, we also used Diana Laurillard's framework for the effective use of educational technology[16] which distinguishes between five different types of media in terms of their purposes for learning and teaching:

1 narrative media (for attending and apprehending)
2 interactive media (for investigating and exploring)
3 adaptive media (for experimenting and practising)
4 communicative media (for discussing and debating)
5 productive media (for articulating and expressing)

We found that the main types of technologies in use in the project were narrative and interactive media, with some exploration of communicative media, for example, for distance teaching. Tutors were asked to map their own use of technologies onto these categories, and Marjorie Drew pointed out that the classifications should be considered with respect to both the use of relevant ICT and the experience of learning numeracy – that is, she interpreted the categories as categories of learning and teaching activities, rather than categories of media (since in Laurillard's work these categories of media had been derived from a categorisation of teaching strategies, this deconstruction of the concepts is easily understood). Marjorie considered the activities within her action research project to be in Laurillard's category 2 (interactive media) on both counts, since the aim of her WebQuest was to encourage learners to investigate the internet, as well as to explore different ways of displaying numerical information. It was also exploratory in pedagogical terms, since no two learners would come to the same conclusions when completing their WebQuests.

By contrast, we saw little evidence of the use of adaptive or productive media. Why was this so and should we be concerned? Adaptive media (for experimenting and practising) include such software as games and simulations. However, much of what is presently available is aimed at children (i.e., the content may be suitable but the presentation is not) or undergraduates (i.e., the presentation may be acceptable but the content tends to be too complex). New forms of games, simulations and modelling tools are needed for an adult literacies audience. Re-using and adapting other people's complex learning objects for a new user base is difficult and challenging, especially since numeracy teaching and resources are often inextricably linked with literacy, and numeracy learning objects frequently demand a high level of literacy skill. Productive media (for articulating and expressing) are media in which the learner builds something (e.g., develops games). These are geared towards modelling or encouraging learners to create their own hypermedia. It is likely that most tutors would need training before they could support learners to use media in this way.

The low use of adaptive or productive media in the project is not surprising, given that this is hardly unique to the literacies context: Laurillard (2002:161) comments on the relative lack of exploitation of the productive capabilities of electronic media in teaching and learning generally. The narrow range of types of ICT media used (in Laurillard's terms) could also be explained by the fact that we were asking tutors to integrate ICT into an existing, largely 'paper-and-pencil' curriculum, rather than exploiting the wider range of skills, processes and activities that ICT makes possible.

The outcomes in this project could be understood as the result of tutors in very diverse situations adapting ICT to suit their particular contexts, abilities and experience, and

16 For a more detailed account of Laurillard's classification of media, see Appendix 6.

balancing the use of ICT against other pressures, in particular those of time and money and their own capabilities as numeracy tutors attempting to introduce ICT into their teaching. Many of the tutors in the project were not initially confident in their own ICT skills. In this they were probably typical, as very few people have the combination of time and technical skill required to create or adapt complex ICT learning objects such as simulations or games. We could not have expected the tutors to do this within this project, even less could we expect learners to produce or critique materials or approaches from an informed position.

Overall, the use of ICT appeared to be dominated by tutors' existing approaches to teaching numeracy: ICT failed to dent the mould. We should not be surprised at this. This finding concurs with Ruthven's and Hennessy's in their study of the use of ICT in mathematics teaching in secondary schools in England. They found that:

> [the] 'DNA of classroom life' determines in large part the form of classroom teaching and learning, inhibiting the uptake of successive generations of new information and communication technologies, and shaping such use as does occur so as to fit established practice (Cuban, 1986).
>
> (Ruthven and Hennessy, 2002:86)

Ruthven and Hennessy point out that this has become more evident as immediate constraints, such as the limited availability of technology, are diminishing, so that

> a more fundamental gap is emerging between the conceptions of teaching, learning and thinking guiding the development of pioneering computer-based learning environments, and those underpinning the traditional professional knowledge of teachers, contributing to the slow and uneven pace with which such technologies are being incorporated into everyday practices of mathematics education (Balacheff and Kaput, 1996).
>
> (Ruthven and Hennessy, 2002:86)

Adult education lags behind schooling in terms of the adoption of new technologies so we might expect that the pace would be even more slow and uneven here.

In any case, innovation is risky from the perspective of the person introducing it, and most practitioner-led innovations are inevitably incremental rather than radical in nature. Indeed, change may be more lasting and effective if it *is* incremental, so long as it is well adapted to the context in and for which it was developed. This is the strength of the action research approach: its specificity, its rootedness in local conditions, its flexibility and sensitivity to the capabilities of the protagonists. It offers a model for exploratory practice rather than a 'one size fits all' template. Tutors can only start from their own home ground and their established approaches to tutoring: they must 'dig where they stand' (Lindqvist, 1978).

Action research has limitations when the intended changes are too far ahead of the present skills of the staff involved and there were times during the project when the research team wondered if a more interventionist stance might have been more appropriate. If we had intended to develop specific new practices in the use of ICT in adult numeracy teaching we would have needed to adopt a different approach, such as design research (Design-Based Research Collective, 2003; van den Akker, Gravemeijer, McKenney, and Nieveen, 2006). Design-based research aims to solve current real-world problems by designing and enacting interventions while extending theories and refining design principles. The identification of

situations in which to intervene arises initially from theoretical concepts which are tested through implementing them in designs which are then evaluated. Both design and theory are mutually developed through the design research process. We chose action research rather than design research because we wanted to 'let a thousand flowers bloom' rather than produce fewer 'hothouse blooms' that might not survive in the open ground of Scottish adult literacies provision. To put it another way, we wanted to bring about change geared to local circumstances rather than test theory or solve a specific real-world problem *per se,* but we recognise that a different approach would have produced different outcomes. We think design research may be appropriate in the next stage of development as it would facilitate targeted interventions geared to specific aspects of the use of ICT in adult numeracy in Scotland which we have identified in this project.

The question of whether the development of materials predominated over the development of teaching approaches in the project is a moot point, as is the question of whether ICT concerns predominated over those of numeracy. Certainly, a wide range of materials was produced, breaking new ground for the tutors concerned. One of the purposes of using ICT is to make things – in this case materials – and it does this very well. The materials produced in the project tended to take the form of learning resources for learners to complete. The tutors tended to adopt a structured approach, scaffolding learning in a sequential way so that learners tackled one element before moving on to the next. Learners were well supported – sometimes, perhaps, too well supported. For example, some tutors produced resources with set answers and outcomes. While getting the answer right provided positive reinforcement of learning, a more open, less sequential approach might have encouraged learners to become more autonomous, to think creatively and collaborate with each other in order to 'see through to the numeracy' in a situation. If we agree that

> To be numerate means to be competent, confident, and comfortable with one's judgements on *whether* to use mathematics in a particular situation and if so, *what* mathematics to use, *how* to do it, what *degree of accuracy* is appropriate, and *what the answer means* in relation to the context.
>
> (Coben, 2005:7)

then we must find ways of encouraging learners to exercise their judgement, not just equip them with the skills to tackle problems from which decision-making has been stripped out[17]. Such an approach is embodied in Malcolm Swan's work (Swan, 2005, 2006), which informs the 'Improving Learning in Mathematics' approach currently being disseminated through the NCETM[18]. This approach is being tested with respect to adult numeracy learners in England in Thinking Through Mathematics, part of NRDC's Maths4Life[19] project, and could usefully be tried in Scotland.

Ruthven and Hennessy's study hints at the emergence of 'a gradual mechanism whereby teachers initially view technology through the lens of their established practice, and employ it accordingly' (Ruthven and Hennessy, 2003:87). However, they note that even at this stage,

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17 These tutors were not alone in using ICT in this way. A national survey of elementary and secondary level teachers in the USA found that the predominant use of computers in teaching mathematics was to provide practice of skills (Becker, Ravitz, and Wong, 1999:13, cited in Ruthven and Hennessy, 2003:48).

18 The National Centre for Excellence in Teaching Mathematics (NCETM) in England is a major initiative funded by the DfES to enhance professional development for mathematics teachers, established in response to the recommendations of ACME (Advisory Committee on Mathematics Education) and those made in Professor Adrian Smith's report 'Making Mathematics Count' (Smith, 2004). www.ncetm.org.uk

19 Maths4Life is an England-based project which aims to encourage effective numeracy and mathematics education programmes for adults across the UK. See www.maths4life.org. The final report of the Thinking Through Mathematics project will be published in 2007.

shifts in practice may result, and we have evidence of this in our project, as the examples cited above indicate. There are grounds for hope that the use of ICT may facilitate a more open, investigatory approach to teaching numeracy and mathematics. For example, teachers in Ruthven and Hennessy's study suggested that the use of technology made investigations a more viable option, particularly with lower-attaining pupils. Their comment resonates with our findings:

> So while, in one sense, such use of technology was simply assisting teachers to realise an established form of practice, what is significant is that it was enabling them to employ this practice more effectively and extensively. At the same time, however, this and other ways of using technology were giving rise to unanticipated phenomena, such as tinkering by students, which were leading teachers to start to reconsider aspects of their practice. This resonates with a pattern of 'cautious adoption' (Kerr, 1991) in which technology figures in teachers' thinking about their practice as a contributory, but subsidiary, factor. As well as serving as a 'lever' through which teachers seek to make established practice more effective, technology appears also to act as a 'fulcrum' for some degree of reorientation of practice, and a measured development of teachers' pedagogical thinking.
>
> (Ruthven and Hennessy, 2002:87)

ICT offers exciting opportunities to take such approaches to teaching adult numeracy further into the territory of Laurillard's categories of communicative, adaptive and productive media in interventions with learners. This project has laid the groundwork for such interventions.

We need also to be aware of changes in the technologies available. Three approaches that are already in use in adult numeracy teaching and are likely to relate more to people's everyday lives than the use of standard desktop (or laptop) computers, are: commercial gaming formats such as learndirect's[20] Max Trax game; interactive digital TV, e.g., Kickstart TV[21]; and mobile technologies used for m-learning[22]. Even newer technologies, for example, social software[23] and the rise of Web 2.0[24], present the next challenge to the harnessing of technology for adult numeracy teaching.

Technological changes outside the classroom also present new challenges. Learners and tutors are faced with emerging technologies which alter numeracy practices, such as: self-service cashier points; top-up mobile phone facilities at cash points; using a mobile phone to pay for car parking; booking cinema tickets online; sorting out a travel schedule, including booking seating and paying for tickets, baggage allowance and insurance online; using chip and pin identification when paying by credit or debit card; the phenomenon of free publication on the web through blogging, MySpace[25] etc. All these technological innovations involve new social relationships and hence new literacies; they demand from tutors a new qualitative awareness of numeracy issues.

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20 learndirect offers online courses in computers, office skills, self-development, mathematics and English: see www.learndirect.co.uk/courses

21 See the presentation at: ferl.becta.org.uk/content_files/ferl/pages/news_events/events/2004/november/workshop_presentations/C9.ppt. See also Taylor, Traxler and Attewell (2006) *Interactive Digital TV for Learning: The Kickstart TV pilot project* (LSN).

22 M-learning involves using mobile technologies such as mobile phones, PDAs, pocket PCs and the internet to enhance the learning experience. See www.m-learning.org

23 Software that enables people to collaborate via computer-mediated communication; see: http://en.wikipedia.org/wiki/Social_software

24 Web 2.0 refers to second generation internet-based services that emphasise online collaboration and sharing among users (O'Reilly, 2005).

25 MySpace is an online community to which anyone aged 14 or over can sign up, free. www.myspace.com

Other social changes are relevant here: for example, demographic changes, such as an increase in migrant workers, refugees and asylum seekers in Scotland, mean that numeracy teaching needs to cater for more ESOL learners. ICT can help in many ways, not least through the use of sound and the availability of representations of 'realia' (objects or activities used to relate classroom teaching to real life) in English and language translation sites on the web. The population is also ageing: ICT can enable tutors and learners to customise teaching and learning materials and devise activities geared to the interests, needs and capabilities of older people. It can also cater for those of all ages with, for example, impairment of hearing or sight, and, through communication at a distance, provide learning opportunities for those who are housebound or who live in isolated parts of the country.

Against this background, the aim of this project was to explore, extend and improve the use of ICT in adult numeracy teaching in Scotland. The quality and diversity of the work developed through the tutors' action research projects amply demonstrate the benefits of an approach tailored to local circumstances and geared to enhancing tutors' capacity to use ICT to teach numeracy. Together, ICT and numeracy can and do make a whole that is greater than the sum of the parts. The project has made an impressive start but more remains to be done. The final section of this report presents our recommendations to carry this work forward.

6 Issues and recommendations

First of all, the lessons of this project should be disseminated, as is already happening, for example, through conference presentations by the tutors and the research team, through tutors cascading their work to their colleagues in the adult literacies partnerships, and through the publication of this report and the associated action research reports and teaching and learning materials. But dissemination alone is not enough. It is also important that the project outcomes are adapted to suit local circumstances by literacies practitioners across Scotland. That requires support for tutors who, like many of the project participants at the outset, are unsure of the potential of ICT for developing their numeracy teaching. The tutors involved in the project should be actively encouraged to become ambassadors for new and exciting developments in adult numeracy work, carrying forward the work begun in this project and sharing it with others.

A range of strategies for further development is suggested here, some of which are already underway. These recommendations are addressed to Learning Connections, to adult literacies partnerships and their managers and to literacies tutors. The aim is to build on progress made in the project and promote the use of ICT in numeracy learning and teaching throughout Scotland through:

1 Training and continuing professional development

- *Provide training and continuing professional development (CPD) in a variety of formats,* including: roadshows; local, practical workshops geared to different levels of ability, varied to suit local contexts; regular face-to-face meetings; project participants 'cascading' experiences in their own area; mentors to support tutors.
- *Provide institutional and financial support for tutors providing and undertaking professional development.* Both release time and additional payment were mentioned by tutors as important ways of supporting professional development.
- *Encourage the appointment of ICT and Numeracy Champions* to promote tutors' confidence and provide support within partnerships for literacies tutors to develop their use of ICT in numeracy, including email and telephone support, since ICT coaching can be undertaken remotely.
- *Encourage collaborative numeracy learning*, e.g., through dissemination in Scotland of the findings of the Thinking Through Mathematics project in Maths4Life (www.maths4life.org) in England.
- *Showcase and cascade the work of the action research projects* at national literacies conferences and locally, through partnerships, including hands-on learning using ICT.

2 Planning

- *Partnership co-ordinators should be encouraged to consider the findings of this report and to consider how this work might be cascaded, implemented and further developed.*
- *Specify numeracy clearly in reporting mechanisms:* Partnerships should be asked to tell ETLLD how they are promoting numeracy to their tutors, including through the use of ICT.

3 Networking

We hope that this project will prove to have contributed to the development of a community of practice in adult numeracy alongside and complementary to existing local, regional and national networks. We recommend that Learning Connections should:

- *Continue the support and development of national and local networks and meetings,* such as the Adult Numeracy Network and the ICT and Literacies Network run by Learning Connections and an online adult numeracy forum. These networks provide support and enable tutors to share ideas and learn from one another. The tutors in this project should continue to be fully involved in these networks and be supported to continue developing their knowledge and cascading it to colleagues, in order to keep the momentum and energy for using ICT in adult numeracy teaching going.

4 Resources and materials

- *Create numeracy case studies* based on the action research tutors' programmes of study and build them into resources held on the ALO website to inspire and inform literacies tutors.
- *Produce a series of guides to good practice in using ICT in adult numeracy education in Scotland, featuring a variety of different approaches*, such as WebQuests, blogging, videoconferencing, mind mapping, using sound, spreadsheets, etc. written by project tutors and posted on the ALO website. Lessons learnt in the project can thereby be passed on to the wider adult literacies field.
- *A numeracy resource or teaching idea of the month* should be produced and publicised on the ALO website. This would raise the profile of numeracy and encourage the sharing of resources and ideas.
- *Make materials and activities developed in the project available in a variety of formats* (e.g., CD-ROMs as well as online posting on the ALO website, since not all literacies tutors are routinely able to go online).
- *Develop more freely-available materials* using ICT for adult numeracy teaching, e.g., games and simulations.
- The Scottish Further Education Unit (SFEU) and Learning Connections should together explore the potential for greater collaboration with respect to planning, resources and training/CPD, including web fora and resource banks.
- *Develop an online community of literacies tutors and continue to disseminate information and resources* via the ALO website, the Learning Connections e-newsletter and Adult Numeracy Network updates.

5 Research

- *Further action research at local level* should be facilitated through tutors cascading their work on this project to their colleagues, with support from partnerships.
- *Further ongoing research and development is needed on the use of new technologies with numeracy teaching* (this project does not claim to have covered the full range of what is available). These would include popular technologies such as games and simulations, new personal and home technologies, such as multi-functional mobile/handheld devices (for m-learning), interactive TV and emerging social software (Web 2.0). Research on these is needed not only in creating and updating materials for use in classrooms but also in developing the skills of tutors and learners to create their own artefacts to enhance learning.
- ICT offers exciting opportunities to take approaches to teaching adult numeracy further into the territory of *Laurillard's categories of communicative, adaptive and productive media in interventions with learners*. This project has laid the groundwork for such interventions. In particular, design research should be undertaken on:
  - effective models of the use of m-learning, digital TV and other new technologies
  - the use of games and simulations in numeracy teaching and the possible development of new games suitable for adult numeracy learners
  - expressing numeracy: an investigation of the tools learners need to express their understanding of mathematics through what Laurillard calls 'productive media'.

Appendix 1:

Full list of tutors who participated in the project

Tutor	Organisation
Dot Butler	West Fife Enterprise Ltd.
Ana Calixto*	Edinburgh University Settlement Community Learning Centre
John Cameron and Darragh Hare	Adult Literacy and Numeracy Team, South Lanarkshire
Nancy Craig*	Dundee Council
Marjorie Drew*	Midlothian Adult Literacy and Numeracy Initiative (MALANI) in partnership with Jewel and Esk Valley College
Mark Frith	Inverclyde Adult Literacies Partnership
Suzi Gibb, Louise Clark* and Ruth Burton	Bethany Christian Trust, Edinburgh
Carol Gibbons	Clydebank College
Shirley Jones	Shetland College
Zoe Kennedy and Joe Lennon	British Trust for Conservation Volunteers (BTCV), Scotland, Ayr
Sheila Maher	Workers' Educational Association (WEA), Inverness
Kirsty Paterson	Angus College, Arbroath
Angela Smith	Dumfries and Galloway College
Owen Smith	Inverness College
Donna Stafford	Community Learning – Adult Literacies, Barrhead, East Renfrewshire
Neil Sutherland	Fife Council, Education Services
Trisha Tilly	Stirling Council/Cortonvale Prison
David Watson	Anniesland College, Glasgow

* These tutors also participated in Phase 1 of the project.

Appendix 2:
Introduction and questionnaire issued to project participants

A warm welcome to 'The Use of ICT in Adult Numeracy Teaching in Scotland: Phase 2'.

This outline is intended to give you some basic information about the project. It also includes a questionnaire – please complete and return this before 11 November. Thanks.

What is the project?

'The Use of ICT in Adult Numeracy Teaching in Scotland: Phase 2' is an action research and staff development project commissioned by Learning Connections, Communities Scotland, under the auspices of Prue Pullen, and organised by researchers from the Universities of London and Edinburgh.

Phase 2 builds on the Phase 1 project which ran from January to March 2005. The project report for the Phase 1 project is on the Communities Scotland website at: www.communitiesscotland.gov.uk/stellent/ groups/public/documents/webpages/lccs_011083.pdf

We are delighted that some of those who participated in the Phase 1 project are also participating in Phase 2.

Who is it for?

The project is for adult literacies tutors with an interest and/or experience in using ICT for numeracy teaching.

The project team consists of:
Diana Coben, King's College London (Project Co-Director)
Jim Crowther, University of Edinburgh
Maria Kambouri, Institute of Education, University of London
Harvey Mellar, Institute of Education, University of London
Nora Mogey, MALTS, University of Edinburgh
Sheena Morrison, Sheerface Ltd. (Development Officer)
Ian Stevenson, King's College London (Project Co-Director)

The overall aim of the project is:

- To explore, extend and improve the use of ICT in adult numeracy teaching in Scotland.

We shall do this by:

- supporting you to develop action research projects with and for the adult numeracy learners with whom you work, exploring the use of a wide variety of ICT
- promoting self-reflection
- developing the sharing of ideas and expertise through face-to-face meetings and online

- providing staff development in the use of a range of technologies and their application to adult numeracy
- developing online and electronic media-based teaching and learning materials and guidance for tutors on using ICT in adult numeracy, based on your action research projects, for use in the wider adult numeracy field.

What does the project involve?

The project comprises eight face-to-face meetings at the University of Edinburgh, with online activity between these sessions using WebCT. The online activity will be co-ordinated by MALTS, the Media and Learning Technology Service, University of Edinburgh, and facilitated by members of the team. **You should already have received information about how to log on to the website. If you have not received this information, please contact Nora Mogey** (nora.mogey@ed.ac.uk).

The project will be interactive and practical and involve reflection on your present and/or future use of ICT in numeracy work in an adult literacies context. There will be opportunities to situate your use of ICT in adult numeracy teaching in relation to various research-based models of engagement with ICT and approaches to teaching, drawing on your own experience and existing examples of ICT use in adult numeracy.

Online activity will be negotiated with tutors, linked to your past experience, current practice and future possibilities in relation to teaching adult numeracy using ICT.

You will be asked to reflect on your past experience and to collect and analyse instances of any particularly interesting examples of ICT use in adult numeracy teaching (successful or unsuccessful; your own or someone else's). We shall also look at examples from schools where these are relevant.

We shall produce a project report setting out the findings of the project, including key issues, proposals for further research and development, including staff development, and examples of innovative or particularly interesting practice in adult numeracy teaching using ICT developed in the project.

The venue

Exhibition Room
Wolfson Suite
Main University Library
George Square
Edinburgh EH8

Map: http://www.ed.ac.uk/maps/central-area/
Photo: http://www.ed.ac.uk/buildings/mainlibrary.html

The Library is building number 33 on the map. Please note the 'paid parking' on this map at Crichton Street NO LONGER exists. We strongly suggest you use public transport in preference to parking.

The library is about a ten-minute walk from Waverley train station. If this is problematic for you, please contact Nora Mogey (nora.mogey@ed.ac.uk) and she will try to help.

When you arrive, please give your name at the Porters' desk and they will let you in.

Dates

The dates of the eight one-day face-to-face sessions (all Fridays) are:

- 2005: 11 November; 2 December;
- 2006: 27 January; 3 March; 26 May; 23 June[1]; 27 October; Third National Numeracy Seminar, 6 December.

Times (tea/coffee and lunch are provided)

9.30am coffee, for 10.00am start
12.30pm lunch
2.30pm tea
4.00pm depart

QUESTIONNAIRE – for session 1: Friday 11 November

Please complete the following questionnaire and come prepared to describe your use of, or interest in, ICT in adult numeracy.

If possible, please bring with you a scheme of work, or notes describing a recent session in which you have used ICT to teach numeracy.

You may be asked to make a brief presentation to the group in one of the sessions.

The questionnaire

1 Are you currently using ICT in your numeracy teaching?
   a If so:
      i what ICT are you using?
      ii how are you using ICT in your teaching?
         - to support you in achieving numeracy goals?
         - to teach numeracy (e.g., using an intelligent tutoring system to teach numeracy)?
         - is ICT the main focus of your teaching, with numeracy a subsidiary element?
      iii how do you know if you're succeeding in your use of ICT in numeracy teaching?
   b If not, why not?
      i Would you use ICT if it were available?
      ii What ICT, if any, do you think would be most useful for adult numeracy teaching?
2 What are you trying to achieve in terms of numeracy learning?
3 What are you trying to achieve in terms of ICT learning?

1 The June workshop was moved to 18 August at the request of the tutors.

4 What do you think teaching is and how do you conceive of yourself as a tutor of adult numeracy?
5 What experience do you have of ICT in your life beyond teaching? How do you see the ICT demands of the workplace and the ICT demands of everyday life?
6 What do you consider is, or should be, the relationship between ICT and adult numeracy teaching?
7 How do you consider that ICT skills in a numeracy context and/or numeracy skills in an ICT context should be assessed?
8 What training and support would enable you to make use, or make better use, of ICT in your adult numeracy teaching?
9 What resources are you aware of that would help you to make use, or make better use, of ICT in your adult numeracy teaching?
10 How is ICT being used in adult literacy teaching in your area?

Please post your response on WebCT as soon as possible.

Thank you very much. We look forward to working with you.

Diana Coben, for the project team
November 2005

Appendix 3:
Action research – guidance for tutors

Useful articles

Dick, B. (2000) A beginner's guide to action research [online], available at www.scu.edu.au/schools/gcm/ar/arp/guide.html

Wadsworth, Y. (1998) What is Participatory Action Research? In: Action Research International, Paper 2. Available online: www.scu.edu.au/schools/gcm/ar/ari/p-ywadsworth98.html

Examples of exercises used to guide tutors' action research projects

Please respond to the following questions by putting messages on WebCT in the topic 'Action Research':

- What are you planning to do with your group by way of action research (AR) on using ICT to teach numeracy?
- Please describe your group, including number of learners, focus and level of group, time and place, etc. (Please be as specific as possible).
- Do you need any help to get started? If so, how can we help you?

Appendix 4:
Copyright issues (questions by tutors and answers by Jason Campbell of the JISC Legal Department)

What is covered by copyright?

Whilst it is clear that most text, video and audio resources are covered by copyright, tutors had a number of queries about specific resources.

What about clip art?

More or less anything created originally has copyright protection. The good news is that many clip art licences are quite wide. For example, see http://office.microsoft.com/en-gb/FX100750911033.aspx for the Microsoft online clip art (media elements) licence.

What about information from government websites?

This will depend on the licence (permission) granted by the copyright holder. Look for a 'copyright' link from the government website in question. Some government information is available under Crown copyright – more on this at www.opsi.gov.uk/advice/crown-copyright/copyright-guidance/re-use-of-crown-copyright-extracts.htm

What about links to a website?

There can be an issue if you try to pass off the material on the other website as your own, or you 'deep-link'. Deep-linking is where you bypass important parts of another's website through linking. In particular, bypassing brand identity, advertising, or legal notices, is likely to be a problem. For example, putting a link into the 'printer friendly' version of a *Guardian* news story into a web page frame, surrounded by my own brand image, is likely to cause trouble.

Are you allowed to copy a resource and then name it as reference?

It'll depend on whether you have been given permission to copy it. Copying without permission is copyright infringement whether you acknowledge or not. Referencing might mitigate the amount of damages a court might award, but not necessarily.

If you adapt something and acknowledge the source (e.g., adapted from) is this still breaching copyright?

The basic answer is yes, for more details see the previous answer.

What are the intellectual property with regards to a contribution and how this is affected by copyright?

In simple terms, if a contributor's part is distinct (i.e., you can point to it and say 'Jason wrote that!'), the contributor has copyright in that part only, and can give permission individually for that part to be used. Where contributors collaborate such that no part can be specifically identified with them, they are joint copyright owners of the whole. Unless the contributors have delegated their authority to someone (or to each other), someone wanting permission to use the materials will need to get all the contributors' permissions in this case.

If material purchased by an organisation states it can be photocopied but is instead retyped, can it be incorporated into a published report or circulated to other organisations on the internet?

Probably not. The question is always whether you have been given the permission to do what you want to do. If the licence says you can photocopy, then that's all you can do. If I desire, I could specify that you can only photocopy my materials on Mondays, whilst you are wearing pink. In law, the copyright holder is free to choose his or her conditions of use. Circulating to other organisations on the internet is likely to be a more serious infringement. The user is always free to go back and ask for further permissions, and that might be best practice here.

If material used in the creation of our learning and teaching material has been retyped and slightly adapted from material that is under copyright, will this get around the issue?

No. It will still be under copyright. Adaptations of work can only be made with the copyright holder's permission, so making an unauthorised adaptation will be an infringement in itself. However, there is no copyright in ideas, only in expression, so you can (legally) 'borrow' someone else's ideas, as long as you can express them in your own language. I'll leave you to ponder the morality of passing the ideas off as your own!

If material we have used for creating our learning and teaching resources has breached copyright, what action is the copyright holder likely to take?

It very much depends on who it is, and what their business is. Some copyright holders will just be glad to see their material used (e.g., some academics). Some might just want you to stop using the material until you comply with their conditions of licence. At the more risky end, some might want back royalties. For example, I know that a major image gallery has been asking infringing UK colleges for £1,800 in back royalties for unlicensed use of their images. Clearly, the risk of a big bill is higher where material is taken from a commercial materials provider.

Does working for local authority (LA) community services raise any different copyright problems to that of higher education or Scotland's Colleges?

The differences between working for an LA rather than being employed by one of Scotland's Colleges or an HE establishment will primarily concern the availability of licences which allow certain activities (some of these are only available to Scotland's Colleges or HE establishments), and the availability of education-specific statutory copyright exceptions.

The interesting question is finding out which licences the LA holds. Often, licences are paid for, then left in desk drawers or filing cabinets. It's a case of asking around (corporate

office, legal department, etc.), and getting the issue raised. You might even be praised for pointing out that licences are being paid for without publicising their availability within your organisation!

If I do not have a contract can I still use materials owned by or licensed by the LA?

It is likely that there is an 'implied licence'. Given all the circumstances, it would be reasonable to say that the LA allows (implicitly) you to use their materials for you to fulfil your work. There may be some cases where this isn't the case (e.g., the LA materials in question are marked 'not for release', or 'confidential'), but for most LA-produced material, it's likely to be okay.

How should we reference copyright material? Can we state on our learning and teaching material that 'every effort has been made to contact copyright holders of material used in the creation of our learning and teaching material and that if any have been overlooked, we will be pleased to make any necessary arrangements'?

It is probably a good idea to do this, but it should be noted that it's fairly irrelevant from a legal point of view. If you copy material without the copyright owner's permission, it's still likely to be infringement, whether the owner is 'findable' or not.

Is there a standard way of acknowledging copyright?

No, unless the copyright owner lays down a particular format or content as part of copyright permission. Where the law requires acknowledgement to be given, the acknowledgement should give the title of the work and the name of the author (not the copyright holder). The test as to whether the acknowledgement is sufficient is whether it conveys 'to a reasonably alert member of the relevant audience that the identified person is the author' (from Pro Sieben Media v Carlton UK TV, 1999).

How should copyright be acknowledged for non-text elements e.g. video or sound extracts?

Make sure a reasonably alert person would see the acknowledgement. This could be text accompanying a link, or it could be incorporated into the multimedia element (e.g., text which appears on a video, or an oral acknowledgement in an audio file).

Who owns the copyright for my work?

Under s.11 of the Copyright, Designs and Patents Act 1988, materials produced in the course of employment belong to the employer, unless there is an agreement otherwise. So, if a tutor writes materials as part of their employment, copyright belongs to the organisation. If a tutor brings in materials written outwith the course of employment, copyright will stay with the tutor, unless there's an agreement otherwise. If there is an agreement between a tutor and an organisation that copyright in materials produced will remain with the tutor, that's valid. This sort of agreement needs to be in writing, and signed by the parties, but no particular legal language is required.

Where a tutor produces materials outwith an institution, the copyright will first vest in the author (the tutor). However, if there is a valid, written contract that provides for the assignment (assignation in Scotland) of those materials to the employer, that will be binding provided it is sufficiently certain.

If, as a sessionally-paid tutor, I have no written contract with the Local Authority, does that mean I hold the copyright for all I produce?

Not quite. You are still working under a contract, albeit unwritten. The question will be whether you are producing the materials in order to meet what's required of your employment. If so, by virtue of s.11 of the Copyright, Designs and Patents Act 1988, copyright in what you produce will belong to the LA.

If we were to make our materials available to others under Creative Commons what would this imply?

In legal terms, letting someone else use the material you've created is giving them a 'licence'. You can either write one from scratch stating what can and can't be done with your materials, or you can use a general one, such as Creative Commons. Creative Commons is likely to get popular in the near future, as it's being added in to Microsoft Office. You'll be able to specify that the stuff you are word processing is available to others under the Creative Commons licence, for example.

The Creative Commons licence comes in various 'flavours', depending on:

- whether you want to allow others to modify your work
- whether you want to allow commercial use of your work
- whether you want others to be able to license on your work under the same conditions (known as 'share-alike')

There is always an obligation to acknowledge the author of the work (known as 'attribution' under the Creative Commons licences).

For more information, see the Creative Commons website at http://creativecommons.org/worldwide/uk/ for England and Wales, and http://creativecommons.org/worldwide/scotland/ for Scotland.

However, if a person wishes to allow any use with attribution, a statement such as 'You may use these materials as you wish, subject to acknowledgement of authorship and source' will do it, without going near any more complex licence.

Appendix 5:

Ginsburg's classification of approaches to the use of technology within adult basic skills education

Technology as curriculum

From the perspective of maximizing the acquisition of information about and competence in using specific technology applications, a curriculum focused on the computer and its applications might be desirable. Components of such a curriculum include keyboarding skills, database manipulation, spreadsheet use, word processing, desktop and Internet publishing, and Internet search skills. Hands-on opportunities to develop a comfort level with the various applications and discussions about the kinds of tasks that might be best managed with each application would provide a basis for using the technology in the various situations in which it is appropriate.

(Ginsburg, 1998:37)

Technology as delivery mechanism

Another way that technology can be used in an adult education environment is as an instructional delivery mechanism. Individualized learning systems (ILS) have been designed to provide instruction and practice in each of the subskills that together forms an entire curriculum. Following an initial placement test, each learner is placed at the particular point in the sequence of programmed lessons that is appropriate for him so he does not have to work at tasks that have already been mastered and will not be given tasks for which he does not display prerequisite knowledge. Each learner's progress is tracked within the system so that a learner can return to the same subskill level at which she was working when she stopped using the system. In addition, the learner is unable to progress from one subskill to another without first achieving some predetermined level of mastery. Individual learners' progress through the series of activities can be reported to an instructor as well as to the learner.

(Ginsburg 1998:38)

Technology as complement to instruction

Some adult education programs conduct traditional classes for adult learners but also make available opportunities for learners to use computers to practice skills addressed in class or extend learning. In some settings the instructor assigns a learner to work on a particular piece of educational software that targets a weak or undeveloped skill area; in other settings, a number of software programs are available and learners can explore and use whatever interests them. Additionally, applications software such as word processing programs or spreadsheets may be available.

(Ginsburg 1998:39-40)

Technology as instructional tool

> In this approach, technology is seamlessly integrated into the instructional activities of the class. The primary goals and outcomes of instruction remain the stated goals of a class or program – improving literacy and numeracy skills, progress toward high school completion or another gatekeeping target, or functional skills. The development of technology-related skills is a valued, but secondary, outcome. Just as books, workbooks, a chalk board, and paper are tools that are used as needed within the classroom or to support learning, technology applications are used when they are appropriate.
>
> (Ginsburg, 1998:41)

Appendix 6:
Laurillard's classification of educational media

In *Rethinking University Teaching: A framework for the effective use of educational technology* Diana Laurillard sets out a conversational framework identifying the activities necessary to complete the learning process. This teaching strategy is summarised as being discursive, adaptive, interactive and reflective:

Discursive

- teacher's and student's conceptions should each be continually accessible to the other
- teacher and student must agree learning goals for the topic
- the teacher must provide a discussion environment for the topic goal, within which students can generate and receive feedback on descriptions appropriate to the topic goal.

Adaptive

- the teacher has the responsibility to use the relationship between their own and the student's conceptions to determine the task focus of the continuing dialogue
- the student has the responsibility to use the feedback from their work on the task and relate it to their conception.

Interactive

- the teacher must provide a task environment within which students can act on, generate and receive feedback on actions appropriate to the task goal
- the students must act to achieve the task goal
- the teacher must provide meaningful intrinsic feedback on the students' actions that relates to the nature of the task goal.

Reflective

- the teacher must support the process in which students link the feedback on their actions to the topic goal for every level of description within the topic structure
- the student must reflect on the task goal, their action on it, and the feedback they received, and link this to their description of their conception of the topic goal.

(Laurillard 2002:77-78)

Laurillard goes on to apply this description of teaching strategies in order to generate a classification of educational media into five principal forms, and it is this classification that we refer to in our study.

Narrative media

Learning experience: Attending, apprehending
Narrative media are linear non-interactive presentational media such as print, TV, and video.

Interactive media

Learning experience: Investigating, exploring
Interactive media are presentational media such as hypermedia and the world wide web, which are essentially linear media delivered in an open, user-controlled environment.

Adaptive media

Learning experience: Experimenting and practising
An adaptive program is a program such as a simulation that allows the user to provide input which changes the state of the model, and the new state is displayed. 'In this sense, it 'knows' what the user has done in its world, and can therefore provide direct intrinsic feedback on their action ... the ability to offer intrinsic feedback is unique to the computer and forms the core of any understanding of the contribution that ICT can make in education.' (p.126)

Communicative media

Learning experience: Discussing and debating
Communicative media (which may be text/graphics, audio, video) bring people together to discuss.

Productive media

Learning experience: Articulating and expressing
Productive media are media that enable students to produce their own contributions. The fine arts, media studies, design and technology, allow students to produce work in a variety of media, but more theoretical areas have traditionally been restricted to the written word. However, electronic media now offer a wide range of tools for expressing ideas. For example, a student could use the animation capabilities of PowerPoint in order to express their view of how a system works. However, 'There is very little in reality that exploits the productive capability of electronic media to allow the student to be the author.' (p.161)

Glossary

ACME	Advisory Committee on Mathematics Education; www.royalsoc.ac.uk/acme
ALM	Adults Learning Mathematics – A Research Forum. ALM is an international research forum bringing together researchers and practitioners in adult mathematics/numeracy teaching and learning in order to promote the learning of mathematics by adults; www.alm-online.org
ALNIS	Adult Literacy and Numeracy in Scotland – a report by HM Inspectorate of Education (2001); www.hmie.gov.uk/documents/publication/clalns.html
ALO	Adult Literacies Online. A national online databank developed by Learning Connections. It is a single point of access for available resources, training and development, research and networking. There are three sections: Learning Resources; Teacher Training; Research and Reports; www.aloscotland.com
APR	Annual percentage rate. An expression of the effective interest rate that will be paid on a loan. It facilitates calculation of the total cost of borrowing and makes it easier to compare lenders and loan options.
Audacity	Open source software for recording and editing sounds; http://audacity.sourceforge.net
Blog	The term 'blog' is derived from 'Web log', meaning a user-generated journal style website, typically combining text, images and links to other blogs, web pages and other media related to its topic.
BTCV	British Trust for Conservation Volunteers; www2.btcv.org.uk
CBMAC	Computer Based Modelling Across the Curriculum. A project funded by the Technical and Vocational Educational Initiative (TVEI) 1989-92.
CPD	Continuing professional development.
DfES	Department for Education and Skills, the government department responsible for children's services, education and lifelong learning in England; www.dfes.gov.uk
DTI	Department of Trade and Industry, the government department responsible for trade, business, employees, consumers, science and energy in the UK; www.dti.gov.uk

ESOL	English for speakers of other languages.
HEI	Higher education institution.
HotPotatoes®	Software which can be used to create interactive quizzes and puzzles. Hot Potatoes® is produced by Half Baked Software; www.halfbakedsoftware.com
Hyperlink	A hyperlink is a reference or navigation element in a document to another section of the same document, another document, or a specified section of another document, that automatically brings the referred information to the user when the navigation element is selected by the user – see http://en.wikipedia.org/wiki/Hyperlink
Hypermedia	Hypermedia denotes the linking of graphics, sound, text and video elements in ICT.
ICT	Information and communication technology.
ICT Toolkit	A collection of ideas, examples and approaches to help practitioners think through how they use ICT in the structure and delivery of their adult literacies programmes; www.lc.communitiesscotland.gov.uk/stellent/groups/public/documents/webpages/cs_011079.hcsp
ILP	Individual learning plan.
Interactive Wheel	The CD-based Curriculum Framework Interactive Wheel was piloted by Learning Connections with literacies tutors in Autumn 2006. It will be evaluated and amended for distribution in 2007.
JAVA	An object-oriented computer programming language.
JISC	Joint Information Systems Committee. Funded by HE/FE funding councils and the Learning and Skills Council to support the innovative application and use of IT in UK FE and HE institutions; www.jisc.ac.uk
JISC Legal	A free information service offering high quality legal information to further and higher education relating to the use of information and communications technologies; www.jisclegal.ac.uk
learndirect (learndirect Scotland)	An organisation developed by the University for Industry to provide high quality post-16 learning which aims to: ■ Reach those with few or no skills and qualifications who are unlikely to participate in traditional forms of learning ■ Equip people with the skills they need for employability, thereby strengthening the skills of the workforce and increasing productivity ■ Be delivered innovatively through the use of new technologies. In England, see http://catalogue.learndirect.co.uk/courses/100216BS001 In Scotland, see www.learndirectscotland.com

Learning Connections	During this project and the writing of the report, Learning Connections was part of the Community Regeneration Division of Communities Scotland, a Scottish Executive Agency. Learning Connections now sits within the Scottish Executive's Directorate General for Education and Lifelong Learning.
Learning and Teaching Scotland	The main organisation for the development and support of the Scottish curriculum; www.ltscotland.org.uk
M-Learning	Mobile learning, undertaken using mobile technologies such as mobile phones, PDAs, pocket PCs and the internet in order to enhance the learning experience; www.m-learning.org
MALANI	Midlothian Adult Literacy and Numeracy Initiative; www.malani.org
Maths4Life	Maths4Life is a DfES-sponsored programme in England, based at NRDC from 2004-07, which aims to encourage effective numeracy and mathematics education programmes for adults. Maths4Life will become part of NCETM (see below) from 2007-08, with NRDC as an NCETM partner organisation; www.maths4life.org
Mind maps	A mind map is a graphical way of organising information or ideas. The use of the term 'Mind Maps' is trade-marked by The Buzan Organisation, Ltd in the UK. A list of mind mapping software is at: www.mind-mapping.org
MySpace	An online community to which anyone aged 14 or over can sign up, free; www.myspace.com
NCETM	National Centre for Excellence in Teaching Mathematics. Funded by the DfES in England to enhance professional development for mathematics teachers, established in response to the recommendations of ACME and those made in Professor Adrian Smith's report 'Making Mathematics Count' (Smith, 2004); www.ncetm.org.uk
NDPB	Non-departmental public body.
NRDC	The National Research and Development Centre for Adult Literacy and Numeracy. Established by the DfES in 2002 as part of Skills for Life, the national strategy for improving adult literacy and numeracy skills in England. NRDC is led by the Institute of Education, University of London, with 11 partners as listed on the back cover of this publication; www.nrdc.org.uk
NSOL	Numeracy for speakers of other languages.
Numeracy Skills Up Front	A new (2006–07) project which aims to enhance the numeracy skills of NHS Scotland staff, jointly funded by NHS Education Scotland and Learning Connections; www.nes.scot.nhs.uk/news/items/default.asp?id=298

PALM	Pupil Autonomy in Learning with Microcomputers. PALM was an action research project involving teachers in 30 schools, funded by the National Council for Educational Technology in conjunction with Cambridgeshire, Essex and Norfolk Education Committees (1988-90). PALM aimed to test claims made for the role of computers in learning; www.uea.ac.uk/care/research/palm.html
PC	Personal computer.
PDA	Personal digital assistant. A hand-held computer used as an organizer for personal information.
PLRI	Practitioner-led research initiative. PLRI was a nationally co-ordinated series of small-scale practitioner-led research projects funded by the NRDC in England, 2004-06; www.nrdc.org.uk/content.asp?CategoryID=512
Serious games	These are video and computer games whose primary purpose is other than entertainment; www.socialimpactgames.com
SETT	The Scottish Learning Festival, organised annually by Learning and Teaching Scotland; www.ltscotland.org.uk/SETT
SFEU	Scottish Further Education Unit. The key development agency for Scotland's Colleges; www.sfeu.ac.uk/about
Sheerface Ltd.	A specialist consultancy that works with organisations operating in vocational education, adult learning and social inclusion. Part of the project research team; www.sheerface.co.uk
Skills for Life	Skills for Life is the national strategy for improving adult literacy and numeracy in England; www.dfes.gov.uk/readwriteplus
Social software	Software that enables people to collaborate via computer-mediated communication. See the Wikipedia definition: http://en.wikipedia.org/wiki/Social_software
SQA	Scottish Qualification Authority. An executive non-departmental public body sponsored by the Scottish Executive Education Department. It is the national body in Scotland responsible for the development, accreditation, assessment and certification of qualifications other than degrees; www.sqa.org.uk
TQAL	Pilot Teaching Qualification in Adult Literacies started in Autumn 2006. Run by a Scottish consortium led by Strathclyde University; www.strath.ac.uk/Departments/CommunEdu/tqal/index.html
URL	Uniform resource locator, the global address of documents and other resources on the world wide web.
USB	Universal serial bus: a standard to interface IT devices. A USB stick, also

	known as a USB flash drive, is a small, portable flash memory card that plugs into a computer's USB port and functions as a portable hard drive.
VLE	Virtual learning environment. A software system designed to facilitate teachers in the management of educational courses for their students (see the Wikipedia definition of a VLE: http://en.wikipedia.org/wiki/Course_management_system)
Web 2.0	Second generation internet-based services that emphasise online collaboration and sharing among users.
WebCT	Web Course Tools. Commercial VLE software; www.webct.com/index.html
WebQuest	WebQuests usually involve the following stages: ■ An introduction that sets the stage and provides some background information. ■ A task that is do-able and interesting. ■ A set of information sources needed to complete the task. Many (though not necessarily all) of the resources are embedded in the WebQuest document itself as anchors pointing to information on the world wide web. Information sources might include web documents, experts available via email or real-time conferencing, searchable databases on the net, and books and other documents physically available in the learner's setting. ■ A description of the process the learners should go through in accomplishing the task. The process should be broken out into clearly described steps. ■ Some guidance on how to organize the information acquired. This can take the form of guiding questions, or directions to complete organizational frameworks such as timelines, concept maps, or cause-and-effect diagrams as described by Marzano (Marzano, Pickering, and Pollock, 2001) and Clarke (Clarke, 1990). ■ A conclusion that brings closure to the quest, reminds the learners about what they have learned, and encourages them to apply it in further activity (Dodge, n.d.).

References

Balacheff, N., and Kaput, J. (1996). Computer-based learning environments in mathematics. In A. J. Bishop, K. Clements, C. Keitel, J. Kilpatrick and C. Laborde (Eds.), *International Handbook of Mathematics Education* (pp. 469–501). Dordrecht: Kluwer Academic Publishers.

Becker, H., Ravitz, J., and Wong, Y. (1999). *Teacher and Teacher-Directed Student Use of Computers, Teaching, Learning, and Computing: 1998 National Survey Report #3*. Irvine, California: Centre for Research on Information Technology and Organizations, University of California Irvine.

Bransford, J. D., Brown, A. L., and Cocking, R. R. (Eds.). (1999). *How People Learn: Brain, mind, experience, and school*. Washington, D.C.: National Academies Press.

Clarke, J. H. (1990). *Patterns of Thinking: Integrating learning skills in content teaching*. Needham Heights MA: Allyn and Bacon.

Coben, D. (2005). *Adult Numeracy: Shifting the focus. A Report and Recommendations on Adult Numeracy in Scotland*. Edinburgh: Learning Connections, Scottish Executive.

Coben, D., Stevenson, I., Mellar, H., Kambouri, M., and Mogey, N. (2005). *The Use of ICT in Adult Numeracy Teaching in Scotland*. Edinburgh: Learning Connections, Communities Scotland.

Cuban, L. (1986). *Teachers and Machines: The classroom use of technology since 1920*. New York: Teachers College Press.

Design-Based Research Collective. (2003). Design-Based Research: An emerging paradigm for educational research. *Educational Research, 32*(1): 5–8.

DfEE. (1999). *A Fresh Start: Improving literacy and numeracy. The report of the Working Group chaired by Sir Claus Moser*. London: Department for Education and Employment.

Dick, B. (2000). A Beginner's Guide to Action Research [online] from www.scu.edu.au/schools/gcm/ar/arp/guide.html

Dodge, B. The WebQuest Page: San Diego State University, Educational Technology Department. http://webquest.sdsu-edu

DTI. (2000). *Closing the Digital Divide: Information and communication technologies in deprived areas*. London: Department of Trade and Industry.

EC. (2000). *eEurope: An information society for all*. Brussels: European Commission.

Ginsburg, L. (1998). Integrating Technology into Adult Learning. In C. E. Hopey (Ed.), *Technology, Basic Skills, and Adult Education: Getting ready and moving forward*. Ohio: ERIC Clearinghouse on Adult, Career, and Vocational Education, Ohio State University.

Hamilton, M., and Wilson, A. (2005). *New Ways of Engaging New Learners: Lessons from round one of the practitioner-led research initiative*. London: NRDC.

Hartman, J., Moskal, P., and Dziuban, C. (2005). Preparing the academy of today for the learner of tomorrow. In D. G. Oblinger and J. L. Oblinger (Eds.), *Educating the Net Generation* (pp. 6.1-6.15). Boulder, CO: Educause.

Kerka, S. (1995). Not just a number: Critical numeracy for adults. ERIC Digest No. 163. Columbus, OH: ERIC Clearinghouse on Adult, Career, and Vocational Education.

Kerr, S. (1991). Lever and fulcrum: Educational technology in teachers' thought and practice. *Teachers College Record,* 93(1): 114–136.

Laurillard, D. (2002). *Rethinking University Teaching: A framework for the effective use of educational technology* (2 ed.). London: Routledge Falmer.

Learning Connections. (2004). *Report on the Scottish Adult Literacy and Numeracy Strategy 2001-2004*. Edinburgh: Scottish Executive.

Learning Connections. (2005a). *An Adult Literacy and Numeracy Curriculum Framework for Scotland*. Retrieved from www.lc.communitiesscotland.gov.uk

Learning Connections. (2005b). *Report on the Scottish Adult Literacy and Numeracy Strategy 2004–2005*. Edinburgh: Scottish Executive, Enterprise, Transport and Lifelong Learning Department.

Learning Connections. (2005c). *The Innovations in ICT report from the projects funded by Learning Connections 2004/05 on innovative approaches to using ICT in adult literacies learning*. Edinburgh: Scottish Executive.

Learning Connections. (2006). *Report on the Scottish Adult Literacy and Numeracy Strategy 2005/2006*. Edinburgh: Scottish Executive.

Leavey, J. (2007). *Improving Teaching and Learning for Adults with Basic Skill Needs Through Formative Assessment. Scotland background paper. OECD Study.* Edinburgh: Learning Connections, Communities Scotland.

Lindqvist, S. (1978). *Dig Where You Stand, How to Research a Job* (A. Henning, Trans.): Manuscript registered in the database of the Research Libraries Group (RLG); unpublished English translation of Gräv där du står, Hur man utforskar ett jobb. Stockholm: Bonniers 1978.

Marzano, R. J., Pickering, D. J., and Pollock, J. E. (2001). *Classroom Instruction That Works*. Alexandria, VA: ASCD.

Mellar, H., Kambouri, M., Logan, K., Betts, S., Nance, B., and Moriarty, V. (2007). *Effective Teaching and Learning: Using ICT*. London: NRDC.

Mellar, H., Kambouri, M., Sanderson, M., and Pavlou, V. (2004). *ICT and Adult Literacy, Numeracy and ESOL*. London: NRDC.

Niks, M., Allan, D., Davies, P., McRae, D., and Nonesuch, K. (2003). *Dancing in the Dark. How do adults with little formal education learn? How do literacy practitioners do collaborative research?* Ottawa, Ontario: National Literacy Secretariat (HRDC) and the Province of British Columbia, Ministry of Advanced Education.

NRDC. (2003). *Using Laptop Computers to Develop Basic Skills: A handbook for practitioners*. London: National Research and Development Centre for Adult Literacy and Numeracy. www.nrdc.org.uk/uploads/documents/doc_2838.pdf

O'Reilly, T. (2005). What Is Web 2.0? Design patterns and business models for the next generation of software [Electronic Version] from http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html.

Oblinger, D. G., and Oblinger, J. L. (Eds.). (2005). *Educating the Net Generation*. Boulder, CO: EDUCAUSE.

OECD. (2002). *Understanding the Brain: Towards a new learning science*. Paris: OECD.

OECD. (2005). *Formative Assessment: Improving learning in Secondary classrooms*. Paris: OECD.

Prensky, M. (2001). Digital Natives, Digital Immigrants, Part II, Do they really *think* differently? *On the Horizon,* 9(6): 1-9

Ruthven, K., and Hennessy, S. (2002). A practitioner model of computer-based tools and resources to support teaching and learning in mathematics. *Educational Studies in Mathematics,* 49(1): 47-88.

Savill-Smith, C., Attewell, J. and Stead, G. (2006). *Mobile Learning in Practice. Piloting a mobile learning teachers' toolkit in further education colleges.* London: Learning and Skills Network

Scottish Executive. (2001). *Adult Literacy and Numeracy in Scotland*. Edinburgh: Scottish Executive.

Scottish Executive (2006). *Digital Inclusion Strategy*. Edinburgh: Scottish Executive.

Smith, A. (2004). *Making Mathematics Count: The Report of Professor Adrian Smith's Inquiry into Post-14 Mathematics Education* (No. 2/04 937764). London: The Stationery Office.

Somekh, B. (1997). Classroom investigations. Exploring and evaluating how IT can support learning. In B. Somekh and N. Davis (Eds.), *Using Information Technology Effectively in Teaching and Learning* (pp. 114-126). London: Routledge.

Stevenson, I. J., and Hassell, D. (1994). Modelling and teacher change. In H. Mellar, J. Bliss, R. Boohan and C. Tompsett (Eds.), *Learning with Artificial Worlds: Computer-based modelling in the curriculum* (pp. 207-213). London: Falmer Press.

Swan, M. (2005). *Improving Learning in Mathematics: Challenges and strategies*. London: DfES Standards Unit, Success for All.

Swan, M. (2006). *Collaborative Learning in Mathematics: A challenge to our beliefs and practices*. Leicester: NIACE/NRDC.

Taylor, P., Traxler, J. and Attewell, J. (2006). *Interactive Digital TV for Learning: The Kickstart TV pilot project*. London: Learning and Skills Network

van den Akker, J., Gravemeijer, K., McKenney, S., and Nieveen, N. (2006). *Educational Design Research*. London: Routledge.

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