

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. Uptis 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, Uptis, 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;



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