Preface

Manchester, one of the largest cities in the United Kingdom and a major centre of the Industrial Revolution in the 19th century, was the host city for the IFIP TC3 Working Group 3.5 (Early and Elementary Education) conference on e-learning in school, home and community. Since e-learning is a latter-day revolution, changing the way learning is designed and delivered, the conference site was an appropriate signal that the days of smoke and iron have been replaced by fibre and silicon.

Sixty-seven delegates from 14 countries, including WG 3.5 members, analysed e-learning from the perspectives of learners, teachers, evaluators and policy makers. This collection of 16 papers represents less than a third of the conference papers submitted for publication. As a refereed collection, they were chosen for the quality of presentation, the depth of their research, and the applicability of their topics and results to other educational environments around the world. Many other papers, which could not be included because of space limitations, are equally interesting, and grapple with the same problems and prospects as the papers we present to you.

The authors describe how children learn in e-settings, what interests them and how their learning often differs from adult conceptions of what the task entails. Those glimpses into e-world reality show us that childhood is a different place, one which designers of e-learning materials and environments should investigate. The descriptions of teaching and teachers' conceptions of e-learning situations show us that e-teaching is as complex as the world of the classroom has always been. Discussions of policy issues tell us that some solutions are possible and some situations are still as fraught with difficulty as they were before computers appeared in classrooms.

We have collected papers that reflect current practices and policies in all three spheres — learning, teaching and policy making — so that the reader can focus on one category or move through the volume, creating his/her own pathways through the complexity that is e-learning.

Learning

Nicola Yelland tells us that all software is not equal in children's eyes. Software evoking complex thinking is rated more highly by children than software calling for lower levels of thinking. Her work also shows us that multi-age grouping in after-school settings can be a powerful stimulus for socialisation and learning. Work by Mandy Medvin and her colleagues in a preschool and Head Start centre also shows that computer use can foster, not deter, socialisation. The team's guidance on structuring the e-learning scene for young children provides suggestions for other early and elementary school technology-based environments.

Bracha Kramarski and Adiva Liberman tell us that e-mail can fruitfully be used to scaffold the acquisition and application of mathematical skills by upper elementary school students. Matthew Pearson provides a similar window into the minds of upper elementary school students, cautioning us that the way they engage with technology differs from adult engagements and understandings.

Yaacov Katz discusses a tool for e-learning — virtual reality software — that promotes prospective nursery school teachers' understandings of the classroom from the child's point of view, a valuable learning experience for novice teachers. Ivan Kalas and Andrej Blaho describe a different learning tool. Their version of Logo, Comenius Logo, has the power to make mathematics visual, exciting and interactive — all characteristics to enhance the learners' grasp of important mathematical ideas.

Kate Crawford tells us how young learners can serve as teachers of teachers, initiating their teachers into the e-learning environment through contextually-based experiences with new technologies. She also describes how communities of learners — students, teachers, scientists and business people — can collaborate for technologically-driven change.

Teaching

While young children often adopt technology with few problems, the situation is different for teachers. Used to methods developed over years of practice, buffeted by different and often competing government directives, and challenged by the on-rush of technological innovation, teachers often believe that technology is like a fast-approaching train and they are tethered to the tracks. Steve Kennewell stresses important elements of ICT capability and then compares features of home and school settings. By suggesting goals and guidelines for monitoring progress in both settings, he helps bridge the gulf.

David Benzie provides a different perspective on the gulf, telling us that teachers are members of many different communities. They are learners, teachers and community members all at the same time. His work on the

implications of power, motivation and legitimacy in those disparate roles shows us how those forces can constrain or empower.

Avril Loveless shares insights into teachers' thinking, just as Pearson showed us how children react in e-learning situations. She tells us that as practitioners in both school and community, teachers must negotiate a range of pedagogical practices as changes in technology cascade around them.

Márta Turcsányi-Szabó also discusses change but from the perspective of a teacher educator working in a country with under-developed communities in remote villages. By developing a distance learning model that includes children as active technology learners/stakeholders, her work enables us to examine how change, growth and empowerment can occur in the remote regions and in under-developed communities.

Policy

The vision of policy makers dwelling in ivory halls remote from their constituents is only partly true. Many educators involved in making or shaping policy work actively in their communities and are aware of the challenges posed by different sectors of the community. Their work attempts to inform policy at all levels — school, home and community.

Pedro Hepp and Ernesto Laval discuss the policy problems in schools and communities where conditions for technology are often inhospitable. Wind, sand and remoteness conspire to make the maintenance of technology problematic.

Sindre Røsvik also works in a rural educational setting, one which differs significantly from the Chilean situation where Hepp and Laval provide vision and support. Giske kommune in Norway, while geographically isolated, has economic and social ties with major centres of commerce and industry around the world and collaboration is a key community value.

Margaret Scanlon and David Buckingham address the publishing situation by analysing trends in e-publishing, describing resource design and development, and discussing the contentious atmosphere of policy making and implementation at the business and government level. Bridget Somekh's descriptions of four e-learning projects conducted in the UK repeat Scanlon and Buckingham's story of the multiple initiatives and mixed messages that clutter the e-learning landscape.

Margaret Cox surveys the status of e-learning evaluations and provides a framework for designing and analysing rigorous studies of the effects of e-learning on participants. Her work, developed over many years, reflects the multi-faceted approach that is essential in assessing the impact of ICT on home, school and community.

Taken as a whole, the conference papers can serve a variety of e-learning situations and inform the policies and practices of students, teachers and communities.

Gail Marshall Ph.D. has participated in the evaluation of innovative projects and practices, first at Washington University in St. Louis, MO and then at the Division of Evaluation and Research of the St. Louis Public Schools, where she was responsible for the evaluation of all federal, state and private foundation funded projects. Subsequently she joined the evaluation team for the Comprehensive School Mathematics Project (CSMP) at CEMREL, a federally funded educational research laboratory. She then rejoined the St. Louis Public Schools in 1983 as the director of the DeBalivere Project, the first system-wide initiative for ICT sponsored by local benefactors and IBM. She is also the designer of six prize-winning software programs published by Sunburst Communications and she designed workshops in conjunction with Sunburst and Apple Computers for the development of teachers' ICT expertise.

Yaacov Katz Ph.D. serves as the Chair of the Pedagogic Secretariat of the Israeli Ministry of Education. In this capacity he is responsible for strategic pedagogic and curriculum planning for the Israeli state school system. He also serves as Professor of Education at the Bar-Ilan University and heads the university's Institute for Community Education and Research.

Professor Katz specialises in the investigation of attitudes in the educational system with special emphasis on attitudes of students and teachers toward the use of ICT in learning and instruction. He has edited a number of academic volumes and published numerous scholarly articles on the above topics.

Learning in school and out: Formal and informal experiences with computer games in mathematical contexts

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Abstract: This paper presents the results of a study investigating the mathematical understandings, social processes and features of computer software that most appealed to children of primary school age. The study was conducted in both school and after-school contexts where computer games were used in different settings. The data reported here pertain to the out-of-school component of the study. The children attended a suburban primary school in a large urban area in Australia, and, in the after-school program located on the site, were free to choose and use the software in any way that they desired. The results of the study revealed that the children enjoyed games that had a narrative content and activities that went beyond those of traditional mathematical tasks. They preferred playing games that were problem-solving tasks, such as puzzles or spatial activities. They interacted frequently across age and gender, and indicated that they recognised the mathematical content of the majority of the games presented to them. The study highlights some major differences between in-school and after-school uses of computers, and suggests that the informal context was not only conducive to learning but also afforded opportunities for the children to interact in new and dynamic ways.

Key words: early childhood education, elementary education, social contexts, research, curriculum

1. INTRODUCTION

Computers connect us with other people, store knowledge that we can access, and provide entertainment and leisure activities for us when we are not working. Many educational justifications for the use of computers in

school centre around the need to prepare students for the information age and life with computers is an integral part of that preparation.

Computer games constitute an important part of young children's lives in and out of school (Provenzo 1992), and in school contexts games are often used to consolidate practice of a specific skill such as being able to add in mathematics. Computer games also motivate students to engage conceptual material or ideas. There has been little systematic study of the use of computer games either in school or in contexts other than at-home uses of computers. After-school programmes are becoming increasingly popular as places where children go when the school day has ended and parents are working.

There have been successful examples of after-school computer clubs for students, such as the Fifth Dimension (Cole 1996) and the computer clubhouse (Resnick and Rusk 1996), as well as a variety of summer computer camps (Edwards 2002) with specific technological goals in mind. All of those contexts have demonstrated that game and design environments are conducive to the development of effective teaching and learning scenarios in which children are actively engaged with materials and ideas, promoting collaborative and individual learning.

1.1 Learning and the role of computer games in school and out

Since the early 1970's many research studies on school uses of computers have been conducted. Computer-based activities have been studied in the context of different applications, ranging from computer programming contexts, Internet-based information exchange and communication projects, community problem solving contexts through to aspects of integrating computer activities into traditional curricula. School-based use of computer games, especially in relation to mathematics, has been a recent research interest. Studies show that computer-based mathematical activities can be powerful learning tools for children (Battista and Clements 1984; Clements 1987; Yelland 1999), and the study of conceptual and skill development facilitated by mathematical computer games has become increasingly important. While information about specific environments that may promote the use and development of mathematical thinking exists, we do not know much about the role of integrating existing commercial software into mathematics programs or how the development of specific software may play a role in helping children prepare for the demands of this new century. This is an important area for research since it has been demonstrated (Upitis 1998) that students' use of video and computer games in out-of-school contexts affects their interactions with the media in school

in pervasive ways. Upitis has shown that students in her study judge computer games in school contexts against the video games that they played at home, and the finding has important consequences for in-school activity since many school-based applications are less sophisticated than games, and many students find those school-based applications "boring". As a result, the students seem not to engage with the mathematical ideas inherent in the school-based applications.

Gender also plays a role in students' acceptance and use of software. The E GEMS project found significant differences in performance based on gender (Inkpen, Klawe, Lawry, Sedighian, Leroux and Hsu 1994). The research also indicates that the role of the teacher was critical in explicating the mathematical inferences in games. In a related study, De Jean, Upitis, Koch, and Young (1999) also noted the importance of a teacher or mentor who could help children to make connections with the mathematics content in the computer games that they played. They stated, "Without specific guidance from a teacher or mentor, it would appear that many students, and significantly more girls than boys ... will not detect the underlying mathematical concepts that might be embedded within a computer game" (216). Other research has also highlighted the importance of the teacher in making mathematical connections explicit to learners (Leitze 1997).

It is apparent that computer games have the potential to engage children in learning in ways that were not possible without them. Game contexts motivate children to play with ideas, interact and collaborate with peers in sharing strategies and articulating ideas. Through their work with the games, they acquire skills for learning and new knowledge that seem to be adaptive to new and differing contexts. The ways in which children do this is still not clearly understood and the present study sought to add to our knowledge by identifying the levels of interest, mathematical understandings and learning of students as they engaged with computer games in an after-school context.

2. THE STUDY

The study was designed to examine and describe the ways in which children in after-care settings chose, used and evaluated computer software designed to develop specific mathematical processes and thinking. It was especially concerned with obtaining data that would elucidate:

- mathematical learning via descriptions of the mathematical understandings that emerged as children played and interacted in computer-based contexts, and the ways in which children developed and refined their mathematical strategies and representations as they gained experience with the various types of software;

Developing an ICT capability for learning

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Abstract: Learning effectively with Information and Communication Technology (ICT) requires an appropriate level of ICT capability. This paper explores the ways in which children develop their capability in home and school, and how their skills support ICT activity and learning in each setting. Conditions for developing ICT capability during such activities are identified using a framework for analysing learning situations based on affordances, constraints and abilities. It is concluded that all aspects of young children's ICT capability can be developed effectively through a combination of structured activities in school designed primarily for learning other subjects, provided that subsequent reflective activity is generated. This learning is supported by unstructured activities at home, and provided that they have access to appropriate guidance from more capable family and friends. Suggestions are made concerning the coordination of school and home ICT activities in order to exploit the positive features of each setting, and generate effective learning within and beyond the formal curriculum.

Key words: elementary education, conditions for learning, organising for learning, sites of learning

1. INTRODUCTION

Evaluations of the role of ICT in learning must consider different perspectives (Squires and MacDougall 1994) and recognise that the influence of ICT is dependent on the ICT capability of the user (Kennewell 2001). What the user knows about ICT affects the quality and quantity of the learning with ICT. The features of ICT that aid learning include interactivity and provisionality (Teacher Training Agency 1998). But to exploit interactivity, the user must know how to respond to screen prompts from the software; in order to exploit provisionality, the user must know how to save,

load and edit work in progress. If learners do not have sufficient skills in using ICT, they experience the 'ICT interference factor' (Birnbaum 1990), and ICT becomes a barrier rather than an aid to learning.

The ability to use ICT to carry out worthwhile activity, including the learning of subjects other than ICT, has been characterised as ICT Capability (Kennewell, et al. 2000). Five key components of ICT capability have been identified:

- routines such as using a mouse or double clicking on an application;
- techniques such as adjusting margins to make text fit a page;
- key concepts such as menu, file, database, spreadsheet, web site or hypertext link;
- processes such as developing a presentation, seeking information, organising, analysing and presenting the results of a survey;
- higher-order skills and knowledge such as recognising when the use of ICT might be appropriate, planning how to approach a problem, making and testing hypotheses, monitoring progress in a task, evaluating the result, and reflecting on the effect of using ICT in a particular situation. (Kennewell, et al. 2000)

It is anticipated that those skills will develop together during the course of worthwhile tasks across increasingly challenging contexts, with help from those who are more capable.

2. INFLUENCE OF ICT ON LEARNING

Learning of specific subject matter is expected to take place through goal-directed activity in which there is a gap between the learning objectives and the student's current knowledge. The "learning gap" is bridged through cognitive effort. The learners utilise the affordances and constraints of the setting, such as those provided by ICT, in combination with their existing abilities in the subject matter to be learned, and in generic skills such as ICT capability. Those abilities, together with the affordances and constraints of the setting, provide both potential and structure for activity (Kennewell 2001). For example, when children are learning about the process of volcano eruption, they may use an encyclopaedia on a CD-ROM. The software affords searching by keyword and by successive focusing on subject headings; it also constrains the user to the specific material that the authors have decided to include. This constraint may be very valuable in the case of encyclopaedias designed especially for young children, although over time it will be unhelpful for children seeking up-to-date information. The CD-ROM does not do all the work and the child must know something about the

process of searching and the particular techniques needed to carry out the searches with the CD-ROM. Furthermore, merely accessing information may not bring about learning and a reflective stage is an important element of the learning activity (Kennewell 2000).

The information retrieval scenario described above could take place in either home or school. The technological, human and cultural resources will vary between the formal school setting and the more informal setting of home. However, we may expect the differences in the features of the settings to have fundamental effects on the nature and process of children's learning with ICT. Home ICT activity is characterised by "bricolage" and "hard fun" (Papert 1996), whereas school use is largely routine, unstimulating (Kennewell, et al. 2000) and prescriptive (Sutherland, et al. 2000a).

3. FEATURES OF THE HOME SETTING

In the UK, the technological resources available in homes are increasingly sophisticated and widespread (Harrison, et. al. 2001). Indeed, many homes contain more sophisticated resources than schools (Kennewell, et al. 2000; Downes 1998), affording more effective presentation and access to greater range of information sources. Other affordances arise from the human and cultural resources available to support activity; for instance, the willingness and ability of parents and other family members to help, their networks of social and professional contacts, and the models of ICT activity that they provide (Sutherland, et al. 2000b).

Children's use of the resources may be constrained in various ways (Sutherland, et al. 2000b; Downes 1998). Table 1 illustrates some of the technological, human and cultural features that constrain home ICT use for children; some may have a positive effect on learning, others are potentially negative.

Table 1. Constraints on home use of ICT

Constraint	Example
Location of resources	In a communal room
Preparation needed	Connecting a telephone line for Internet connection
Parental restriction or security provision	Password protection on Internet filtering
Competition of hierarchy with family	Older siblings have priority
Perceived role in relation to technology	Feeling of inadequacy in comparison to more expert members of the family
Imposed priorities for different activities	School has priority over games

ICT for rural education

A developing country perspective

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Abstract: In 1991, as part of its educational reform, the Chilean government launched the Information and Communication Technologies (ICT) in Schools initiative, the "Enlaces Network". Its aim is to properly integrate ICT into Chilean public schools. After more than ten years of development, with 100 percent of Chilean secondary schools and more than 50 percent of the primary schools already using ICT, Enlaces is entering a new phase with a more curriculum-oriented focus and with the goal of incorporating all rural schools by year 2005.

The paper addresses the main implementation constraints of the Chilean rural environment and their effect on the ongoing ICT policy: The geographical isolation and precarious infrastructure; the fact that rural schools are usually very small schools with different grades sharing the same classroom. The cultural reality of rural areas involves a special kind of relationship between the school and the local community. Those constraints, together with the previous experience with Enlaces in different Chilean realities, have been taken into account to define a special ICT policy for rural schools in Chile. First, a special long-term teacher training program with a specific pedagogical approach that fits a rural environment has been developed and tested in pilot schools. Second, the definition of a local support organisation to help sustain development strategies in the long run has been established. Third, the hardware and software infrastructure required and Internet access have also been analysed together with the technical support. Finally, community involvement in school activities was also included in the policy.

Key words: elementary education, conditions for learning, developing countries

1. THE CHILEAN EDUCATIONAL REFORM

Chile is a country with close to 15 million inhabitants with a UNDP Human Development Index of 38 among 160 countries and 16 percent of the population is rural.

Its educational system has close to 10 300 schools (9 000 primary and 1 300 secondary schools), 130 000 teachers and 3 100 000 students (2 300 000 in primary and 800 000 in secondary schools). The rural population data are shown in Table 1.

Table 1. Chilean rural schools

Characteristics of rural schools	Number of schools
One teacher school	2115 (65%)
Less than twenty students per school	1600 (49%)
Regular public transportation	706 (22%)
Schools with electricity	3027 (92%)
Schools with telephones	653 (20%)
Total number of rural schools	3280 (100%)

For the last twelve years, Chile has undergone major educational reform. A new curriculum for both primary and secondary education has been designed and gradually introduced in all school grades; new teaching and learning methodologies are being implemented in order to achieve a higher quality and more equity in our education; more resources, textbooks, infrastructure and better teacher salaries are all part of the comprehensive effort. The Information Technology initiative, the "Enlaces Network", is an important component of the reform and aims to determine the benefits, contents, costs and replicability of initiatives involving educational computing and networking in Chilean public schools. It incorporates mechanisms for evaluating impact and seeks to determine the roles of computer technology on schools with the fewest resources (Hepp 1999).

In 2001, after 10 years of implementation, Enlaces could show the following results: three million students (90 percent) using ICT in 6 300 Schools (5 000 primary and all 1 300 Secondary); 70 000 teachers trained; 75 percent of all schools with free Internet; ICT is an integral part of the new curriculum; teachers have access to a special plan to buy low cost computers; and total expenditure of Enlaces for the decade US$110 Million.

Each school has received: Teacher training for three years together with technical support; equipment (38 000 computers together with printers, local area networks and furniture); a variety of productivity and educational software; free Internet access for most schools; and curriculum-oriented digital content on Internet. As a result, Chile has now 57 students/computer; 9/14 computers per primary/secondary school; and 10 teachers per computer.

In 2000, after completing its main goals, Enlaces began a new era and the rural schools became one of the highest priorities for the next six years. They were not included from the beginning because their poor infrastructure and weak communication facilities made it very difficult for Enlaces to train teachers and incorporate computers. After more than a decade of progress with the educational reform and improved conditions, Enlaces was ready to embrace rural education.

2. ICT FOR THE RURAL SCHOOLS

2.1 Institutional framework

Since its beginning, Enlaces has built a working relationship with close to 25 universities all over the country that contribute to the program with teacher training activities and materials, web-based content production, software evaluation, field research and healthy criticism. The universities are organized in five geographical zones for their work with Enlaces. The southern zone has the largest number of rural schools where piloting began a few years ago. The zone has 1 651 schools, about 50 percent of the total, with an average of 27 students and 1.6 teachers per school.

To improve the information exchange with the rural schools and also to promote the sharing of ideas and solutions among them, the Ministry of Education works on a monthly basis with groups of schools geographically close to one another organized in clusters of five to twelve schools per cluster. The clusters are called "microcenters" (San Miguel 1999; Wenger 1998). In the southern zone 1 651 schools have been grouped into 231 microcenters with an average of 7.1 schools per cluster.

Each university that works with Enlaces has the responsibility for a number of microcenters for a period of at least three years. Their work is closely coordinated with other professionals from the local Ministry of Education that attend the same schools and they normally organize together each visit to the microcenter meetings. Specially prepared teacher trainers attend each microcenter at least four times a year and visit a specific school another four times. Given the geographical situation of many of the schools, visits may last for a whole day and sometimes, during winter, even longer.

2.2 Rural Conditions and Opportunities

Chilean rural schools present a number of characteristics that are different from urban schools and call for a special ICT policy. The characteristics can be grouped in four categories: Location, infrastructure,