2001

Young children's collaborative interactions in an educational computer environment

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Young Children's Collaborative Interactions in An Educational Computer Environment

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A Thesis Submited in Partial Fulfilment of the

Requirements for the Award of

Master of Education

at the Faculty of Education, Edith Cowan University

Date of Submission: 12.06.01

Abstract

This study investigated the collaborative interaction patterns exhibited by five-year-old pre-primary children in an educational computer environment. The case study method was used in one pre-primary centre in metropolitan Perth, Western Australia, to examine the patterns of collaborative interaction among young children whilst engaged with the computer. The one event case study was of the interactions exhibited by pre-primary children whilst engaged, in dyads, with the computer within a naturalistic classroom environment.

This study involved three phases of data collection. Phase I consisted of observations and videotaping sessions, compilation of written observations, narrative descriptions and relevant field notes on each participant. To assess the children's current social skills and computer competence and their general social interaction with peers, the researcher interviewed the children and their teacher using a semi-structured interview schedule to guide the discussion. Phase II comprised reviewing and transcribing the videotapes and coding children's interactions, while Phase III consisted of analysing all the data obtained. Both observational comments and descriptions and data analyses were presented with anecdotes.

243 interactions were identified and classified into 16 interaction patterns. They were: directing partner's actions; self-monitor/repetition; providing information; declarative planning; asking for information/explanation; disagreeing with partner; accepting guidance; terminal response; exclaiming; correcting others; defending competence; showing pleasure; showing displeasure; sharing control; defending control; and suggesting ideas. Frequency of occurrence of identified interactions was analysed in the form of descriptive statistics. Factors facilitating the collaborative interaction of children whilst engaged with the computer activities were found to be: developmental appropriateness of the software; preexisting computer competency between children; children's preexisting positive attitude towards computer; mutual friendship between collaborators; children's social goals; appropriate structure of enjoyable learning environment; mutual understanding of turn-taking system; and positive non-isolated physical settings of the computer environment. Factors inhibiting collaborative

interaction were identified as: non-developmentally appropriate software; lack of computer competency between children; negative attitude (on the part of both children and teacher) towards computer and learning; sense of competition between collaborators; social goals of each child; inappropriate structure to promote enjoyable learning environment; no mutual understanding of turn-taking system; and isolate physical settings of the computer environment. Associated with the findings were three major variables: (1) the classroom teacher variable (philosophy and educational beliefs, task-structure and computer management); (2) the software variable (developmentally appropriateness, content, design, and programmed task-structure); and (3) the child variable (computer competency and attitude towards computer, social goals, social skills, and personal relationship with collaborators).

By identifying the collaborative interactions of children, and factors that may facilitate or inhibit these interactions, early childhood educators will be in a better position to integrate the computer into their classroom and to promote positive prosocial interaction among children whilst engaged at the computer. In general, findings suggest that computers should be integrated into all early childhood classrooms and afforded the same status as other traditional early childhood learning materials and activities.

Declaration

"I certify that this thesis does not, to the best of my knowledge and belief:

(1) incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education;

(2) contain any material previously published or written by another person except where due reference is made in the text;

(3) contain any defamatory material"

Signature..

Mohamad Ibrani Shahrimin

Date.....12/06/01.............

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CHAPTER 1

INTRODUCTION

1.1   Background to the study

This study is in the field of early childhood education generally and is concerned specifically with young children's collaborative interaction while using computers. The impetus for this study arose from the need for early childhood educators to integrate computer activities into their program in an appropriate manner as suggested by the National Association for the Education of Young Children (NAEYC) position statement on technology and young children-ages three through eight (NAEYC, 1996).

Computer technology has transformed much of Western society and dominates many aspects of everyday life. Some claim that without the advantage and benefits of computer technology, it has become virtually impossible to function normally on a daily basis (Shade, 1994; Haugland, 1997b). The tools that people use in professions such as architecture, science, health care and business rely upon computer technology. Because the nature of computer technology used by society influences what the society is and becomes, individuals who do not become technologically literate will be left behind. In schools around the world, computers are used for teaching and administrative purposes, ranging from setting up and marking test and examination papers; to keeping track of attendance; to presenting simulations; to printing out student reports. Traditional activities can now be complemented with different experiences that have been made possible by the new information technologies (Haugland, 1997; Yelland, 1999; Haugland, 2000a).

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The growing use of computers in offices, factories, homes, and schools is often cited as a reason for introducing computers to children at ever earlier ages. In one Australian study of attitudes towards computers, students of upper primary and lower secondary years demonstrated very positive attitudes towards computers (Hattie & Fitzgerald, 1987). Clarke (1990) advances the argument that most primary-aged children display a high interest in using computers, with boys demonstrating a greater interest than girls. As indicated by Silvern and Silvern (1990), as long as computers are emotionally satisfying, satisfy the "need to know", and provide self-constructive activity, then using computers with young children is as appropriate as any other "good" early learning activity. Hohmann (1994) argues that for preschoolers and kindergarteners, the addition of computers and appropriate software to their environment has positive social consequences and appears not to disrupt other classroom social interactions. Hohmann (1994) advances the argument that computer activity can also provide young children with self-esteem and effectively promote self-control. Many people also hold the general assumption that if computers are introduced into the classroom, the learning process will somehow be enhanced (Sewell, 1990). As Haugland and Wright (1997, p. 10) elaborates:

> "When children are provided developmentally appropriate experiences, computers have tremendous potential to benefit young children. Used in developmentally appropriate ways, the computer is a resource which fits children's learning style. It also has a unique potential to provide scaffolding opportunities enabling children to successfully explore and master tasks which would be impossible without a computer" (Haugland & Wright ,1997, p. 10).

Children have their own style of learning about themselves and the world. They acquire skills and learn about their world through exploration and discovery, through trial and error, and through experiencing cause and effect relationships (Berk, 1994; Berk, 2000a; Berk, 2000b; Haugland & Wright, 1997). Children need to be aware of the nature and uses of computers in order to be able to cope with the present and future technological society (Lipinski, Nida, Shade & Watson 1986; Nastasi & Clements, 1992; Lomangino, Nicholson & Sulzby, 1999; Nicholson, Gelpi, Young & Sulzby, 1998; Teng, 1997; Solomon, 1998; Haugland, 2000b). In order to provide young children with an accurate picture of how the computer may assist their learning, teachers need to be aware of, and confident in using, the computer's many diverse

applications. It is also important that the computer be used across the various curriculum areas and not confined, as is often the case, to just one application in one subject area. Teachers need to use their knowledge of the learning process in combination with the needs of the children, to identify the most appropriate times when the computer, and specific programs, should be utilised as a resource to learning. Furthermore, it is also essential for teachers and early childhood educators to realize that the use of computers in the classroom is a process of exploration and discovery for both the children and the educators (Haugland, 2000a). The computer provides us with the view that it is not an end in itself-a new task for children to master-but one more tool for children to use in discovering and mastering the world of familiar experience (Hohmann, 1994). Research has also convincingly demonstrated that teachers who are involved in integrating computers into their early childhood classrooms often believe that with appropriate strategies and techniques, computer activities can support autonomy and facilitate the normal activities of early childhood classrooms (Hohmann, 1994).

Young children can and do profit from computer activities if the activities suit the children's stage of development and are supported by adult assistance (Lipinski, Nida, Shade & Watson 1986; Clements & Nastasi, 1992; Lomangino, Nicholson & Sulzby, 1999; Nicholson, Gelpi, Young & Sulzby, 1998; Teng, 1997; Solomon, 1998; Haugland, 2000b). Trinidad (1992) convincingly demonstrates that computers benefit young children by providing a "print-rich environment".

> "Computers may enable young children to demonstrate knowledge and understandings which are not revealed by traditional means. Activities which provide a print-rich environment may stimulate the development of language and literacy skills in a meaningful context. The computer, with appropriate software, can produce such a print-enhanced environment" (Trinidad, 1992, p. 116)

Early childhood educators often develop effective learning techniques and devise appropriate strategies to incorporate computers into the classroom. Such strategies are comfortable for teachers and in harmony with the social and emotional needs of young children (Shade, 1994; NAEYC, 1996; Haugland, 1997b). Research

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has indicated that the computer area in the classroom is rich ground for social interaction, as children frequently prefer working with a peer to using the computer alone (Bergin, Ford & Hess, 1993; Haugland, 1997; Haugland, 2000a). According to Haugland (1997), speculations on characteristic patterns of interacting with computers may serve to organise distinctive patterns of interacting around computers. Thus, it is argued that there is a need for research that focuses attention on task structures and the way in which they promote different styles of interaction (Crook, 1994).

Haugland and Wright (1997) view children as participatory learners, as children control their own learning process, and through exploration of the learning context the children construct concepts and build knowledge. Lomangino, Nicholson and Sulzby (1999) further postulate that both Piaget's and Vygotsky's theories of development support the potential benefits of collaborative activity. Lomangino et.al (1999) advance the argument that social interaction among children during joint activity enhances learning according to both sociocognitive and sociocultural theories of development. Hence, it is concluded that within the context of learning processes, children depend on the social climate of the classroom and the opportunities created for interaction to enhance productive and constructive learning (McLoughlin & Oliver, 1998). Furthermore, children need to be helped to control and understand computers as learning tools within the preparatory settings of schools (Crook, 1994).

The word 'collaboration' is often used in research on computer-mediated collaborative learning in the fields of education, psychology and computer science, even though the elements embedded within the definition can be interpreted in different ways (Dillenbourg, 1999). According to Dillenbourg (1999), the adjective "collaborative" refers to four aspects of learning: 1) the situation; 2) the interactions that take place between group members; 3) the learning mechanisms that are intrinsically collaborative, and; 4) the effects of collaborative learning. Lomangino, et. al (1999) and Nicholson, et. al (1998) convincingly demonstrate the successfulness of children's computer-mediated collaborative composing activities within the early childhood classroom context. Numerous aspects of the nature of children's interactions while they collaborate on literacy tasks, including the frequency, nature,

and task relevance of their talk were examined. Conversely, in both studies, the notion of collaborative interaction implicitly refers only to composing activities, which are task-focused and concentrated on localized task completion. The multiplicity of disciplinary perspectives in studies of collaborative learning have helped to reduce the gap that separates the various definitions of collaboration (Ploetzner, Dillenbourg, Preier & Traum, 1999). Literature reveals that collaborative computer use is often associated with the social nature of interactions occasioned by the social demands of complex collaborative activities on computers (Lomangino, et. al, 1999; Permutter, Behrend, Kuo & Muller, 1989; Haugland & Wright, 1997). Furthermore, literature on computer-mediated interactions has also revealed the possibility of cognitive and motivational benefits of collaborative computer use (Lomangino, et. al, 1999; Nicholson, et. al, 1998; Haugland, 2000; Lipinski, Nida, Shade & Watson 1986; Clements & Nastasi, 1992).

1.2   Significance of the study

Research on interactions and computer use of preschool and kindergarten children stands in stark contrast to findings obtained with older children and adults (Nicholson, et. al, 1998; Teng, 1997; Haugland, 2000a). Computers empower young children and may lead them to become totally immersed in the joys of learning (Haugland, 2000a). Given the inevitable proliferation of computer technology in primary and secondary schools, the need to understand how to optimize children's collaborative interactions around computer activities is becoming more important. When computers are placed in classrooms, research confirms that there are as many social interactions around the computer as in other activities or learning centres within the classroom (Lipinski, Nida, Shade & Watson, 1986; Clements & Nastasi, 1992; Lomangino, et. al, 1999; Nicholson, Gelpi, Young & Sulzby, 1998; Teng, 1997; Haugland, 2000a). Clements & Nastasi (1988) state that the investigation of social interactions within different educational environments is significant, not only because social development is a fundamental educational goal, but also because these valuable interactions are essential components of children's cognitive growth. Literature also confirms that the social effects of using computers in the classroom are "overwhelmingly positive" (Bergin et. al, 1993). However, Lomangino et. al (1999)

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suggest from their study that teachers need to be aware of both the positive and negative peer discussions and behaviours that often accompany young children's collaborative interactions. Identifying these interactions may provide understanding and empower teachers to carefully structure other collaborative activity settings for success. Furthermore, the outcomes of the current study will provide early childhood educators with information regarding the types of discourse involved in collaborative interactions that develop between young children when engaged with educational computer programs. Information about these discourses will assist educators to make informed judgments on the learning benefits and potential of educational computer software packages, and their suitability and potential to foster positive collaborative behaviour among young children. Also, information pertaining to the patterns of collaborative interaction occurring between young children whilst engaged in educational computer programs will assist in providing guidelines for the development of children's educational software. It is important to ensure that future educational computer software packages are structured and developed so as to best maximise young children's collaborative behaviour, so they may scaffold one another's learning. Moreover, it is up to the teachers of young children to ensure that computers live up to their potential. The educational goals of computer usage can only be achieved, however, if the teachers, early childhood educators, and researchers are informed of the relevant issues, demand that computer programs used with children are developmentally appropriate, and contribute to both theoretical and experimental data bases to guide computer use with children (Silvern & Silvern, 1990).

1.3   Purpose of the study

The purpose of this study is to investigate the collaborative interaction patterns exhibited by five-year-old pre-primary children in an educational computer environment.

1.4   Statement of the problem

Weber (1998) reported that the state government of Western Australia (WA) had promised $100,000,000 over the next four years for primary schools to have a

ratio of 10 students per computer and high schools to have a ratio of 5 students per computer. The Education Department of Western Australia (EDWA) emphasized the need for schools to have coherent, well thought out Information Technology (IT) plans, whereby schools were required to plan for the physical site, where IT would be used in the achievement of educational objectives, and how IT would be applied across the curriculum (Weber, 1998). Furthermore, organisations that manage early childhood services (for example, KU Children's Services, 1989) have also developed policies that include advice about the use of computers (Downes & Fatouros, 1995). However, there is a need to develop a consensus on how computers should be used for learning, as well as across curriculum and developmental areas. There is a need for children to move beyond print and develop skills in communicating and handling information using a variety of modes (images, text and sound) and media (Downes & Fatouros, 1995).

In order to enhance the effectiveness of young children's collaborative interactions while using computers, teachers need to identify these interactions and be aware of the impact of social behaviours on learning. Teachers also need to cultivate positive social interaction in small groups to foster improved learning. Encouraging young children, specifically pre-primary children, to request information and acknowledge others' requests is critical for them to support each other's learning. Vygotsky (1978), as cited in Smagorinsky (1995, p. 195) asserts 'children's zone of proximal development reaches a higher level of mental functioning when scaffolding is paced in congruence with a child's learning needs by "expert" guidance.' A zone of proximal development denotes a child's current learning potential and mental functioning and this process is rendered through a series of repetitive and reciprocal teachings (Smagorinsky, 1995; Berk, 2000a). When children's zone of proximal development is addressed in presenting stimulation, their mental processes are simultaneously aroused, thereby enabling them to attain a higher level of cognitive functioning beyond their normal range of mental achievement (Sheingold, 1986). By identifying young children's interaction while collaboratively using computers, teachers are able to determine the children's pace of learning and hence they can assist them by scaffolding and modelling the appropriate essential learning.

According to Berk & Winsler (1995, p. 12), the impetus for Vygotsky's theory stems from the view that "all uniquely human, higher forms of mental activity are derived from social and cultural contexts and are shared by members of those contexts because these mental processes are adaptive". Baker-Sennet, Matusov & Rogoff (1998) advance the argument that sociocultural contexts provide fertile ground for the development of new ideas and structured exploration for greater cognitive processes. Social and cognitive development are essential aspects of each another. Current research postulates that cognition is socially situated, and social influences and engagement are powerful forces in transforming young children's thinking (Berk, 2000a; Berk 2000b; Berk & Winsler, 1995).

In order to promote a positive social context for computer use among young children, it is necessary to look for the processes that are mediating effective peer collaboration (Crook, 1995). In the context of research on learning mediated by peer interaction, the need for reciprocal understanding between collaborators has been highlighted as an essential prerequisite for collaborative learning (Littleton & Hakkinen, 1999). Roschelle and Teasley (1995) advance the argument that collaboration necessitates that the collaborators are engaged in a coordinated effort to solve a problem or perform a task together. Although such interactions among young children are often coordinated by teachers in classrooms, the role of social interaction in the development of cognition, learning and knowledge, often does not distinguish between interactions with experts (adults or more knowledgeable peers) and interactions with peers (Forman & Cazden, 1999). Therefore, it is essential for researchers to develop an understanding of collaborative learning environments as systematic wholes where all the factors reciprocally affect each other, rather than simplifying them without capturing the vital complex processes in a schematised manner (Salomon, 1994; Littleton & Hakkinen, 1999). The following figure (Figure 1) demonstrates the key principles of planning to use technology to its fullest educational potential. As demonstrated in Figure 1, Downes and Fatouros (1995) developed a framework of planning that is based on learning theory, which also takes into account the diversity of children's experiences with technology; the curriculum framework of educational systems; and the significant changes in the skills and understandings needed to function effectively in today's society.

... within a learning environment that recognises the complexity and diversity of today's world;	... within the context of planned learning outcomes; of today's world

CHILDREN NEED OPPORTUNITIES TO ...
- work with images, sounds and text separately as well as in multi-model contexts
- work with electronic texts as well as paper-based texts

... in partnership with families and communities;	... in an environment that encourages: - play and purposeful use; - interaction with others; - control of the technology

<u>Figure 1</u> Key principles for planning to use information technologies for learning (Downes & Fatouros, 1995)

Downes and Fatouros (1995) further the argument, asserting that: (1) wider social issues that result in changes to the way we communicate and handle information need to be considered; (2) there is a need to identify the supports as well as the constraints that exist in the educational systems, whereby they influence the impact on what resources are likely to be available as well as what learning outcomes need to be addressed; (3) it is vital to acknowledge the diversity of experiences that children have with technology outside the classroom, in order for teaching and learning activities to be relevant to the needs and strengths of individuals; and, (4) relevant theories of learning should guide practice.

1.5   Statement of research questions

This study seeks to answer the following research questions.

1. What are the patterns of collaborative interaction exhibited by five-year-old pre-primary children whilst engaged collaboratively with the computer?

2. What factors facilitate collaborative interaction of five-year-old pre-primary children whilst engaged collaboratively with the computer?

3. What factors inhibit collaborative interaction of five-year-old pre-primary children whilst engaged collaboratively with the computer?

1.6 Definition of terms

Young children

In general terms, young children refers to those aged 2-6 years (Berk, 1995; Berk, 2000a; Berk, 2000b; Trinidad, 1992; Haugland, 1997a). Operationally, in this study, young children refers to five-year-old pre-primary children from metropolitan Perth, Western Australia.

Collaborative interaction

In this study, general reference to collaborative interaction means the individual action of one child that is directed at another (for example, talking to another child, responding to a question, gesturing) (Brown, Odom & Holcombe, 1996). In operational terms, collaborative interaction refers to patterns of discourse exhibited by five-year-old children while using educational computer programs in a classroom environment. Based on a study by Mercer (1994) and the System for Observation of Children's Social Interactions (SOCSI) by Brown, Odom & Holcombe (1996), three categories are chosen to code these interactions. The initial categories are as follows:

1. Disputational talk; whereby speakers challenge other speakers' views, but without attempting to justify their challenge by building on previous utterances or offering new information
2. Cumulative talk; whereby speakers contribute to discussion by taking up and continuing a previous speaker's utterances, without explicit comment
3. Exploratory talk; whereby hypotheses are proposed, objections are made and justified, and new relevant information is offered.

Educational Computer Environment

In this study, educational computer environment refers to the activities arising from children using one educational computer software program. This software was selected after discussion and agreement between the classroom teacher and the researcher.

1.7   Organisation of the thesis

This thesis is organised in the following way:

Chapter 2 provides a detailed overview of relevant literature, previous findings and current research studies. Chapter 3 describes the method of investigation, including details of the design of the study and the sample used, and identifies the limitations of the study. Chapters 4 and 5 report the findings, along with an analysis and discussion of the findings. Chapter 6 addresses the conclusion of the study, as well as the implications and recommendations for further studies. References and appendices are included.

CHAPTER 2

REVIEW OF RELEVANT LITERATURE

2.1   Overview

In this chapter, a critical analysis is made of studies of children and computers in general, and the context of young children's collaborative and cooperative interactions whilst working on computers in particular. The first section presents literature on early childhood education and computers. The second section discusses peer-based collaborative interactions among young children whilst using computers and summarizes the potential educational benefits of collaborative learning situations. The final section of this chapter addresses current issues concerned with studies of young children and computers and reviews literature on young children interacting with each other whilst working on computers.

2.2   Early childhood education and computers

Technology figures prominently in all aspects of today's life, with computer technology playing a central role in the educational environment. Computers allow for development, adaptation and delivery of tools which may facilitate more effective thinking, problem solving and learning (Papert, 1993; Haugland & Wright, 1997). These developmental tools are mediated into the computer by means of well-developed and convincing software. Together with an appropriate program, children are able to experience enjoyment by playing games in education (Haugland & Wright, 1997; Haugland & Shade, 1994; Teng, 1997; Papert, 1993). Learning to use computers can assist children's development. In discussing pre-primary children and their computer experience, Haugland (1999, p. 28) asserts:

"Through exploring computer experiences, these children build memory skills, learn how to seek out information, use knowledge until they have a clear understanding from multiple sources, and integrate their knowledge of how each ecosystem functions. In the process they learn to delegate responsibility, interact with others, problem solve and cooperate to reach a goal" (Haugland, 1999, p. 28).

Furthermore, Nastasi and Clements (1991) reveal that classrooms that are managed to support cooperative learning practices can be very effective in terms of both student attitudes and academic performance. Crook (1995) argued that based on sociocultural theories, learning is inherently social because it involves appropriating modes of social discourse in gaining access to representational systems that permit distinctive ways of interacting, organising and communicating. In addition, recent research on situated learning, proposed that the unit of analysis of learning events can no longer be the decontextualized performance of an isolated individual, but a unit involving people interacting in a goal-directed activity setting (Forman & Larreamendy-Joerns, 1995). The logistic reality that most schools do not have enough computers for each student to use individually, and the likely cognitive and motivational benefits of collaborative computer use, provide a compelling argument for young children to work together collaboratively on the computer.

2.3   Peer-based interactions

In the field of early childhood education, children's ability to engage in social play with peers has traditionally been accorded a role of prominent importance (NAEYC, 1996; Haugland, 2000a). General teaching practices and the overall organisational structure of the classroom may influence the quality of children's peer interactions by affecting the emotional climate and opportunities for peer interactions (Berk, 2000a; Berk, 2000b). Furthermore, the format of classroom organisation relates closely to the teacher's teaching style, beliefs and educational philosophy of learning (Berk, 1997; Berk, 2000a; Berk, 2000b). Children at their desk may be seated individually, in rows, in small groups or in a combination of these styles. The specificity of use of curriculum materials and activities in supporting social skills and peer relationships in classrooms may include social problem-solving exercises,

discussion of stories relevant to peer relationships, and planned or spontaneous social interventions (Kemple, David & Hysmith, 1997). However, literature convincingly demonstrates that a teacher's spontaneous mediation of naturally occurring peer interaction may be the most effective type of social intervention for young children (Hazen, Black, & Fleming-Johnson, 1984; Katz & McClellan, 1991; Kemple, 1991; Kostelnik, Stein, Whiren, & Soderman, 1993; Ramsey, 1991).

2.3.1 Children's collaborative interactions at the computer

With the continuing growth of early childhood education and care, young children are experiencing more opportunities for social interaction with peers. Some, extrapolating from child development literature, in combination with the practical wisdom of the teaching profession, have suggested that peer-relationships contribute to children's long-term development (Haugland, 2000a; Haugland, 2000b; Berk, 2000a; Berk; 200b). Furthermore, in recent studies of peer collaboration, different configurations of task, social partners, and individual characteristics have been evaluated by examining different indices of conceptual change before and after social interaction, to discriminate which social context facilitates or impedes cognitive changes (Forman & Larreamendy-Joerns, 1995). Mevarech and Light (1992, p. 275) postulate that "... theoretically, the accumulating research on peer-based interaction at the computer may clarify basic questions regarding the processes of cognitive change and social development".

Some claim that the words cooperation and collaboration are often used rather loosely to describe people acting together in some way (Crook, 1991). Education technologists and researchers in the field of computing in education are familiar with the acronyms of CSCL (Computer Supported Cooperative Learning) and CSCW (Computer Supported Collaborative Working), which refer to the terms "cooperation" and "collaboration" invoked in the development of tools and environments to support joint action for group use. According to Crook (1991), cooperation depends on a supportive community and actors who agree to help one another in activities aimed at attaining the goals of each target actor involved. Collaboration, on the other hand, depends on the establishment of a common meaning and language in the task, which

leads to the community setting a common goal. Research, which examines the mechanisms that underlie children's acquisition of new knowledge or new cognitive strategies via peer-computer interaction, is commonly referred to as "technology driven" research (Lepper & Gurtner, 1989). However, as Mevarech and Light (1992, p.276) assert:

> " ... as "technology driven" research may raise more sophisticated questions concerning the interaction between the cognitive and social factors, it does not remedy the lack of more basic "theoretically driven" research ...Vygotskian and Piagetian theories offer possible starting points, but there is need for more refined and specific theories in the area, in particular, such theories need to address the roles of pre-existing knowledge, peer collaboration, and external feedback in facilitating the learning processes".

Mevarech and Light (1992) advance their arguments by recommending that future research should concentrate on delineating the relationships between student entry characteristics, learning behaviours, schooling outcomes in both the cognitive and social domains, and metacognitive strategies used by children solving problems cooperatively at the computer. Furthermore, further research needs to focus on understanding the extent to which children can be trained to use general strategies, as well as how these strategies can be applied outside the computer context to facilitate problem solving processes (Mevarech & Light, 1992).

2.3.2   Potential benefits of collaborative learning situations

Understanding the nature of young children's collaborative interaction while working with computers has been proposed to offer several potential educational benefits (Lomangino, Nicholson & Sulzby, 1999; Nicholson, Gelpi, Young & Sulzby, 1998; Haugland & Wright, 1997; Wright, 1998; Clements, 1998; Haugland, 2000). Collaborative use of computers may also provide potential benefits for both curricular and logistical reasons in early childhood classrooms. As most schools do not have the resources to provide a computer for each student, most children need to work in pairs or small groups (Sulzby & Young, 1990).

Some claim that Western industrial societies tend to promote competitive school environments that rely heavily upon teacher-directed lessons rather than peer collaboration for classroom instruction (Cazden, 1988; Mevarech & Light, 1992). However, a body of research indicates that there is a need for research related to peer collaboration (Dillenbourg, 1999; Kewley, 1998; Armstrong, Johnson, & Balow, 1981; Garibaldi, 1979; Johnson, Johnson, & Scott, 1978; Tjosvold & Johnson, 1978). Furthermore, Kewley (1998) postulates that many of the studies were etic, and dealt with a limited number of *a priori* aspects at one time to offer a narrow explanation of the relationship between cooperative learning and cognitive growth. Consequently, as asserted by Kewley (1998, p. 27) "there does not seem to be an adequate explanation of the global picture". The global picture as described by Kewley (1998) may indicate the possibilities of research in understanding the multidimensional effects of peer interaction on a large variety of cognitive outcomes including knowledge skills, general strategies, problem-solving processes, and creative thinking, as well as psycho-social variables such as motivation, self-esteem, interpersonal relationships, and social behaviours.

The possible cognitive benefits of collaborative computer use among young children have begun to be explored by recent research (Lomangino, et. al, 1999; Trinidad, 1992; Dickinson, 1986). Recent theories of development support the potential benefits of collaborative activity among young children (Berk, 1994; Berk, 2000a; Berk, 2000b; Lomangino, et. al, 1999; Nicholson, et. al, 1998; Haugland & Wright, 1997; Wright, 1998; Clements, 1998; Haugland, 2000). This is in line with both Piaget's and Vygotsky's views on the importance of interaction with others for learning. The application of Vygotskian principles to the realm of peer interaction suggests that children can interact more competently in the presence of a supportive adult, or a more expert peer, than they can without their sensitive support, tuned in relation to the child's level of competence (Fine, 1993). Thus, when children use computers collaboratively, opportunities for development may occur when partners have different areas of competence and interact positively in dialogue that includes questioning, providing elaborated responses, and instructing.

In contrast, Teng (1997) speculates that these interactions would also involve a substantial number of negative responses and expressions of disagreement due to conflicting perspectives among children. In addition, engagement in interindividual cognitive conflict in the process of collaboration may lead to even greater cognitive gains. Thus, children ought to be involved beyond mere disagreement to benefit from cognitive conflict. The process of resolution of cognitive conflict, rather than the occurrence of conflict, is thought to be a catalyst for cognitive growth, with cognitive gains enhanced when partners contribute equally to conflict resolution (Bearison, 1986; Nastasi & Clements, 1992). Shachar and Sharan (1994) convincingly demonstrate that collaborative learning has the potential to facilitate the acquisition of problem solving strategies, verbal abilities, meta-cognitive knowledge, and curriculum content. Gillies (1997) postulates that firstly, collaborative learning situations provide teachers with the opportunity to adjust the pace of instruction to take into account the diverse learning needs of children. Secondly, children are encouraged to assist and support each other by sharing information and ideas. Thirdly, collaborative learning situations may encourage all students to be active members of their group as they work on group-based tasks, which enables teachers to manage large numbers of children in single classrooms, while ensuring their time is spent productively. Finally, Gillies (1997, p. 77) stresses that "collaborative learning appears to have a positive effect on students' classroom behaviours".

2.3.3 Developmental appropriateness of software

In a seminal study of young children (aged 4 through 8) and computers by Shade (1994), the author convincingly demonstrated that young children do not respond immediately to the "developmental appropriateness" of the software. According to his findings, young children's first-time 10-minute exposure to new software is not a straightfoward response. Responses are mediated more by age, gender, and social condition than by the developmental appropriateness of the software. From this study, it was found that children need encouragement to work at the computer in groups and that they will exhibit increased positive emotional responses even with a randomly selected partner. Furthermore, children in this study exhibited little or no negative emotions (fear, sadness, disgust) when working with

computers, regardless of software appropriateness, social condition, gender, or age. This finding is in contrast to that of Teng (1997) and Lomangino, et. al (1999) who reported a substantial amount of anti-social interaction and disputational behaviour between peers whilst using computers. However, since Shade's study was conducted in two different laboratories held during summer computer day camps, the naturalistic environment of an early childhood classroom was significantly eliminated. Thus, in discussing young children and computers, the difference in social context of studies appears to produce different outcomes (Mevarech & Light, 1992; Shade, 1994; Teng, 1997; Lomangino, et. al, 1999; Haugland, 1997b, Haugland, 2000b).

However, a study by Anderson, et al (1999) investigated the question of whether the task structure embodied in computer software affects the patterns of interaction among users who are collaboratively using that software. Research was undertaken comparing teacher-pupil and pupil-pupil dyads using computer-assisted learning programs, of both 'open' (where the means of achieving the task goal are under the users' control) and 'closed' (where the routes to achieving the task goal are much more controlled by the computer) types (Anderson, et al., 1999). Ten dyads of each type were tested. The pupil participants, who were paired into same-sex dyads, were secondary schoolchildren with learning difficulties (excluding extremes of low or high attainment within that category), and the teacher participants were drawn from the Mathematics and the English Language departments of the same schools, five from each subject domain (Anderson, et al, 1999). The interactions within teacher-pupil and pupil-pupil dyads whilst using the programs were video recorded and subsequently analysed to ascertain whether the nature of the software (open or closed) exerted any constraining effect upon the dyads' interactions. Conversational sequences and variations in interactional styles were identified using both qualitative and quantitative methods (Anderson, et al, 1999). It was concluded that the open-closed distinction conflates several dimensions of the computer 'behaviour' (for example, prompting and cueing), particularly the number of options of action available to users at any given point, the frequency of computer interventions (for example, prompt versus question) and the granularity of the task (Anderson, et al, 1999). Overall, this study demonstrated that the structure of the computer task does indeed affect dialogue among users of the software, and that the data stipulate the

need for a more detailed consideration of program 'behaviour' and its relation to user dialogue (Anderson, et al, 1999; Mercer, 1999; Mercer & Wegerif, 1999).

2.4   Young children and collaborative computer activities

Until recently, few researchers and educators directly related young children's social interactions to cognitive enhancement and established this relationship in today's early childhood classrooms (Haugland, & Wright, 1997; Mercer, 1999; Littleton & Hakkinen, 1999). Many educators assumed that classrooms promote learning in both cognitive and social frameworks but the individual was often the focus of learning (Forman & Cazden, 1985). More recently, educationists have drawn upon theories such as those of Vygotsky (1978) to show that learning takes place in a social context, and thus cognitive and social frameworks can be structured by teachers to mutually support learning (Littleton & Hakkinen, 1999). For example, Vygotsky (1978) saw make-believe play as the ideal social context for fostering cognitive development in early childhood. Language was seen as the foundation for all higher cognitive processes, including controlled attention, deliberate memorisation and recall, categorisation, planning, problem solving, and self-reflection (Berk, 2000a). In contrast, Piaget believed that cognitive maturity and certain social experiences, for example, disagreement with peers, eventually bring an end to egocentric speech (Berk, 1999). As children repeatedly see that others hold viewpoints different from their own, the egocentric speech gradually declines and is replaced by social speech, in which children adapt what they say to their listeners (Werstch, 1991).

2.4.1   Social development of five-year-olds

"Generally speaking, the five-year-old child seems well-balanced and is definitely a 'social animal', enjoying the transactions in the social worlds" (Berk, 2000a, p.103).

Children of five years old are different from those of their previous ages, since they are more 'adult-like' (Berk, 1994). Although most five-year-olds are more mature than children of four or three, they still have vocabulary skills beyond their understanding and social skills that lack complexity and meaningful purpose. Also,

most five-year-old children are capable of designing complex sentences, understand most grammatical structures, and believe in the literalness of language (Berk, 2000a; Berk & Winsler, 1995). These understandings will eventually be incorporated into socialised speech (Werstch, 1985). However, previous findings (Berk, 2000a) indicate that preschoolers' communication does vary considerably across contexts, as their conversations appear less mature when they cannot use gestures and other concrete props to help overcome the limits of their current knowledge, vocabulary, and memory. According to Piaget's cognitive developmental theory, the thinking process of children who are in transition between preoperational and concrete operations wavers back and forth (Wertsch, 1985). However, Piaget's description of the preoperational child is no longer fully accepted, as cited in Berk (2000a; p.335):

> "They believe that Piaget's strict stage definition needs to be transformed into a less tightly knit concept, one in which a related set of competencies develops over an extended time period, depending on biological maturity and specific experiences"

Piaget emphasised social interaction, and more specifically peer interaction, from the perspective of its specific role in the development of logical reasoning (Wertsch, 1985). Vygotsky (1978) however, conceptualised social interaction as being at the core of the developmental process. Peer interaction provides an important context for the development of social skills. Over the preschool years, cooperative play becomes common in most early childhood classrooms, although solitary and parallel play are also frequent (Berk, 2000a). Central to the neo-Vygotskian analysis of social interactions, the emphases on negotiation and joint construction of understanding between children have been previously studied (Mercer, 1999; Littleton & Hakkinen, 1999). Even though preschoolers do not have a mature understanding of relationship, interactions between friends are already more positive, emotionally expressive, and rewarding (Schickendanz & Schickendanz, 1997). As cited in Berk (2000a, p.374), 'because peers interact with one another on an equal footing they must assume greater responsibility for keeping a conversation going, cooperating, planning, and setting goals for a play theme than with adults or other siblings'. Moreover, these responsibilities concerning social interactions have been demontrated in the studies of

young children whilst collaboratively engaged at the computer (Mercer, 1994; Mercer, 1999; Lomangino, et al., 1999; Nicholson, et al., 1998)

2.4.2 Social and cognitive benefits of collaborative interactions

Decisions on implementing collaborative computer-assisted learning in dyads or small groups rather than individually can substantially cut the costs of teaching with computers. In the same vein, understanding how to construct the "zone of proximal development" (Vygotsky, 1978) within computer environments may improve students' higher mental processes (Haugland & Wright, 1997; Haugland & Shade, 1994; Teng, 1997; Papert, 1993). Peer-based interaction at the computer may assist a better understanding of theories of information processing and social-cognition, and clarify the distinction between different types of cognitive and metacognitive components and strategies used by children while solving problems collaboratively at the computer (Crook, 1995; Mercer, 1994; Forman & Larreamendy-Joerns, 1995). Perlmutter, Behrend, Kuo, and Muller (1989) revealed the need to examine the nature of young children's engagement in the social demands of complex collaborative activities on the computer, and stressed looking beyond the cognitive impact of collaboration to consider the motivational influence of working with peers on computers.

Three concurrent studies (two studies involving four and five-year-olds, and a third study examining children aged four to seven years) were conducted by Perlmutter et. al (1989) in an attempt to examine both cognitive and motivational outcomes of collaborative use of computers among young children. The studies adopted a developmental perspective and the results revealed significant outcomes of young children's collaborative interactions. The research involved simple prereading and counting computer games, and a more complex EZlogo task. The findings indicate that young children can effectively interact, providing instruction and direction to facilitate problem solving activity, when engaging with simple task-oriented software. Among five-year-olds, the findings showed higher satisfaction when working with a peer than working alone. However, when children of the same age worked together on more complex and sophisticated software (EZlogo), the

amount and quality of assistance dropped over time. Although peer interaction was found not to improve learning, children in pairs were observed to stay longer at the computer. However, the findings indicated a decline in the amount of social interaction over time. In addition, cognitively, peer interaction of preschool children was scored lower than that of the elementary-aged children. Moreover, younger children showed greater engagement in terms of less off-task behaviour when working with a partner. The authors concluded that young children can effectively interact among peers, and provide instruction and direction to facilitate each other in problem-solving activities. The authors also suggested that for young children just mastering skills, the presence of a peer may not lead to cognitive benefits, but will provide motivational benefits. However, Teng (1997) argued that young children of five-years-old may benefit cognitively from each other's prosocial interactions. Moreover, in recent developmental work in peer collaboration, the recommendation is made to examine the extent to which children can be trained to use general strategies and how these strategies can be applied outside the computer context to facilitate problem solving processes (Mercer & Fisher, 1992; Kewley, 1998; Mevarech & Light, 1992; Nastasi & Clements, 1993).

Neo-Vygotskian sociocultural theory posits three distinctive and contrasting theoretical perspectives on computer use in education (as shown in Figure 2). In discussing tertiary education and computer usage, McLoughlin and Oliver (1998) emphasised that learning around computers is a social activity where learners share resources, talk, discuss ideas and collaborate. McLoughlin and Oliver (1998, p. 134) further the argument by stating:

> "The quality of learning around computers is not entirely dependent upon the interface between learners and the technology. Instead, it is related to the whole social climate of the classroom and the opportunities created for interaction and 'exploratory talk' between participants in the learning process"

Mercer (1999) claims that in a conversational sequence of exploratory talk, the collaborators engage critically but constructively with each other's ideas, while knowledge is made publicly accountable and reasoning is visible in the talk. However, these conditions are not to be found in most five year olds. Moreover, this explanation

is not compatible with that of recent studies of computer-based learning by Shade (1994), Lomangino, et al (1999), and Nicholson, et al (1998). Shade (1994) reported that the children in his study exhibited little or no negative emotion (fear, sadness, disgust), nor confrontational behaviour when working with computers, regardless of software appropriateness, social condition, gender, or age. Thus, the integration of communication into computer tasks has to undergo a certain process, as shown by a diagram (Figure 2) developed by McLoughlin and Oliver (1998):

Figure 2 Social and communicative processes (McLoughlin & Oliver, 1998)
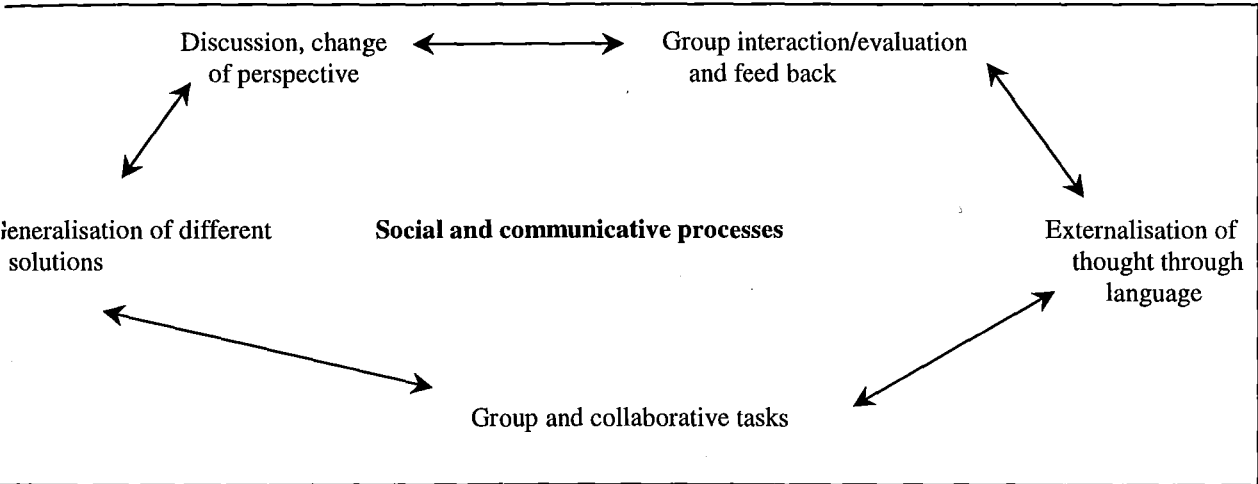
2.4.3 Collaborative composing interaction

Collaborative learning involves children working together either in dyads, small groups, or small sections of a larger class group, with the teacher facilitating, rather than directing, the learning processes. A common learning activity in a classroom is group composing, or collaborative composing. Considerable attention has been given to support literacy development among young children through collaborative composing activities (Lomangino, et. al, 1999; Nicholson, et. al, 1998; Haugland & Wright, 1997; Wright, 1998; Nastasi & Clements, 1992; Haugland, 2000). A recent study by Lomangino, et. al (1999) of the influence of power relations and social goals on children's collaborative interactions while composing on the computer suggested that within the context of collaboration, children exhibit many

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constructive patterns of interaction while composing collaboratively on computers, even with minimal adult involvement. This is in line with the sociocultural theory that emphasizes the importance of support of a more skilled partner and their interactions in facilitating children's development. Vygotsky (1978) proposed that children's development of higher cognitive functions is neither innate nor learned from the caregiving environment, but rather by children constructing their cognitive functions in collaboration with adults or more capable peers. Lomangino, et. al (1999) conducted a study of two American first grade classrooms in a middle class suburb of a large midwestern city for a period of nine months. Data were collected from three cases embedded within a larger series of studies using ethnographic methods. One mixed gender dyad, one male dyad, and one female triad of first graders were selected for in-depth analysis. A recursive process of behaviour coding was conducted and verbalizations of participants were recorded. Codes were constructed to represent the objectives of each new behaviour and verbalization made by the children within their collaborative groups. The outcomes of the study provided insights into positive collaborative interactions among young children whilst sharing a computer. Dyson (1993), as cited by Lomangino, et. al (1999, p. 210) stated:

> "Working together to compose a collaborative computer story was a multi-media affair where children worked through talk, text, and drawings to accomplish not only the cognitive aspects of the activity but also to position themselves socially among their peer groups." (p. 210)

However, a significant pattern of conflictual interactions and disagreements among the children was also observed. This finding suggests that the affectively negative interactions among partners were associated with higher levels of negativism when disagreements occurred. On the other hand, affectively positive interactions among group members signaled less overall contention in partner disagreements (Lomangino, et. al, 1999). Similar to Mercer's (1994) research, negatively charged interactions were often observed as impeding productive collaboration, and thus inhibiting productive composing. Furthermore, these "disputational talk disagreements " (Mercer, 1994), and the negative interactions were rarely followed with justifications or elaborations to help peers understand the reasons behind the opposition. Speakers challenge other speakers' views, but without attempting to

justify their challenge on previous utterances or offering new information' (Mercer, 1994, p.27).

As mentioned above, this study provided significant insights into positive collaborative interactions among young children whilst sharing a computer. However, as the study chose the participants from a school that had focused on the goal of incorporating computer-based technology into their classrooms prior to the study, the outcomes of the research lacked external validity. Therefore, it is important to note that the findings of this study can not be generalised to all pre-primary centres universally. In addition, as patterns of interaction were observed within the influence of the media centre, this investigation failed to distinguish between different collaborative-computer environments and the social-cognitive domains involved (Mevarech & Light, 1992; Nastasi & Clements, 1992; Haugland & Wright, 1997). Mevarech & Light (1992) further postulate that there is a need to identify the types of social-cognitive processes within computer environments on the basis of psycho-social support and those referring to cognitive scaffolding.

2.4.4 Prosocial and anti-social behaviour of young children on computer

Another relevant study conducted in Taiwan advances the argument that in an age-appropriate computer learning environment, young children display high cooperative interactions among peers whilst interacting with peers on computers (Teng, 1997). The researcher observed six five-year-old Taiwanese children in a computer laboratory. The study revealed that the children displayed a high frequency of child to child interaction and also spent a substantial amount of time observing their partner's behaviour whilst using the computer. An ethnographic research paradigm was applied to this study. In analyzing the participants' social interactions in the computer centre, the 'giving guidance' category was the pattern used most frequently by all participants (Teng, 1997). Similar to Lomangino, et. al's (1999) research, the researcher observed a pattern of disagreement related to negative interactions among the children. Blaming others, exhibiting negative physical behaviour and refusing to share were observed as conflictual interactions, and further categorised as anti-social interactions. Although both pro-social and anti-social

behaviours and categories of interactions of the participants were well-documented, the small sample size contributes to a lack of generalizability of the findings of this study. In addition, the naturalistic setting of a classroom environment might produce different outcomes from those interactions exhibited in a computer learning laboratory.

2.4.5   Interactions of younger children on computer

Studies of much younger children (aged 2-3 years) revealed that human interaction is vital to help young children understand the computer environment. A study by Jones and Liu (1997) showed that children aged 2 to 3 years can engage in computer interactions but only to a limited extent. Meaningful and purposeful interactions may not begin until the child is about two-and-a-half-years-old (Jones & Liu, 1997). According to the researchers, prior experience of computers and appropriate input devices (keyboards) are vital in helping young children interact in a computer environment. A similar outcome was revealed by Carlson and White (1998) who found positive effects of computer experience on young American kindergarten children (aged 5-6 years). The study concluded that appropriate computer programs can significantly increase young children's understanding of the concepts of left and right. Children as young as kindergarteners can have positive educational experiences with computer technology and appropriate educational programs (Carlson & White, 1998; Jones & Liu, 1997).

2.4.6   Social interactions of elementary-aged children on computer

Partly due to a lack of resources, most classrooms of British primary schools have one or two computers only to share between some 30 children, so the computers are used in groups of two or three (Jackson & Kutnick, 1996). Thus, a corpus of classroom based research has expressed the need to explore differences in individual and paired performance on a computer task rather than the often used problem solving task (Mevarech & Light, 1992; Jackson & Kutnick, 1996; Wegerif, 1996). An experimental study by Jackson and Kutnick (1996) furthers the argument by suggesting that the grouping of children should depend on the type of task and not

inadequate resourcing or the perception that all computer programs require cognitive learning. This experimental study followed the experimental design of Individual-Pair-Individual format of previous studies in which the children were pre-tested individually, then placed in the individual or paired experimental condition for the computer task or in a control condition, and finally post-tested individually. The results of this study suggest that teachers and researchers should not accept that group work is the favoured grouping method for all computer based activities. Furthermore, educators ought to question the pedagogic intent of the assigned task and ascertain whether individuals, pairs or larger groupings of pupils are most appropriate (Kutnick, 1994; Jackson & Kutnick, 1996).

There is a paucity of research investigation into the nature and value of group interactions, particularly verbal interactions whilst working on computer (Mevarech & Light, 1992; Wild, 1996). Investigation of such interactions would provide insight for classroom teachers to assist them in planning computer activities to facilitate verbal interaction (Wild & Braid, 1995; Braid, 1996). The authors investigated the verbal interactions of twelve Year 5 (ages 9-10 years) students working in cooperative small groups on computers and examined the influence of group structure and software type on the amount and type of talk of the students. Prior to the study, all students had had limited access to the class computer, and had worked independently or in heterogeneously structured groups of four to five students (Wild & Braid, 1995). This study convincingly demonstrated that in order to analyse the students' verbal interactions, or students' talk, there is a need to interlink the dialogue of conversations, to allow the meaning of the talk to be studied in context (Wild & Braid, 1995). The authors advance this argument by suggesting that talk is needed to be analysed in blocks of conversation, as the conversation is often fragmentary, with speakers taking short turns, and speakers actually sharing in the production of the discourse. According to the statistical analysis, 81% of students' talk was cognitively oriented, with directing and reporting the most frequently occurring type of cognitively oriented talk (Wild & Braid, 1995).

Furthermore, Mercer (1994) indicates that talk plays a prominent role in learning. Learning, as an educational process, ought to be seen as a communicative process whereby knowledge is constructed, shared, debated, interpreted and misinterpreted as children talk with teachers and each other (Mercer, 1996). The sociocultural perspective proposes the recognition of the social and historical context as a powerful shaping influence on children's interpretation and understanding of classroom experience, by using language as their medium (Mercer, 1996). According to Mercer (1996), there are three kinds of conversational sequences of children's talk at the computer, (1) disputational talk; (2) cumulative talk; and (3) exploratory talk. It is suggested that exploratory talk may substantially contribute to collaborative computer based activity (Mercer, 1996; Crook, 1994; Rutkowska & Crook, 1987). Exploratory talk proposes hypotheses, makes and justifies objections and offers relevant information, while disputational and cumulative talk are of limited value in achieving educational aims (Mercer, 1996).

In addressing the three kinds of talk, Mercer (1996) stipulates that decision-making and keyboard activity may be stimulated in a certain context. It should be noted that all three kinds of talk identified differ in the social mode of thought that they represent (Mercer, 1996, p. 27):

> "One does not have to step deep into that familiar quagmire of academic debate on the 'relationship between language and thought' to suggest that one of the aims of education should be to encourage and develop children's ability to use talk to reason with, to effectively share the fruits of their reasoning with others, and to be suitably receptive to the reasoned argument of others when drawing conclusions, making decisions....".

Mercer (1994) emphasised the educational value of talk in his study, involving joint research of the Open University and University of East Anglia, in the United Kingdom, called the Spoken Language and New Technology (SLANT) research project (1990-1993). The main aim of the project was to investigate the quality of talk in computer-assisted collaborative activity. Data from a variety of ages of children, urban and rural locations, curricula-related topics and educational software packages were gathered during the three years course of the study. Interactions of 50 children aged between 5 and 13 were recorded working on the computers, assisted by 15

teachers from 10 different schools. According to Mercer (1994), one of the principal outcomes of the analysis was the identification of certain patterns and features of conversational sequences which seemed to be characteristic of children's conversations at the computer. These sequences were acknowledged by the SLANT researchers as having high potential educational significance (Mercer, 1994). They are as follows:

1. Disputational talk; whereby speakers challenge other speakers' views, but without attempting to justify their challenge by building on previous utterances or offering new information

2. Cumulative talk; whereby speakers contribute to discussion by taking up and continuing a previous speaker's utterances, without explicit comment

3. Exploratory talk; whereby hypotheses are proposed, objections are made and justified, and new relevant information is offered.

However, the natural incidence in primary classrooms of talk of an 'exploratory' kind was very low (Mercer, 1999). In discussing children's talk and the development of reasoning in the classroom, Mercer (1999) argued that more often children interacted in uncooperative, competitive ways which generated disputational talk. Mercer (1999) concluded the argument based on the findings of the SLANT research project, by citing a study of Barnes and Todd (1995), that "primary teachers hardly ever drew children's attention to the way they used language together, or explicitly sought to encourage ways of using it to share knowledge and solve problems. However, in relation to the current study, the findings of Mercer's (1994) SLANT research project were found to be of significance. Four computer-specific sub- variables were found to influence the children's way of working together and the kind of discussion that would ensue. The four sub-variables were derived from three major variables identified for analysis of the SLANT project. The other two main variables were the teacher and pupil variables (Mercer, 1994). The computer-specific sub-variables were (1) the physical design of the hardware, (2) how the equipment is laid out, (3) the kind of software used, and (4) the nature and number of tasks pupils have to handle. Reflecting on the data obtained from the current study, the influences of these sub-variables were found to be similar. Furthermore, Philips and Schrimshaw (1992), as

cited in Mercer (1994), observed several characteristics of communicative exchanges, involving talk and computer activity. The simplest forms of exchange were identified as follows: (1) an instruction (for example a child stating what should be done); (2) an action response (a child presses a key or mouse device); (3) an outcome (for example something happens on the screen); (4) an acknowledgment of the outcome (usually a remark by a child) (Mercer, 1994).

Whilst Mercer (1994) acknowledged that all three types of talk are appropriate in certain circumstances, exploratory talk was maintained to offer potential for learning over and above that offered by the other types of talk. Littleton and Hakkinen (1999) postulate that exploratory talk is essential for successful participation in educated communities of discourse, as it is characterised as the embodiment of critical thinking. It is argued by Mercer, Wegerif and Dawes (1999), that this type of talk represents a distinctive social mode of thinking and that, by encouraging the awareness and use of such talk, teachers and educators may be able to help learners to develop intellectual habits that will serve them well across a diverse range of situations.

2.4.7 Type of interaction pattern and task structure

According to Mercer (1994), the computer-specific sub-variables of the physical design of the hardware, and how the equipment was laid out, was found to be influential in the way that the children organised their activity together in the absence of the teacher. It was found that whoever happened to be in front of the keyboard, or mouse device, or who made sure that they were, operated the keys or the mouse device. Similar to the study being reported here, it was found that the task structure and the turn taking system employed by the classroom teacher influenced the interaction patterns exhibited by children. The nature of the tasks provided for the children were determined by the teacher and thus, as stated by Fisher and Selinger (1992), the software used was expected to generate structured tasks with specified, and beneficial outcomes.

The most striking influences observed in this study of the software design of the *Cyber Grannies* program on the interaction patterns, were in the activities

exhibited by children while engaged at the computer. The software program tended to generate a characteristic set of communicative exchanges, which include talk and computer activity. The findings of the study being reported here is similar to the findings of Phillips and Scrimshaw (1992), as indicated in the study by Mercer (1994). Forms of verbal exchanges involved in the interaction of the study being reported here are:

1. an instruction (for example, interaction patterns of directing partner's actions and providing information);
2. an action response (for example, a child presses a key or clicks an icon using the mouse device);
3. an outcome (for example, the animation or prompt generated from an icon when clicked upon); and
4. an acknowledgment of the outcome (for example, interaction patterns of showing pleasure and self-monitor/repetition).

Young children need a way to express their ideas in the technology-integrated classroom. In the study being reported here, the task structure provided in the content and design of the software package facilitated children to type or click the letters or icons they chose with a mouse rather than needing to write with their poor, small motor control. Therefore, it is concluded that a form of scaffolding and developmentally appropriate software can support children within their zone of proximal development, in the same way as peers, parents, and teachers. However, it is not being suggested that the computer should replace traditional drawing or writing activities, but rather, that it can be used to incite and foster new ways of thinking about writing, drawing, and using math.

2.5   Computer studies of Australian children

Although considerable attention has been given to studies of the relevance of computers in Australian classrooms, there are few ethnographic accounts of how young children (aged 5-6 years) interact collaboratively with each other in a naturalistic setting. Trinidad (1992) examined how children's learning and

development can be understood within the social contexts in which the learning takes place. Data were collected from 121 Western Australian children in three Perth metropolitan pre-primary centres over two years. The study adopted both qualitative and quantitative research paradigms. Six groups of children were involved at the three pre-primary centres where two groups did not have any computer exposure for 25 weeks, and four groups had 50 weeks' exposure to the computer using either Software Type 1 (drill and practice software) or Software Type 2 (open-ended, discovery-based software) (Trinidad, 1992). A substantial number of instruments were also involved, including the Battelle Development Inventory (BDI), Friedrich and Stein's observational scale, and Haugland and Shade's (1988) continuum for 'Developmentally Appropriate Software', with Hoffmann's (1986) guidelines of environmental experience and user control.

In Trinidad's (1992) study, ethnographic data were gathered to provide insight into the way the children interacted with the computer, software type and each other, to promote individual learning styles. According to the researcher, the children were observed to be task orientated and cooperative when using the computer for both Software Type 1 and Software Type 2 and on several occasions individual children were given the opportunity to acquire and practice learning strategies with peers and adults. Furthermore, Anderson, et al. (1999) claimed that there is evidence that the structure of the computer task does indeed affect dialogue among users of the software. Thus, Trinidad (1992) concluded that exposure to the computer-based learning environment gave children an opportunity to interact with the computer, peers and adults in a context that facilitates social interaction. The amount of social and interpersonal cooperation, and the encouragement to socialise while using the computer was due to the interactive environment provided by the computer and appropriate software (Trinidad, 1992).

Trinidad (1992) also collected additional data on the children's computer experiences at school and at home, and analysed the data in relation to their social preferences when using the computer. In addition to the experimental data, case study data were also analysed from the field observations of 24 target children. An instrument identified as Matched Familiar Figured Test (MFFT), measured the

children's ability to think reflectively and the twenty children who scored the highest were chosen as target subjects. Over a period of two years, data on the different learning styles in relation to the children's use of the computer were gathered. The major findings of this study were that children will not be disadvantaged if they do not experience computer based learning experiences in pre primary. Moreover, this study exemplifies a comprehensive approach towards examining and investigating children's behaviour and response to computer usage. This study also showed that all children were task oriented and cooperative when using the computer. Furthermore, Trinidad (1992, p. 123) asserts, "the children were involved in two sorts of cooperation: whereby their partner or the adult directed them and provided the necessary scaffolding to complete a task, and mutual cooperation, where children worked together towards a common goal." This study suggests that future research should attempt to provide answers to questions pertaining to the type of cooperation that would provide advantages over other activities found in the early childhood environment with regard to peer scaffolding and other forms of positive social interaction (Trinidad, 1992). As Lomangino, et. al (1999, p. 200) assert 'the quality of children's interactive experiences, or their process of engaging in the task, is of critical educational importance. Examining the product of children's work does not reveal the nature of their experiences in its creation.'

In Brisbane, Australia, Gillies (1997) investigated children's collaborative interactions in a learning task environment in Years 2 and 4 of primary school. The researcher employed particular categories in differentiating children's behavioural interactions. Five verbal interactions were identified. These were: (1) non-specific verbal interactions; (2) unrequested explanation; (3) unrequested, unelaborated responses; (4) unrequested offer of help that could not be categorised as either an explanation or an unelaborated response ; and (5) requested explanations (Gillies, 1997). As for the categorisation of types of language, Gillies (1997) coded the children's interactions for inclusive, exclusive and Group maintenance language. Inclusive language included: a willingness to listen to others; acknowledge other's contributions; and language that recognised the group as a unit (for example, the use of 'we'). Exclusive language included all comments that used 'I' in an authoritative manner, and all negative or disparaging comments directed at others in the group.

Group maintenance language included all language that was not included in one of the two preceding categories (providing unsolicited help; talking to self or others about the task). The study found that children who were trained to work together were consistently more collaborative, helpful, and provided more assistance to each other, even when the help was not explicitly requested (Gillies, 1997). The study suggested that if children were trained in collaborative techniques at an earlier stage of development, then more positive collaborative interactions would be engendered. Although this study was not concerned with computer interaction, it provides an insight into the collaborative interactions of young children.

In discussing computer integration into an early childhood classroom, Downes and Fatouros (1995) constructed a philosophical framework of factors which affect the planning process, as depicted in Figure 3.

Figure 3 Factors which affect the planning process of incorporating technology
(Downes & Fatouros, 1995)

The wider social context

Educational policy
and practice

Family
and community

THE CHILD

Theories
of learning

Social issues

Political and economic climate - affecting
educational priorities and availability
of resources

Political, economic and social issues
Changes in the availability and use of technology
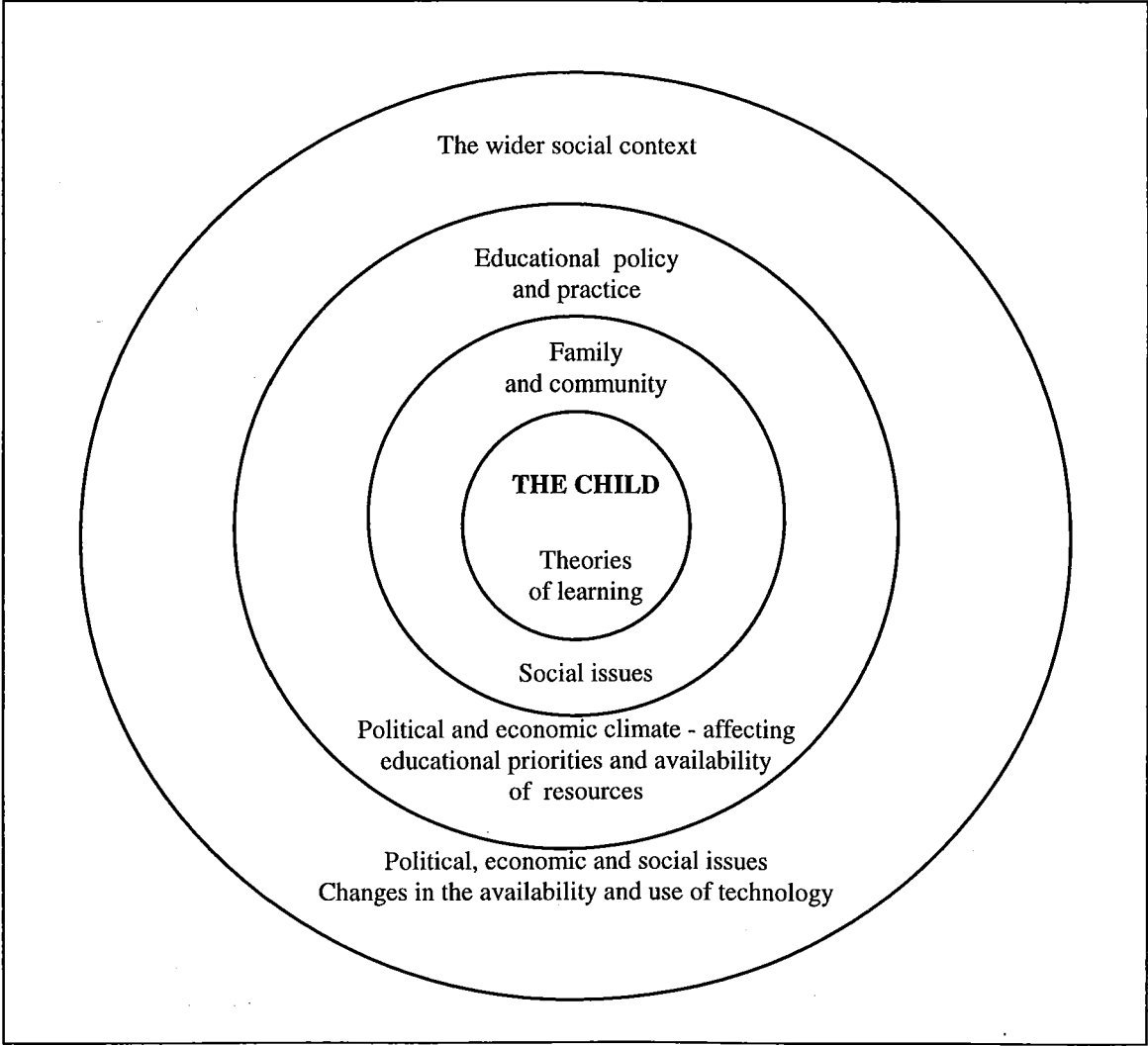
Downes and Fatouros (1995) stress that the use of technology needs to be considered in relation to the major influences, which have an impact on children's lives. The technology alone should never guide the planning process to incorporate it into early childhood classrooms. Rather, theoretical, social, educational and technological issues that have direct implications for planning computer-based learning experiences for young children must be recognised as factors which affect the planning process of incorporating computer technology into classrooms (Downes & Fatouros, 1995). Furthermore, McLoughlin and Oliver (1998) observed changes occurring in learning environments where computers are employed, whereby there is increased emphasis on students learning by collaboration rather than competition. The authors postulate that this pedagogical setting offers opportunities for language use and social interaction, which lead to learning. Thus, teachers in schools are able to maximise learning by incorporating discussion, evaluation of ideas and language activities among students which focus and extend collaborative work using computers (McLoughlin & Oliver, 1998).

2.6   Theoretical framework

This section elaborates on the postmodernist perspective adopted by this study. Developmental theories of Vygotsky and Piaget are also discussed on the basis of postmodernist paradigms, in the context of literature on computers and children. According to Dahlberg, Moss and Pence (1999), postmodernism is not an ideology, but a condition. Thus, a postmodernist views the world of knowledge as "perspectival and ambiguous, contextualized and localized, incomplete and paradoxical, and produced in diverse ways" (Dahlberg, et al., 1999, p. 55). Furthermore, Hlynka, Yeaman, Anderson, Damarin and Muffoletto (1996) argue that the literature of postmodernism reflects a major concern with the influence of technology on society and culture. Hence, this study applies a postmodernist framework to examine the collaborative interaction patterns exhibited by a group of high socioeconomic status, five-year-old children whilst working on computer. By identifying significant factors that facilitate or inhibit the children's interaction whilst using computers, early childhood educators will be in a better position to recognize positive and productive collaborative interactions, that are often indistinguishable from their naturalistic

medium (Haugland, 2000; Haugland & Wright, 1997). A postmodernist analysis will provide early childhood educators with an insight into relatively new computer-related interactions. This framework is premised on the work of Lyotard (1984) and McDermott (1992) who developed and defined the parameters and characteristics of postmodernist perspectives. Lyotard (1984) thinks of postmodernism as the general condition of knowledge in times of information technology. According to Hlynka, et al. (1996), the material base of the postmodernist view is information. Yelland (1999, p. 218), within the context of discussing young children and "technology as play", asserts:

> "Into this body of literature we are now faced with the potential of the new information technologies, not only to enhance learning but also to promote engagement with ideas in a new and dynamic way. In this context, learning is not only fun but children actively construct their own meanings and make sense of the world in their own ways".

McDermott (1992) notes that modernism can be seen as a reaction to the early twentieth-century instructional design machine age, and postmodernism to the age of computers and electronic information design. Postmodernism has also been linked to "double coding" (Jencks, 1986) and the "culture of late capitalism" (Jamison, 1994). Nonetheless, in whichever direction a postmodernist tends to characterise knowledge, it can be seen that the literature of postmodernism reflects a major concern with the influence of technology on society and culture (Hlynka, et al. , 1996).

Figure 4 Cognitive theory and computer use (McLoughlin & Oliver, 1998)

Theory	**Behaviourist**	**Constructivist**	**Sociocultural**
	|	|	|
Activity	Drill and practice tutorials	LOGO programming, micro worlds	Collaborative learning, situated learning
	|	|	|
Learning	Individual instructions and feedback; drill and practice	Individual, discovery based, generalisable ideas	Social, scaffolded, interactive and reflective

McLoughlin and Oliver (1998) made comparisons between behaviourist, constructivist, and sociocultural theories, in relation to their activities and learning processes involved with computer use. As depicted in Figure 4, sociocultural theory of learning has been proposed as the most appropriate for technology supported learning environments, as it: (1) endorses the fact that learning takes place in a social context; (2) recognises that language use is fundamental to learning; and (3) acknowledges that learners need support and assistance to learn, thus providing the basis for maximising learning in technology supported environments (McLoughlin & Oliver, 1998).

2.6.1 Postmodernist perspective on children and computers

According to a postmodernist perspective, children are decentred, where the child is viewed as existing through its relations with others and always in a particular context (Dahlberg, 1999). Some educational researchers, particularly early childhood educators, hold the view that a particular context may include a diversity of human learning, which now includes the powerful cultural artefacts associated with information technology (Dillenbourg, 1999; Sarup, 1993). In an information era, computational environments influence children at an early age (Haugland & Wright, 1997; Dillenbourg, 1999). Computers provide a new context for children's activity with different opportunities for and constraints on the development of cognitive structures (Yelland, 1999; Haugland & Wright, 1997). These cognitive structures, formed through individual and group activity with computers, are influenced by the features of a computational environment and the socio-cultural context in which the activity occurs. Noting significant relationships between technology and communication, Sarup (1993, p. 167) argues that Baudrillard's theory of postmodernism fails to take into account the difference between media technology and communication technology, which are involved in face-to-face communication, as he "abstracts media from the social system and fails to see that media in a contemporary society are a contested terrain, an arena of struggle, in which social conflicts are worked out."

2.7   Summary

The benefits of collaborative computer activity have both theoretical and empirical support from the developmental theories of Piaget and Vygotsky which stress the importance of interaction with others for learning (Lomagnino et. Al, 1999, Teng, 1997; Trinidad, 1992). Given the fact that computers are an integral part of Western Australian education, with most primary schools having at least one computer between two classrooms and most having one computer per class, including preschools and pre-primaries (Trinidad, 1992), and given the importance of social interaction and discourse with others in extending children's learning, it is important to investigate the appropriateness of collaborative computer social interactions in the naturalistic classroom setting. Therefore, this study has investigated the collaborative social interaction patterns exhibited by five-year-old children while using developmentally appropriate educational software programs in their classroom. Furthermore, this study has identified those factors that facilitate or inhibit participants' interactions while using developmentally appropriate computer programs. Finallyn the results of this study have identified those strategies that may be used by early childhood educators to maximise young children's learning and development whilst engaged with the computer.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter describes in detail the methodology of the study. It links the design of the study with the research questions. This is followed by an examination of qualitative research approaches and their significance to the topic under investigation. The methodology for data collection and analysis procedures adopted to ensure authenticity of the findings are described. Finally, the limitations and ethical considerations arising from the study are discussed.

3.2 Research Design

This research was primarily a qualitative study. With the increasing use of computer-based interactive technologies in education and industry, educational technologists have issued a call for the use of more qualitative research methods to explore training and school processes (Mercer, 1994; Mercer, et al., 1999). Qualitative research methods typically include interviews and observations, but may also include case studies, surveys, and historical document analysis. The case-study method, classified as a qualitative research approach (Abu Bakar, 1987; Adams, 1985; Amir, 1989; Ayob, 1985; Baharudin, 1998; Burns, 1994; Burns, 1990; Fraenkel & Wallen, 1993; Kerlinger, 1973; Miller, 1998; Salkind, 1998; Sowell & Cassey, 1982; Wiersma, 1995), was used in this study in order to examine the patterns of collaborative interactions among young children whilst engaged with the computer. The case study "is a detailed [thoughtful] examination of [usually] one particular event" (Bogdan & Biklen, 1982, p. 58) which focuses on behaviours, feelings, and

reactions in order to find meanings in situations or people. According to Yin (1994, p.13), "a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident". Yin (1994) further defines the case study as a research strategy, which constructs a pathway in investigating an empirical topic by following a set of prespecified procedures. Being a case study, the results are the interpretation of responses in a particular place and time (Strauss & Corbin, 1994, p.277). Because of this, the study is 'context dependent' (Mishler, 1979, p.2). That is the results are true and correct for the preschool being studied at the time of the research. However, by selecting a school that is representative of other similar pre-primary schools, it can be posited that similar results would be found in similar pre-primary schools (Burns, 1997). The strength of this method is that the design and procedures can be modified as the study proceeds and as new learning takes place for the observer or as new unanticipated events occur (Ayob, 1985; Baharudin, 1998; Burns, 1994; Burns, 1990; Fraenkel & Wallen, 1993; Kerlinger, 1973; Miller, 1998; Salkind, 1998). In the study reported here, the one event observed was the interaction of pre-primary children, whilst engaged with the computer in dyads, within the naturalistic classroom environment. Both observational comments and descriptions, and data analyses are presented where appropriate.

3.3   Subjects

Subjects for the study were six pairs of children, aged five years, from one Perth metropolitan pre-primary centre in Western Australia. Six children were randomly selected by the classroom teacher, and assigned to the study. Prior to each observation session, the classroom teacher would invite the subjects to take part by saying "Some children are going to work at the computer with Mohamad, and you can choose a friend to play with you" . The teacher would then randomly choose a child and assign them to the researcher. Each of the six randomly chosen children in turn subsequently chose a partner with whom to collaborate and interact at the computer. On two separate occasions, two of the children selected by the teacher to participate in this study were chosen again by two other participants as their partners. The possible effects on the outcome of the study due to this situation are discussed in

Chapter 5. Parental consent was obtained in writing for the twelve children to participate in the study (See Appendix I).

3.4   Procedures

This study was conducted in three phases. Phase 1 involved the observation period and a series of six videotaping sessions. The data were collected by videotaping the participants and taking field notes. Each child was videotaped once, together with their partner for a total of 10 minutes. All the observations took place during the children's daily classroom activities. The computer was located on the far side of the main classroom. Prior to the commencement of the study, a video camera was situated on the left hand side of the computer, facing the children. As the computer was situated on a small rectangular table, a tripod was used to position the lens of the camera to capture the faces of the children whilst using the computer. The video camera was put into position and the researcher visited for a period of two weeks prior to the commencement of the study to enable the children to become used to the presence of researcher and video camera so they would not become over-excited or distracted. The video camera was set up a week before the observation time in order to allow the children to get used to its presence. The camera was switched on, but left unattended without recording. This time period proved to be sufficient to achieve the desired outcome.

3.4.1   Phase 1 (observation and informal interview sessions)

3.4.1.1 Observations

The video camera was situated in front of the computer where the children sat at approximately 45 degrees facing the lens of the camera. For the observations, the researcher situated himself behind the subjects and any required assistance was given by either the teacher assistant or the classroom teacher. Although the researcher was in close proximity to the computer, he remained outside the focus range of the video camera. Data collection was conducted during outdoor activity sessions, which meant that noise interference factors had to be taken into account when choosing the exact

time for recording. The participants needed to be fully focused on the computer activity and the interactions surrounding them. In order to avoid noise distraction from children involved in surrounding play activities, observations of each pair of children engaged with the computer were carried out when all the other children were playing outside. This arrangement also negated the necessity for the children to use audio headphones which, it was thought, would interfere with their collaborative interaction.

The naturalistic non-participant observations of each dyad were carried out three days a week for a duration of three weeks, for a total of nine days. "A non-participant observer stands aloof from the case being investigated and eschews group membership" (Burns, 1997, p.373). The current study chose the naturalistic non-participant observation approach as it is obviously necessary, when it is impossible for the researcher to be a member of the case study group (preschool group) (Burns, 1997). Furthermore, Lincoln and Guba (1985) refer to naturalistic inquiry as a type of research, whereby the researcher plays a more central role in the elucidation and interpretation of behaviours observed. Patton (1990, p.40-41) argues that naturalistic inquiry involves "studying real-world situations as they unfold naturally; nonmanipulative, unobstrusive, and noncontrolling; openess to whatever emerges, which lack of predetermined constraints on outcomes" .

Initially all observations were video recorded for approximately 10 minutes each during the outdoor activity sessions. Subsequently, only six observations were chosen for analysis. While video tape recording the children at the computer, the researcher completed a database of "Field Notes/Observation Record" sheets (see Appendix III p.131-149) to record the day, date, time, software packages, and details of the children. All collaborative interactions between the children and their partners were recorded and field notes were taken.

3.4.1.2 Informal interviews

Informal interview sessions were conducted on the final day of data collection. The interviews were carried out during the outdoor activity session, where each pair of children involved in the observation was interviewed simultaneously. Each interview

session was approximately of 10 minutes' duration. A guiding interview schedule was used to assist the researcher. Four recurring themes in relation to research questions of the current study were applied in designing the interview questions. The themes were : (1) attitude and experience towards computers at home and preschool; (2) knowledge about software (computer games and educational software); (3) accessibility of computer(s) at home and preschool; and (4) cooperative activity with friends in relation to computer activity. The researcher gradually built up a picture of each child's computer competencies and experience with computers at home. All dyads were compiled as target cases and underwent a process of identification and coding of emerging patterns.

Prior to data collection, an informal interview was conducted with the classroom teacher. Information was recorded regarding computer usage and activities in the pre-primary centre. The interview session was carried out with the use of a semi-structured guiding interview schedule (see Appendix p.129-130). Semi-structured interview questions were constructed based on research questions of the current study. Initially, nine samples of questions were developed from three recurring themes of the current study. They were: (1) the teacher's educational philosophy and beliefs in relation to computers; (2) the computer arrangements for access, and turn-taking systems incorporated in the curriculum; and (3) software selections and their educational contents. While conducting the interview sessions, the researcher completed the "Interview Record" sheets by making relevant notes and by constructing concluding comments. All the interviews were audio tape recorded for later analysis.

3.4.2 Phase 2 (transcribing and coding data)

Phase two consisted of reviewing and transcribing the videotapes and coding the children's interactions. The transcriptions were coded for each participant, using an activity coding scheme (Bogdan & Biklen, 1982) and the constant comparative method (Glaser & Strauss, 1967). The collaborative interaction patterns were recorded on individual charts for each child. Each videotape was expanded to include any contextual information recorded from filed notes. All utterances and non-verbal

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behaviours represented in the transcripts were coded. An adjudicator in the field of early childhood education reviewed the videotapes and recorded observations to ensure interrater reliability. Initial codes were constructed and compared with new data until each emerging individual code was mutually exclusive. Codes were constructed to represent each new behaviour and verbalizations made by the children within their respective groups. Furthermore, all codes were constructed to represent the objectives of each child's verbalizations and/or actions.

3.4.3 Phase 3 (analysis and compilation of data)

The third and final phase of the study involved the analysis of all the data obtained. Each individual chart, the videotape transcriptions and the children's audio recordings were analysed. The data were compiled in the two forms of written description and narrative transcription.

3.4.3.1 Data analysis procedures

Data collected from all the interview sessions (the children and the classroom teacher) were used to establish an understanding of the computer integration system in the classroom, the general view of the children's computer experiences and skills, and types of activities and interactions involved while working on the computer. All relevant information was later synchronised to fit the data collected from the field observations. Data collected from the naturalistic non-participant observations were analysed according to three sources. These were after the study of Mercer (1994); a partial application of the System for Observation of Children's Social Interactions (SOCSI), developed by Brown, Odom and Holcombe (1996); and the study of Nastasi & Clements (1992).

A second coder reviewed the videotapes and recorded observations to ensure inter-rater reliability. Initially, the researcher decided that agreement between coders could be checked by looking at totals of categories across each dimension in the interaction patterns. However, this was not considered sufficiently rigorous since a measure of agreement across totals would not necessarily mean a close agreement in

the coding, making the validity of any claims made from the results suspect. An early decision, therefore, was that agreement between coders would be measured pattern by pattern, comparing within a pattern each coder's analysis for each conversational sequence. The inter-rater reliability proceeded as follows: (1) The coding was completed by the researcher, with some checking for consistency included at this stage. (2) The coding rules and procedures were given to the second coder along with a sample of tapes so that the identification of the patterns could be checked for reliability. It was found that there was 50% agreement on the identification of relevant patterns, although only 8% were in disagreement. The discrepancy arose because the second coder tended to define the social behaviours exhibited by the participants, without using the System for Observation of Children's Social Interactions (SOCSI), developed by Brown, Odom and Holcombe (1996), thus merging the first coder's patterns into a smaller number. (3) The researcher and the second coder then agreed on the definition of a pattern and the second coder returned to step (2). There was a high degree of agreement (91%). (4) The second coder tested the reliability of the categories by coding the conversation according to the agreed definition of a pattern. There was a high degree of agreement on the categories of collaborative interactions (93%), and non-collaborative interactions (90%). The goal of the analysis was to distinguish all collaborative and non-collaborative behaviour. Frequency of occurrence of identified interactions were analysed in the form of descriptive statistics.

3.5   Research Question (RQ) 1

RQ 1: What are the patterns of collaborative interaction exhibited by five-year-old pre-primary children whilst engaged collaboratively with the computer?

Interaction patterns observed within the study involved a process of verbal discourse and non-verbal interaction between the participants, whilst working in dyads at the computer. This study was concerned with capturing relevant and significant collaborative interactions exhibited by the children. An observational scheme based on the study of Nastasi & Clements (1993) was employed to distinguish all collaborative and non-collaborative behaviour. *Collaborative interaction* was

represented by behaviours which included cooperative work, turn taking, self-directed work, and parallel work. *Non-collaborative interaction* included behaviours represented by teacher-directed work; seeks attention from teacher or researcher; waits for teacher attention; and off-task behaviour. Descriptions and operational definitions for both interactions are presented in Table 1.

Table 1 Categorisation, description and operational definitions of collaborative and non-collaborative behaviours

Categories of behaviours	Descriptions and operational definitions
Collaborative behaviour	Initiates or engages in collaboration with partner (for example, jointly engages in computer activity); includes initiation of collaborative work Sub-categories of collaborative interactions were cooperative work, turn taking, self-directed work, and parallel work
Non-collaborative behaviour	Initiates or engages in verbal disagreement or physical conflict with partner (for example, exhibiting negative response or displeasure during the computer activity); includes social conflicts over control of keyboard or mouse. Cognitive conflict includes conflict or disagreement concerning task solution or moves taken. Sub-categories of non-collaborative interactions were teacher-directed work, seeks attention from teacher or researcher; waits for teacher attention; and off-task behaviour

All verbal discourses and utterances were represented in selected transcripts and coded using the constant comparative method by Glaser & Strauss (1967). Initial codes were constructed and compared with new data until each emerging individual code was mutually exclusive. Codes were constructed to represent each new behaviour and verbalizations made by the children within their respective groups. Furthermore, all codes were constructed to represent the objectives of each child's verbalizations and/or actions. Finally, the percentages of the occurrence of the ten children's interaction patterns are presented in selective cases in Chapter 4, and further discussed in Chapter 5.

Subsequently, three categories of verbal interaction were chosen to code all the interactions. The categories of verbal interactions (referred to by Mercer (1994) as talks) were as follows: (1) disputational talk; whereby speakers challenge other speakers' views, but without attempting to justify their challenge by building on previous utterances or offering new information; (2) cumulative talk; whereby speakers contribute to discussion by taking up and continuing a previous speaker's utterances, without explicit comment; (3) exploratory talk; whereby hypotheses are proposed, objections are made and justified, and new relevant information is offered.

3.6   Research Questions (RQ) 2 and 3

RQ 2: What factors facilitate collaborative interaction of five-year-old pre-primary children whilst engaged collaboratively with the computer?

RQ 3   What factors inhibit collaborative interaction of five-year-old pre-primary children whilst engaged collaboratively with the computer?

In this study, factors associated with either facilitating or inhibiting the collaborative interaction of the five-year-old pre-primary children whilst engaged collaboratively with the computer are reflected by the frequency of collaborative interactions that occurred during the observation. Some possible and relevant factors related to the environment and the physical setting of the computer and the classroom are discussed in Chapter 5. Prior experience and computer competency of the participants were also taken into account. The analysis of the existing factors are

discussed, based on a body of literature, in the observational study of young children's social goals and behavioural strategies and their social interactions with peers in naturalistic contexts and their peer-related social competence (Brown, Odom & Holcombe, 1996; Nastasi & Clements, 1992).

3.7   Research Limitations

Limitations associated with this study are acknowledged. Time limitations and small sample size are constraints of this study. As this is a qualitative study which examines an event in one setting, the findings are not generalizable to the whole population. Nevertheless, the settings and the computer arrangements are typical of other urban preschool centres in the metropolitan area of Perth, and the study yielded significant insights into young children's collaborative interaction whilst engaged with the computer. It is also acknowledged that data obtained through the interview with the classroom teacher may not account fully for the beliefs and perceptions of all pre-primary teachers.

3.8   Ethical Considerations

It is important that research exhibits the two characteristics of scientific merit and ethical soundness (Miller, 1998). Informed consent was obtained from the principal of the primary school, the pre-primary teacher and the parents of the participants. Participants were appraised of their right to withdraw from the study at any time without penalty. Copies of letters are supplied (See Appendices A,B & C). All data were treated with full confidentiality and no individual, centre, department or school was identified personally. A systematically locked filing cabinet was used to store all documents and raw data to which only the researcher had access for the period of the study and for a subsequent five year period. All these documents will be shredded and all the video and audio cassettes will be burnt at the completion of the 5 year period. Anonymity of the classroom teacher was ensured and pseudonyms were used to protect the identity of the children involved in this study. All the parents of the children involved in this study were sent a letter of gratitude to thank them for their

cooperation. A copy of the bound and completed thesis will be forwarded to the preschool for loan to parents.

3.9 Summary

This chapter has outlined and linked the research questions and the design and procedures of the study. The chapter describes the location and the settings where the study was conducted, the participants, the methodology used to collect and analyse the data, as well as measures that were taken to ensure the authenticity and reliability of data. The ethical issues were also considered. The next chapter provides a description of the findings from the data, elicited through the naturalistic non-participant observation of ten five-year-old pre-primary children whilst engaged collaboratively with the computer.

CHAPTER 4

FINDINGS

4.1   Introduction

In this chapter, six participating dyads of children are profiled and presented selectively in order to facilitate the systematic examination of the patterns of collaborative interactions exhibited by the participants. The interaction patterns of each dyad, obtained from verbal transcripts and audio taped interviews between the participants and the researcher are described in answer to Research Question One. The profile contains a brief summary of the children's experiences and access to computers at home and school. Information regarding the home · computer experiences was reported by the children in an informal interview conducted at the final stage of data collection. In the second part of the chapter, the findings regarding Research Questions Two and Three, which specifically address the factors facilitating and inhibiting collaborative interactions of the children whilst working at the computer are discussed. These findings serve to construct the emerging patterns of, and factors associated with, the collaborative interactions. This in turn guides the ensuing discussion chapter.

4.2   Profile of the Preschool

Information on the preschool centre and its background was gained from an interview with the teacher prior to the commencement of the study. The centre is a purpose-built centre, situated opposite a wetlands park. Originally established as a community based preschool with a governing parent committee, it is now a

transferred pre-primary centre. This means that it now caters for five-year-olds for four days' a week and comes under the auspices of the Education Department of Western Australia (EDWA). However, because of its history, it is located a kilometre from the primary school and is very well established and resourced.

...it's a high socioeconomic area...it's got a high variety of resources, parents are very involved in this centre, um, it's a government (school), but it was, for many-many years it was private where parents pay fees, so what happened is, over those years parents have paid fees, and it has, the money has gone to buy those variety of resources, in recent years, it has become government (school), where parents don't have to pay fees ...(S1)

As discussed earlier, the location of the study was purposely selected at the convenience of the researcher. Situated in a high socio-economic suburb of the Perth metropolitan area, the physical setting of the preschool displays a sense of serenity and is conducive to the provision of high quality early childhood education. An attractive, shady and spacious outdoor play area at the front of the preschool reflects the equal emphasis given to enhancing the children's physical and social development, as well as intellectual development. Inside, the classroom is systematically arranged to accommodate events involved in the planned daily activities (refer to Appendix IV). Five sets of small tables and chairs are distributed accordingly and the 'story time' mat is focused as the central point of the classroom. A kitchen, storeroom and office are situated at one end of the classroom, with the washroom/toilet at the opposite end. A large children's library is located off the verandah adjacent to the outdoor area and with entry from the indoor classroom. The computer is treated as a curriculum learning centre equal to block construction or manipulative materials and is located in a corner of the playroom.

Only have this computer this year. It's used as a tool, it is used like the block corner, the play-doh table, if the child never goes to the computer for the whole year, it doesn't worry me... (S2)

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4.3 Profile of the Computer Learning Centre

The preschool has been using the computer for one year only as a learning tool. It is an IBM Personal Computer (PC) with a Pentium™ processor of 32.0 megabyte of random access memory (RAM). The computer is situated on a small table, together with a colour printer with two chairs facing the keyboard and monitor. Two sets of audio headphones are connected to the computer. According to the classroom teacher, the children are required to use the headphones whilst working at the computer. Apart from being one of the activity centres of the classroom, the computer is also utilised for word processing purposes and publishing the preschool's newsletters. The classroom teacher reported that she seldom used the computer on her own as most of the typing was done by the school's secretary.

4.3.1 Access to the computer

Yeah, yeah what happens is, one person is, the person on the left hand, the person on the right hand side, is the person doing it, and the person on the left hand side is watching, so then, when that person on the left hand side comes over, he knows what to do. So, one person always knows what to do, and he starts, and, you know, goes through whatever his whole game from the beginning to end, and then he goes off. And the person who's been watching sits on his chair, and somebody new comes up. (S3)

The turn-taking process is based on equal access to a limited resource (Berk, 1994) which is a primary concern of the use of computers in early childhood classrooms. In this study, the teacher's decision to integrate a turn-taking system into the computer accessibility was mainly to generate an equitable and harmonious manner of administration with minimal assistance and guidance. The teacher explained it this way:

The other thing here is when you've got 28, I've got 27 children here, I want to put something on the computer that's easy because if something goes wrong, I've got to bear with 2 children, then its 25 other children, you know, they need my help. (S4)

When discussing the lack of assistance in relation to the computer activities, the teacher revealed that:

> ... *it's harder, that's why when we (the teacher and the parents) have new (computer) packages we get a parent to show them all through and then we get them to do it on their own ...' (S5).*

Even so, the notion that the teacher views the computer as an anti-social machine reflects her decision on the actual role of the computer, as featured in the following comments:

> ... *because I won't justify parents sitting or an adult sitting at the computer for the whole hour each day, because there's lots of other things where we should be interacting with the children, reading stories, doing puzzles ...(S6)*

4.4 Profile of the computer software

> '...*when free to explore software, first graders chose a problem-solving simulation as the centre of their computer activities and actively constructed their own set of concepts and expectations about the software.' (Shade, 1994, p. 181)*

Prior to the data collection, an educational computer software package was selected for the purpose of the observation. After discussion with the classroom teacher, *Cyber Grannies: An Animated Vocabulary Adventure*, published by *Kutoka Kids* which had a score of 8.0 on the Haugland Developmental Software Scale (Haugland, 1999) was selected. The software package includes programs involving letter recognition, problem-solving games, counting, addition, subtraction, measurements, spatial reasoning and language skills (see Appendix V for details). The software was introduced by the researcher for a period of one week prior to the observations. Whilst acknowledging the importance of the aspects of learning found in the computer software, such as letter recognition, patterning and rhyming, the teacher revealed her concern about introducing 'less appropriate' packages, by such comments as:

... please, please, I don't want (the children) to play, I don't want programs that are games, I do want games, but you know, these ones are all letter recognition, patterning, rhyming, all of those things which are great for their learning. And that's why we choose the DK ones. Anything that's language or math is perfect ... (S7)

4.5 Profile of the teacher

The classroom teacher is a very experienced early childhood educator with 14 years' teaching experience with young children. It is her seventh year in the centre where she teaches five-year-olds. The classroom teacher seems to be of the opinion that the children prefer to play with blocks and play-doh rather than the computer during the inside activity time, as these comments reveal:

Because lots of the children here at this area have a computer, it is, it is, um, they do like it, but often I'll say, "Is there anyone who wants to go to the computer?" and they're not that fast, it might, it's maybe because the package is so boring, I don't know, ... you know, when you come here, and you've got all these facilities, you know and they're only five (years old), sometimes they really like playing with the blocks, or the play-doh, or painting or you know, we have so many resources here, so many wonderful things ... (S8)

In addition to the children's lack of interest in the computer programs, the teacher reported that she is a novice in computers and she has the perception of the computer as an anti-social machine which promotes anti-social behaviour. The following comments illustrate her perceptions of the computer in the classroom:

... I use them as a teaching tool, you know, I found in this age that it's quite an anti-social thing. I would much rather the children be playing (with something else)... (S9)

Another group of responses indicated a lack of computer skills of the teacher and the need to acquire those skills for various purposes. Such comments included that the teacher is not a 'fan' of computers; attended a computer course but forgot the lessons; needed to gain appropriate word processing and simple technical skills; but believed in the importance of being computer literate in relation to school

requirements in performing management and administration duties. Whilst acknowledging that children enjoy computers, playing on the computer at the pre primary was not seen as being as important as other activities:

> *...all the children here in this school have computers at home. They all have Nintendos. They all have ... they don't have the blocks, they don't have the play-doh, they don't have the home corner and I find it's far more important, why, I'm encouraging that as much as the computer, when they go to (primary) schools, they'll get into the computer and they'll learn all those things, they'll never have the blocks corner, they'll never have the painting hassles again, and , that's why I'm not, I don't use it as an actual teaching tool. (S10)*

Indeed, these comments reflect the teacher's opinion that the computer should be available to the children as a freely chosen play option only. The teacher's view was reflected in the fact that the computer activity corner was set up as one of the available learning centres. Leading on from this was a concern about the noise generated in the form of verbal computer prompts and instructions which led to the children being required to use audio headphones whilst working at the computers. This view was summed up by the teacher who stated:

> *...because when they're on the computers, they use headphones, because that way, um, it's not noisy for the whole class, I find that in the centre, when there's so much noise, normally in a classroom situation you're all on the computer and it's so quiet, but at this age, there's so much, the computer 'talks' to you, so it's quite noisy. As you get older, you read all the instructions, and whatever, whether it's verbal, so we put the headphones on, so they can really listen... (S11)*

4.6   Profile of the children

As already mentioned, the focus of this study was to examine the nature and patterns of the children's collaborative interactions whilst working at the computer. The following section describes the general profile of the children and their interactions with their partners whilst working on the computer. The interactions of all twelve children are described in six dyadic cases. Twelve children were involved

in this study. Six observation sessions were conducted with each pair of children working at the computer. Each of these dyads was analysed exclusively based on each selective case. All participants were five-year-olds, who, according to the classroom teacher, have a similarly high socio-economic background. Each of the participants admitted to having at least one personal computer (PC) at home. Two thirds of the children (66.7%) reported that at least one of their parents had a portable computer (laptop/palmtop). All twelve children exhibited competency in handling the mouse device with no or minimal assistance. This clearly indicates considerable computer experience among the participants. Approximately 41.7% of the children admitted having friends coming over to their house to play with computers. Interestingly, two of the children described in detail games and manoeuvres involved in their computer activities. None reported having any experience in using any type of word processing program.

4.7 Case selection

Children's interactions were video tape recorded over a 3 week period as detailed in Chapter 3. There were six target cases involving twelve children. The children were divided into pairs to form six different dyads for the observation sessions. Each participant was asked by the classroom teacher to choose a partner by saying "Some children are going to work at the computer with Mohamad, and you can choose a friend to play with you". Then, the children would raise their hands and the classroom teacher would select one of them and ask the child to choose another child to join them at the computer. Overall, of the 12 children, two pairs were mixed gender dyads, 3 were female and one was male (see Table 2).

Table 2 *Sex/gender dyads by case and control of the mouse device*

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Controller	Female	Female	Female	Female	Male	Female
Partner	Male	Female	Male	Female	Male	Female

Table 3

The frequency of occurrences of interaction patterns for six cases

	Case 1		Case 2		Case 3		Case 4		Case 5		Case 6		Six cases	
	Boy 1	Girl 1	Girl 2	Girl 3	Girl 4	Boy 2	Girl 5	Girl 6	Boy 3	Boy 4	Girl 7	Girl 8	Total	%
Directing partner's actions	0	1	11	0	0	12	0	2	0	5	0	25	56	23.0%
Providing information/explanation	0	1	6	4	2	6	0	0	6	9	5	9	48	19.8%
Asking for information/explanation	0	0	1	3	1	1	1	0	8	1	3	6	25	10.3%
Self-monitor/repetition	0	0	5	2	0	0	0	0	3	0	11	2	23	9.5%
Declarative planning	0	1	0	0	2	0	0	0	5	0	9	0	17	7.0%
Disagreeing with partner	0	0	2	0	4	0	0	0	0	1	6	2	15	6.2%
Showing pleasure	0	0	4	3	1	0	0	0	0	1	1	5	15	6.2%
Suggesting ideas	0	0	1	0	1	2	0	0	1	0	3	1	9	3.7%
Exclaiming	0	0	0	1	1	0	0	0	1	0	3	1	9	3.7%
Defending control	0	0	0	0	2	0	0	0	0	0	5	0	7	2.9%
Showing displeasure	0	0	1	0	2	0	0	0	0	0	3	0	6	2.5%
Terminal response	0	0	0	0	2	0	0	0	0	0	1	0	3	1.2%
Defending competence	0	0	0	0	0	0	0	0	0	0	3	0	3	1.2%
Correcting others	0	0	0	0	0	0	0	0	0	0	1	2	3	1.2%
Accepting guidance	0	0	0	0	1	0	0	0	0	0	1	0	2	0.8%
Sharing control	0	0	0	0	0	0	0	0	0	0	2	0	2	0.8%
Total	0	3	31	13	19	21	1	2	23	17	59	54	243	100%

The interaction patterns exhibited by all six cases are presented with frequency of occurrence and percentages in Table 3. Through a charting process for each selected case, 16 interaction patterns were identified as follows: self-monitor/repetition, suggesting ideas, directing partner's actions, defending control, declarative planning, accepting guidance, showing pleasure, disagreeing with partner, asking for information/explanation, sharing control, correcting others, providing information, exclaiming, defending competence and showing displeasure.

One of the mixed gender dyads had to use the headphones as their observation session was conducted during the inside activity time. As the focus of this study was to describe the nature and emerging patterns of collaborative interaction on the computer, only their verbal and non-verbal interactions were videotape recorded. Other interactions occurring outside the immediate perimeter of the computer environment were not observed. It is recognised that all target cases do not represent the entire range of children's behaviour exhibited. The aim of this study was not to generalise these six cases to all children's experiences, but instead to gain an insight into the diverse and dynamic experiences that young children have while working together on the computer.

4.7.1   Case 1 (Mixed gender dyad)

The classroom teacher selected Boy 1 and asked him to choose a partner to work on the computer. Boy 1 chose Girl 1 and they sat next to each other in front of the computer. Initially Boy 1 had control of the mouse device and manipulated the computer. After a period of 5 minutes, no interaction took place. The researcher then asked Boy 1 to let Girl 1 have a turn at using the computer. Girl 1 made three verbal utterances, and appeared to be knowledgeable about the computer program. The following examples illustrate this situation:

Example 1a:

(R = Researcher)

R:	Now Boy 1, which one do you want to play ...A, B, C ...any letters you want to choose? (asking Boy 1, as he was controlling the mouse)
BOY 1:	(no response)
R:	What about you GIRL 1?
GIRL 1:	(no verbal response, but points to the screen, to the letter H)
R:	Are you okay with that? (to BOY 1)
BOY 1:	(no verbal response, but nods his head, showing agreement)

BOY 1 then clicks on the letter H icon on the screen. Program responds by explaining about the letter H. Both children listen.

R:	You can click on anything you want there ... have a try (referring to the options of icons on the screen)
GIRL 1:	See that usually happens when it's all black, I only saw the stars (referring to the sky icon on the screen). *(providing information)*

GIRL 1 runs off to toilet. Researcher then takes control of the mouse to guide BOY 1to move to another screen. GIRL 1 returns from the toilet, BOY 1 takes control of the mouse and proceeds to continue the task by clicking on the letter I icon. GIRL 1 pulls her chair closer to the monitor, gazes for a while at the video camera, then points to the screen. BOY 1 starts to play the jigsaw puzzle game.

GIRL 1:	No, the other one (guiding BOY 1 in solving a jigsaw puzzle game) *(directing partner's actions)*

Girl 1 chose to play the jigsaw puzzle game which she solved easily without any help from Boy 1. Her competency in handling the program appeared to be dominant when she offered guidance and directed Boy 1's moves in solving the jigsaw puzzle game

Example 1b:

(R = Researcher)

GIRL 1:	No, the other one (guiding BOY 1 to solve a jigsaw puzzle game) *(directing partner's actions)*

Researcher asked BOY 1 to let his partner take control of the mouse. GIRL 1 gives a deep sigh (sign of boredom?). Then, she takes over the mouse. GIRL 1 continues:

GIRL 1:   I think I'm going to try this one (referring to one of the choice
                         jigsaw puzzle games)

GIRL 1 puts her left hand around the keyboard. Clicks on the matching ID game and attempts to match the correct faces. Failing to solve the game after a few attempts, she asks the researcher to guide her to move to another screen.

GIRL 1:   Now, what do I do with this? (asking the researcher for
                         guidance) *(asking for information/explanation)*

Researcher guides GIRL 1 to go out of the screen. Both of the children nod when asked by the prompt if they want to visit another screen (J world). GIRL 1 moves her chair forward, closer to the monitor. No other interaction occurs. GIRL 1 continues to play the jigsaw puzzle game by herself (the easier level). BOY 1 looks on as his partner completes the game successfully. Then, GIRL 1 chooses another level (harder, with more jigsaw puzzle pieces). After a while (approximately 2 minutes), GIRL 1 gives up on the game, as she is unable to fit all the jigsaw puzzle pieces together. BOY 1 looks away from the screen (sign of boredom?), GIRL 1 starts to bite her nails.

GIRL 1:   I think I want to do another one again (referring to the easier
                         level jigsaw puzzle game). *(declarative planning)*

Boy 1 did not exhibit any verbal interaction throughout the whole observation period, even though he had chosen Girl 1 as his partner. When Girl 1 took over the control of the mouse device, four interactions only were noted: three verbal and one non-verbal interaction. In this case, no patterns of collaborative interaction were coded throughout the whole observation session. Initial categories for the coding scheme were found to be inconclusive. Only four categories of interaction patterns were observed: providing information, declarative planning and directing partner's actions (Table 4).

Table 4 *Frequent interaction patterns employed by Girl 1 throughout interaction*

Directing partner's actions	1.8% (out of 56 times)
Providing information/explanation	2.1% (out of 48 times)
Declarative planning	5.9% (out of 17 times)

4.7.2 Case 2 (Same gender dyad – female)

Initially Girl 3 was chosen by Boy 4 to work on the computer. After a period of 7 minutes, Boy 4 appeared to be distracted by some other children playing outside the classroom. He left the computer and joined the children outside. Girl 2 then approached the classroom teacher and asked her permission to play on the computer. Girl 3 took over the control of the mouse device, and Girl 2 sat next to her. According to an informal interview with the children, Girl 3 reported that she used to invite Girl 2 to her house to play with her on the computer. Based on the researcher's observations, Girl 2 appeared to be popular among the children in her classroom. Girl 3 was seen by the other children to be a close friend of Girl 2. The following example illustrates sequences of disagreement between the children when the interaction patterns of directing partner's actions and disagreeing with partner occurred:

Example 2a.:

(R = Researcher)

GIRL 3 clicks on the A-R-M-C-H-A-I-R icon again.

GIRL 2:	(laugh) Press on that one again (laugh) do that one (pointing to the screen), do the fish one (3 times), the fish one, press on the fish (laugh), press on that one, press on the table (laugh), press on that chair (pointing to the screen), press on that, press on that rock (both girls laugh) *(showing pleasure) (directing partner's actions)*
GIRL 2:	Do that one again (then she gets distracted by children passing by) ...(laugh) Then, get back to the other one ...Ahh...press on ... I'll tell you what to press on (finger lingering in front of the screen, deciding on which icon to point to) Press on the chair, A-R-M-C-H-A-I-R (laughing, looking at GIRL 3), that one A-N-G-E-L, A-N-G-E-L, click on the A-N-G-E-L ... now, press on that one. *(directing partner's actions)*
GIRL 3:	No, I have pressed on the A-N-G-E-L (laugh)

GIRL 3 had clicked on another icon instead (A-R-C-H-E-R)

GIRL 2:	Press on the A-N-G-E-L. No, you lie (pats GIRL 3's shoulder). *(showing displeasure) (disagreeing with partner)* Ahh...do that one (pointing to the screen, then both girls laugh). And do it again, the one...so funny. Do the ...chair one, chair one (pointing to the screen) ...ON ME (both girls repeating after the prompt, then laugh) *(directing partner's actions)*

GIRL 3:	EVERYBODY'S ALWAYS SITTING ON ME (repeating after prompt) *(showing pleasure) (self-monitor/explanation)*
GIRL 2:	Do it again (laugh) *(directing partner's actions)*
Both:	EVERYBODY'S ALWAYS SITTING ON ME (repeating after prompt, then laugh) *(showing pleasure) (self-monitor/explanation)*
GIRL 2:	Do that, the good one. *(directing partner's actions and providing information)*

Although there is considerable direction of Girl 3 by Girl 2 and some disagreement, the interaction takes place in an enjoyable environment without any display of negative behaviour. The next example further demonstrates the dominant role played by Girl 2 although she does not have control of the mouse. Again, the interaction takes place within a friendly and happy context.

Example 2b.:

(R = Researcher)

GIRL 2:	I've pressed, press on the arrows, press on the arrows, they do, do something. *(providing information)*
GIRL 3:	Do they? *(asking for information/explanation)*
GIRL 2:	Yeah (both girls laugh), press on ... ahh... that one (pointing to the screen) A-R-C-H-E-R. Do those one again, those were funny (then she tries to take over the mouse) *(showing pleasure) (providing information)*
GIRL 3:	Aww...me, me, me, me. *(defending control)*
GIRL 2:	Do that one, do that one (tries to point to the screen) *(directing partner's actions)*

GIRL 3 tries to prevent her partner from pointing to the screen)

GIRL 2:	That doesn't do anything. How about the light? *(providing information) (asking for information/explanation)*
GIRL 3:	No. *(providing information)*
GIRL 2:	How about the A. Book A. Book A (both girls smile and dance to the music from the ACCORDIAN) *(suggesting ideas) (showing pleasure)*
GIRL 2:	Ummm...press on that (pointing to the screen) *(directing partner's actions)*
GIRL 3:	(laugh) The head fell off. *(providing information) (showing pleasure)*
GIRL 2:	And now, press on this (pointing to the screen). The A. The A. *(directing partner's actions)*

Table 5 *Girl 2 and Girl 3: Percentages of occurrences of interactions*

Frequency of interaction patterns employed by both children throughout interaction

Directing partner's actions	19.6% (11 out of 56 times)
Providing information/explanation	20.8% (10 out of 48 times)
Suggesting ideas	11.1% (1 out of 9 times)
Asking for information/explanation	16.0% (4 out of 25 times)
Self-monitor/repetition	30.4% (7 out of 23 times)
Showing pleasure	46.7% (7 out of 15 times)
Exclaiming	11.1% (1 out of 9 times)
Showing displeasure	16.7% (1 out of 6 times)

It may be seen from Table 5 that throughout the observation, 8 different categories of interaction pattern were identified. The most frequently observed interaction pattern was directing partner's actions (19.6%), followed by providing information (20.8%). The least occurring interaction pattern was exclaiming, showing displeasure and suggesting ideas, which were identified only once during the observation. Patterns of self-monitor/repetition and showing pleasure were observed 7 times throughout the observation. Disagreeing with partner was observed twice and the category of asking for information/explanation was exhibited four times (15.4%) out of a frequency of 26 times occurring in all six cases. No observation was recorded for the remaining 7 interaction patterns: declarative planning, defending control, accepting guidance, sharing control, correcting others, defending competence and terminal response.

In summary, it would appear that an enjoyable environment and existing personal relationship between the collaborating children increases the frequency of occurrence of some of the interaction patterns. Girl 2 exhibited an array of verbal interactions that were acceptable by her partner. Girl 3 on the other hand, was receptive of the ideas and suggestions of her partner. Furthermore, disagreements of actions taken during their exploration of the program were also non-aggressive. Both

children appeared to enjoy each other's company. Prior experience in working together on the computer may have contributed to a lack of negative behaviour exhibited by the children.

4.7.3 Case 3 (Mixed gender dyad-using audio headphones)

In this particular target case, both children used audio headphones. The observation was conducted during the morning freely chosen inside activity session. Initially, two children, Girl 4 and another boy, were chosen by the classroom teacher to work on the computer. After a few minutes, the boy left and Boy 2 asked the researcher's permission to play at the computer. The researcher then referred to the classroom teacher, before allowing Boy 2 to join Girl 4 at the computer. It was not known whether or not the children enjoyed a close friendship in relation to playing at the computer outside the preschool. Girl 4 took control of the mouse device, while her partner, Boy 2 sat next to her facing the computer screen.

Table 6 *Girl 4 and Boy 2: Percentages of occurrences of interactions*

Frequency of interaction patterns employed by both children throughout interaction

Directing partner's actions	21.4% (12 out of 56 times)
Providing information/explanation	16.7% (8 out of 48 times)
Suggesting ideas	33.3% (3 out of 9 times)
Asking for information/explanation	8.0% (2 out of 25 times)
Showing pleasure	6.6% (1 out of 15 times)
Exclaiming	11.1% (1 out of 9 times)
Showing displeasure	33.3% (2 out of 6 times)
Declarative planning	11.8% (2 out of 17 times)
Disagreeing with partner	26.7% (4 out of 15 times)
Defending control	28.6% (2 out of 7 times)
Terminal response	66.7% (2 out of 3 times)

Table 6 gives frequency of interaction patterns with percentages of occurrences of interaction exhibited by children in Case 3. It may be seen that eleven

categories of interaction occurred during the observation. The most frequently occurring interaction was directing partner's actions (21.4%), followed by providing information (16.7%). None of the following interaction patterns were exhibited: self-monitor/repetition, sharing control, correcting others and defending competence. Twice the children exhibited interaction patterns of showing displeasure (66.7%), terminal response (66.7%), asking for information/explanation (7.7%), declarative planning (11.8%) and defending competence (66.7%). Disagreeing with partner occurred 4 times (26.7%) and suggesting ideas was exhibited 3 times (33.3%). The interaction patterns of accepting guidance, showing pleasure and exclaiming were each exhibited once during the observation. The following episodes were examples of how these interaction patterns occurred between the children:

Example 3:

(R = Researcher)

BOY 2:	Now, let's find the letter F. Ohh... *(suggesting ideas)*
GIRL 4:	Joe! Now I want to find all the emeralds. *(disagreeing with partner and defending control)*
BOY 2:	Well, we could've found one there, and see we're going to go that far, and now we have to try again, to go to somewhere else to find the emeralds. Could you try to dig the emerald over there? I wish we could go and find another emerald, given the letter F, must, there's one in every screen, there must be one in this screen. Ah, look, try click on there (pointing to the screen). Do you know what I want to do? We click on F, we click on there (points to the screen) and can we click on there. I want to go and find another emerald, I remember there was, there's one on each screen. *(suggesting ideas and providing information/explanation and directing partner's actions)) (asking for information/explanation)*
GIRL 4:	Aw, okay (giving in to her partner's demand) *(accepting guidance)*
BOY 2:	So, when we look at one of these pictures, then we want, there might be an emerald (pointing to the screen) *(providing information)*
GIRL 4:	Ahhh ... (smiling to her partner) *(showing pleasure)*
BOY 2:	Because I wouldn't go to the farm, I think it's the farm, we might go to the farm ... *(suggesting ideas and directing partner's actions)*
GIRL 4:	I heard you say the farm ... I can see you say it, use your teeth ... *(providing information/explanation)*

BOY 2:	And now I have the farm, let's follow the fox ... *(directing partner's actions)*
GIRL 4:	There's the bell! *(exclaiming)*
BOY 2:	How about click on there, click on the fox, click on the fox, let's see what the fox does. *(directing partner's actions)*
GIRL 4:	NO! *(terminal response)* *(disagreeing with partner)*
BOY 2:	We might going to a picnic, who knows. Back to the person and the fox .. ooops (laugh) *(providing information)*
GIRL 4:	I want to play again! (appears angry at her partner) *(disagreeing with partner and defending control and declarative planning)*
BOY 2:	Look at the floor works. Let's click on the fox (pointing to the screen) *(directing partner's actions)*
GIRL 4:	Gahhh! *(showing displeasure)*
BOY 2:	So, click here again ... that fox to that fox (pointing to the screen) We don't, I don't think I know the way. *(directing partner's actions and providing information)*
R:	You have to drag, drag the mouse (guiding GIRL 4)
BOY 2:	You use that way, then that way, then that way. No, turn around, turn the dog, make it turn around and go (pointing to the path on the screen) *(directing partner's actions)*
GIRL 4:	I know, Joe! *(showing displeasure)*
BOY 2:	And then take it to the dog (after successfully accomplishing the task, both children laugh) *(directing partner's actions and providing information)*
GIRL 4:	We had that didn't we? We've done that (looking at her partner, asking for confirmation) *(asking for information/explanation)*
BOY 2:	Let's go follow her (pointing to the screen). Let's follow her. See? (pointing to the screen again). The G world, the G world, the G world, I want to go to the G world, the G world, the G world, the G world (singing). Let's click on J this time, we've clicked on A and then we're going to click on J, where's J? (pointing to the screen) *(directing partner's actions)*
GIRL 4:	NO! (pulls her partner's hand away from the monitor) We're going to B world. *(disagreeing with partner and declarative planning)*
BOY 2:	B world (GIRL 4 prevents her partner from trying to push some keys on the keyboard) Just click on the hand, just click on the hand, just click on the hand, if you want to go off. *(directing partner's actions)*
GIRL 4:	Go off ... *(terminal response)*
BOY 2:	Let's click on the door, let's click on the door (pointing to the screen) *(directing partner's actions)*
GIRL 4:	I'm trying to find the bell (pushes her partner's hand off the screen) *(providing information)*
BOY 2:	Pardon? And, that's the door (pointing to the screen). Let's go ... let's move to the big bell at the top, there was a bell at the top. *(providing information and directing partner's actions)*

In respect of Case 3 (mixed gender dyad-using audio headphones), it can be concluded that identifiable interaction patterns occur despite the children using audio headphones whilst working together at the computer. It may suggest that children need to interact with each other in order to maximise their cooperation levels. It may be that Boy 2's frequent directive actions served to promote anti-social behaviour from Girl 4, particularly given that Girl 4 exhibited two out of the three terminal response behaviours for all target cases. Even so, there was no indication of aggressiveness among these behaviours. The display of displeasure by Girl 4 also indicates her level of competency in working independently. Boy 2 directed almost all of Girl 4's moves and decisions whilst using the computer. These actions resulted in the interaction patterns from Girl 4 of terminal response, showing displeasure, disagreeing with partner and declarative planning (see Table 6). It would appear that more positive social interactions are promoted between children by providing a conducive and enjoyable educational environment. Both children appeared to find the content of the software enjoyable, interesting and appropriately challenging. The content of the program included a problem solving game, in the form of a labyrinth, where the user needed to drag and move the 'wolf' icon to another end of the labyrinth, to unite it with another 'wolf' icon. After completing the task, animations of both icons would appear, together with joyful music background. Both children displayed pleasure in completing the task.

4.7.4 Case 4 (Same gender – female)

As with Case 1, little interaction occurred between these two children. Apart from being chosen by the teacher, and having the choice of partner, Girl 5 did not exhibit any of the 16 interaction patterns identified in this study. Girl 6, on the other hand, interacted twice with her partner by directing her partner's actions (3.6%). The following episodes illustrate their interactions:

Example 4:

(R = Researcher)

No verbal interaction was displayed for the first 4 minutes. GIRL 5 turns to her partner, before clicking (decides which one to click), but still no verbal interaction occurs.

GIRL 6:	(points to the screen) *(directing partner's actions)*
GIRL 5:	What? Umm ... *(asking for information/explanation)*
GIRL 6:	The hand, just click on the hand. Arrows on the little hand*(directing partner's actions)*

The findings from Case 4 indicate that novelty effects (of the program and the presence of the researcher) may inhibit some interaction patterns identified in this study. However, both Girl 5 and Girl 6 showed a substantial amount of computer competency, by way of handling the mouse and exploring the content of the software. According to the classroom teacher, both these children have computers at home, but have limited access to them. This may inhibit their inquisitiveness with the new program introduced to them. Even so, it also appears to the researcher that these two children are quiet and timid by nature. However, they have equitable access to the computer at the centre. The teacher added that both children had played at the computer as frequently as most of the other children in the classroom.

4.7.5   Case 5 (Same gender dyad – male)

Boy 3 was chosen by the classroom teacher to work on the computer. Then he went around the classroom and selected Boy 4 and asked him to join him at the computer. Boy 4 had used the computer program prior to this observation. Hence, the interaction pattern of providing information was the most frequently observed during the session.

Table 7 *Boy 3 and Boy 4: Percentages of occurrences of interactions*

_____

Frequency of interaction patterns employed by both children throughout interaction

_____

Directing partner's actions	8.9% (5 out of 56 times)
Providing information/explanation	31.2% (15 out of 48 times)
Suggesting ideas	11.1% (1 out of 9 times)
Asking for information/explanation	36.0% (9 out of 25 times)
Showing pleasure	6.6% (1 out of 15 times)
Declarative planning	29.4% (5 out of 17 times)
Disagreeing with partner	6.7% (1 out of 15 times)
Self-monitor/repetition	13.0% (3 out of 23 times)

_____

It may be seen from Table 7 that a total of 8 patterns emerged. The frequency of interaction patterns in percentages are as follows: providing information (31.2%); asking for information/explanation (34.6%); directing partner's actions (9%); declarative planning (29.4%); self-monitor/repetition (13%); suggesting ideas (11.1%); showing pleasure (6%); and disagreeing with partner (6%). No observation was recorded for the following interaction patterns of defending competence, accepting guidance, sharing control, correcting others, exclaiming, defending control, terminal response and showing displeasure.

Boy 3 and Boy 4 appeared to be good friends. According to the classroom teacher, both children are considered good friends outside their school, as they constantly invite each other to play at their homes. In addition, both children reported having at least one personal computer at home. This is likely to contribute to their skills in handling the mouse device. In addition, prior to data collection, Boy 3 displayed a keen interest in the existence of the researcher and the new program the researcher was about to introduce. Almost every time the researcher came into the classroom, Boy 3 asked questions, such as: Is the computer game any good? Can I have a go at it? What is that camera for? Are you going to stay here for the day? These questions reflect that this child is beginning to apply language and intellect by wanting to know what things are for and what to do with them (Berk, 1994). These

understandings will then be incorporated into forms of socialised speech (Vygotsky, 1978). Boy 3 appeared to acknowledge Boy 4's experience in using the program by frequently asking for information/explanations and disagreeing once only with his partner. The following examples illustrate these interactions:

Example 5:

(R = Researcher)

The children are playing a problem-solving game (animal-matching game)

BOY 3:	E-L-E-P-H-A-N-T *(self-monitor/repetition)*
BOY 4:	C ! *(directing partner's actions)*
BOY 3:	C-A-T! Where's C-A-T? *(self-monitor/repetition) (asking for information/explanation)*
BOY 4:	There! (pointing to the screen) *(providing information)*

Both children vocalising the sound of the letter B

BOY 3:	B-B-B-B- ...
BOY 4:	B-B-B-B- ...
BOY 3:	I'll see if it's this one (clicks on the correct answer, and smile to his partner). F! ... F-O-X *(declarative planning and providing information)*
BOY 4:	Kangaroo, kangaroo (pointing to the screen) *(directing partner's actions)*
BOY 3:	Monkey ! *(providing information)*

BOY 4 points to the screen, asking BOY 3 to click on the arrow.

BOY 3:	C-A-T, no. *(self-monitor/repetition and providing information)*
BOY 4:	No (shakes his head) *(disagreeing with partner)*
BOY 3:	Kangaroo! I don't want to do this thing. *(declarative planning)*
BOY 4:	Click on there (points to the screen) *(directing partner's actions)*
BOY 3:	I want to ... Okay. What? Ahh ... *(declarative planning)*
BOY 4:	Dog, need one. *(providing information)*
BOY 3:	I want to get out of here (after finishing the animal-matching game) I want to go to A. Block. Where do you want me to go? *(asking for information/explanation)*
BOY 4:	J! *(providing information)*
BOY 3:	Is this J? *(asking for information/explanation)*
BOY 4:	Yeah. *(providing information)*

BOY 3:	A journalist? (after clicking on the JOURNALIST icon, and hearing the prompt) I've never seen a journalist before. *(asking for information/explanation) (providing information)*
BOY 4:	I don't know what it is. I don't know. *(providing information)*
BOY 3:	Always the office lady ... Oh, I'll click on the juggler. I want to click on here. The jaguar. *(declarative planning)*
BOY 4:	Oh, this one is an easy one (indicating that he had tried/played the game before) *(providing information)*
BOY 3:	What? . *(asking for information/explanation)*
BOY 4:	Oh, no, this isn't, this isn't (shaking his head). This isn't easy. I tell you that this isn't easy. *(providing information)*
BOY 3:	What do I suppose to do? *(asking for information/explanation)*
BOY 4:	You want to get out of here. You want to get out? *(asking for information/explanation)*
BOY 3:	This is hard. *(providing information)*
BOY 4:	You should click on the hand, it's not easy. You should try the other, the other puzzle. You should try the other puzzle. Um, click on that jaguar, and then click on that one, click on those (pointing to the screen) *(directing partner's actions and providing information)*
BOY 3:	This one? *(asking for information/explanation)*
BOY 4:	Nope. *(providing information)*
BOY 3:	I don't know which one. *(asking for information/explanation)*
BOY 4:	That bit will go to ... (pointing to the screen, guiding his partner, referring to moves taken in solving the jigsaw puzzle) *(directing partner's actions)*
BOY 3:	Or go here. *(suggesting ideas)*
BOY 4:	You did it! *(showing pleasure)*
BOY 3:	I want to do it again ... Cool ... J-O-C-K-E-Y? ... Do you want to, I want to ... Ahh ... *(declarative planning and providing information)*

In this target case, Boy 3 needed guidance from Boy 4 in explaining the content of the program. The patterns of providing information and asking for information/explanation, which emerged in a highly frequent manner, indicate a level of collaborative interaction between the children (see Table 7). Furthermore, it appears that the level of speech exhibited by both children permitted a considerable amount of positive communication to occur. The children also appeared to have good literacy development such as phonological awareness, letter and word recognition and spelling ability. The content of the software program indicates its ability to reinforce and scaffold the learning of both children.

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4.7.6 Case 6 (Same gender dyad – female)

In this particular case, the classroom teacher chose both children. Initially, another child, whom Girl 7 had chosen, was supposed to join Girl 7 at the computer. Instead the teacher chose Girl 8. Girl 7 controlled the mouse device, while Girl 8 sat next to her. This observation revealed the most significant interaction patterns of all target cases. Both children exhibited all categories of interaction identified in this study. Conflict also occurred between the children in the form of negative responses. Girl 7 exhibited a total of 8 interactions indicating disagreement and possible conflict with her partner. For example:

Example 6a:

(R = Researcher)

GIRL 8:	Press on that (pointing to the screen), doesn't do anything, then press on that hand there (points again) *(directing partner's actions)*
GIRL 7:	It didn't work! *(defending control)*
GIRL 8:	Press on that hand (points to the screen) *(directing partner's actions)*
GIRL 7:	No, I don't want to press on that (shaking her head). I'm going to press on this. *(disagreeing with partner and defending control and declarative planning)*

Example 6b:

(R = Researcher)

GIRL 8:	Click that, press that, press on there. *(directing partner's actions*
GIRL 7:	I don't want to. *(disagreeing with partner and defending control)*
GIRL 8:	Okay, you don't have to. How do you get out of this place? (looking up to the researcher) *(acknowledging other's behaviour) (asking for information/explanation)*

Example 6c:

GIRL 7:	I can't, I can't find the little ... *(exclaiming)*
GIRL 8:	I'll show you (leaning to her right, trying to take over the mouse device from her partner) *(correcting others)*
GIRL 7:	Oh, there, I know, I know where it is (prevents her partner from taking over the mouse) *(defending control and defending competence)*
GIRL 8:	Press, um, Old Granny, press on the Old Granny *(directing partner's actions)*
GIRL 7:	No, I want to press on H, H, boing, boing. *(disagreeing with partner and declarative planning)*
GIRL 8:	We know a lot of H in our house ... *(providing information)*

The interaction pattern of defending competence between the children was also apparent when both of them argued and disagreed in defining the icon of the cursor (illustrated as arrow or point, and arrow). The following episodes illustrate the argument:

Example 6d:

GIRL 7:	Yes you do. *(self-monitor/repetition)* Where is this, point?
GIRL 8:	There's the point (points to the screen) *(providing information)*
GIRL 7:	No, it's just, where is that little arrow? *(asking for information/explanation)*
GIRL 8:	No, that's called, that's called a mouse. It's a funny name, but it's called a mouse (pointing to the cursor on the screen) *(providing information)*
GIRL 7:	Ah, this is called a mouse (using her left hand to point to the mouse device/referring to the mouse device she's using in her right hand) *(disagreeing with partner and providing information)*
GIRL 8:	And that is called a mouse as well (pointing to the cursor on the screen) *(disagreeing with partner and providing information)*
GIRL 7:	Oh, it doesn't do anything. Where's, where's this point? It's always going everywhere. *(exclaiming and showing displeasure)*
GIRL 8:	There (pointing to the screen) It's not a point, it's a mouse! *(disagreeing with partner and providing information)*

Figure 5 Frequency of occurrence of interactions exhibited in Case 6

Figure 5 clearly illustrates the frequency of occurrence of the interaction patterns in Case 6. Directing partner's actions was exhibited 25 times (44.6%), with the percentages of (56.5%) of self-monitor/repetition, 29.1% of providing information, 52.9% of declarative planning, 34.6% of asking for information/explanation, and 53.3% of disagreeing with partner. Accepting guidance and terminal response were observed once only (1.2%). Exclaiming was exhibited 7 times (77.8%), while correcting others, defending competence and showing displeasure were observed three times (3.2%). Sharing control was observed twice (2.3%) and suggesting ideas was exhibited four times (4.0%) during the observation. The following episodes illustrate all of these interactions:

Example 6e:

(R = Researcher)

GIRL 7:	Let's touch the eggs. *(self-monitor/repetition and suggesting ideas)*
GIRL 8:	Ohh ... (laugh) E-G-G-S. *(self-monitor/repetition)* Press on one of the, um, hand ... (pointing to the screen) *(directing partner's actions)*
GIRL 7:	Anything! *(defending control)*
GIRL 8:	Press on the egg (pointing to the screen, then laughs) *(directing partner's actions)*
GIRL 7:	And where's ... ah, there it is. E-L-M? *(self-monitor/repetiton)* And I'll press on this. Now, I'll press on the A. *(declarative planning and self-monitor/repetition)*
GIRL 8:	And press on ... *(directing partner's actions)*
GIRL 7:	On hand. Now we got some ... *(accepting guidance)*
GIRL 8:	Oohh ... Yummie! *(showing pleasure)*
GIRL 7:	I want the person to come, so I ring the bell. *(declarative planning and suggesting ideas)*
GIRL 8:	Bell! Look at her earrings on ... and (inaudible) on her. Quennie! *(showing pleasure)*
GIRL 7:	Where is ...
GIRL 8:	Press on that (pointing to the screen), doesn't do anything, then press on that hand there (points again) *(directing partner's actions)*
GIRL 7:	It didn't work! *(defending control)*
GIRL 8:	Press on that hand (points to the screen) *(directing partner's actions)*
GIRL 7:	No, I don't want to press on that (shaking her head). I'm going to press on this. *(disagreeing with partner and defending control and declarative planning)*

GIRL 8 was distracted by teacher's voice (talking to someone in the class)

GIRL 8:	Now press on that, do you want to go? (looking at her partner) *(asking for information/explanation) (directing partner's actions)*
GIRL 7:	Yep. *(sharing control)*
GIRL 8:	That. Press on that hand there. Then it try to go back ... (pointing to the screen) *(directing partner's actions)*
GIRL 7:	Oohh ... I don't want to do it. *(disagreeing with partner)*
GIRL 8:	Press on that hand (pointing to the hand icon on the screen) *(directing partner's actions and correcting others)*
GIRL 7:	Oohh ... yes. *(self-monitor/repetition)*
GIRL 8:	Exit, exit (pointing to the screen) *(directing partner's actions)*
GIRL 7:	Exit, exit ! Boing, boing, boing, and where's ... Yes, I do, and I can't even find (anxious, looking up to the researcher, asking for help) *(self-monitor/repetition and declarative planning)*

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GIRL 8:	I'll do it (leaning over to take over the mouse, her partner let go of the mouse, GIRL 8 moves the mouse device around randomly) *(correcting others)*
GIRL 7:	Oh, there it is, I've found it. Found it (then she gain control of the mouse device) Press on the exit ... *(defending control and defending competence and declarative planning)*
GIRL 8:	Grandma Granny! *(showing pleasure)*
GIRL 7:	I want to go to Grandma Granny's. Boing. Boing. *(declarative planning)*
GIRL 8:	Boing! (then smiles at her partner), here she goes. *(acknowledging other's behaviour)*
GIRL 7:	Oh gosh! *(exclaiming)*
GIRL 8:	What? *(asking for information/explanation)*
GIRL 7:	Where is the ... (looking for the cursor on the screen) *(asking for information/explanation)*
GIRL 8:	Bell? (points to the screen) *(asking for information/explanation)*
GIRL 7:	No, just where is, where is the point? Where's the point? Oh, there it is. *(self-monitor and defending competence)*
GIRL 8:	Yes.
GIRL 7:	Should I play, press on this? *(suggesting ideas)*
GIRL 8:	Yep. Press on hand. *(directing partner's actions)*
GIRL 7:	F-L-A-M-I-N-G-O-S (repeating after prompt) *(self-monitor/repetition)*
GIRL 8:	What have the foxes? *(asking for information/explanation)*In there (pointing to the screen). That's why there's a fox on there, because it make the fox tails ... *(providing information)*
GIRL 7:	Come on, you don't do anything (referring to the cursor, which didn't move when she moved the mouse device) *(showing displeasure)*
GIRL 8:	Press on ... *(directing partner's actions)*
(Computer Prompt:	Can you get the fox to get to his friend?)
GIRL 7:	No, I don't want to (looking at researcher) *(terminal response)*
GIRL 8:	Click on the hand, then (pointing to the screen) *(directing partner's actions)*
GIRL 7:	Umm, where's the ... *(asking for information/explanation)*
GIRL 8:	There, there, the hand (points to the screen) *(directing partner's actions)*
GIRL 7:	Well (inaudible)
GIRL 8:	Press on it, so you don't have to do that (pointing to the screen). And then press on that hand, so you go back, do you want to play back at the place ? (looking at her partner) *(directing partner's actions and providing information)*
GIRL 7:	No. *(disagreeing with partner and defending control)*
GIRL 8:	Oh, well, then we won't go ... *(acknowledging other's behaviour)*

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GIRL 7:	I'll play now, press this one ... F-R-O-G *(self-monitor/repetition and declarative planning)*
GIRL 8:	Press on the bell to see how you get out. Press the bell! *(directing partner's actions)*

(Computer Prompt: Do you know my name?)

GIRL 7:	No. *(showing displeasure)*

(Computer Prompt: Do you know what farmers do?)

GIRL 7:	Yes. *(showing displeasure)*

(Computer Prompt: We grow things in our field)

GIRL 7:	Yes you do. *(self-monitor/repetition)* Where is this, point?
GIRL 8:	There's the point (points to the screen) *(providing information)*
GIRL 7:	No, it's just, where is that little arrow? *(asking for information/explanation)*
GIRL 8:	No, that's called, that's called a mouse. It's a funny name, but it's called a mouse (pointing to the cursor on the screen) *(providing information)*
GIRL 7:	Ah, this is called a mouse (using her left hand to point to the mouse device/referring to the mouse device she's using in her right hand) *(disagreeing with partner and providing information)*
GIRL 8:	And that is called a mouse as well (pointing to the cursor on the screen) *(disagreeing with partner and providing information)*
GIRL 7:	Oh, it doesn't do anything. Where's, where's this point? It's always going everywhere. *(exclaiming and showing displeasure)*
GIRL 8:	There (pointing to the screen) It's not a point, it's a mouse! *(disagreeing with partner and providing information)*
GIRL 7:	Now what? Oh yes, I do ... (both children laugh) *(showing pleasure)*

(Computer Prompt: F-L-O-W-E-R-S)

GIRL 7:	Flowers, like she said (repeating after the prompt) *(self-monitor/repetition)*
GIRL 8:	Like say that, press on those again (points to the screen) *(showing pleasure) (directing partner's actions)*
GIRL 7:	Flowers, like she said (repeating after the prompt) *(self-monitor/repetition*
GIRL 8:	Click that, press that, press on there. *(directing partner's actions*
GIRL 7:	I don't want to. *(disagreeing with partner and defending control)*

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GIRL 8:	Okay, you don't have to. How do you get out of this place? (looking up to the researcher) *(acknowledging other's behaviour) (asking for information/explanation)*
GIRL 7:	I don't know. Okay (nods her head)
GIRL 8:	Already there.
R:	What about this?
GIRL 7:	I can't even ... *(exclaiming)*
GIRL 8:	The gate! *(exclaiming)*
R:	Yes, the gate.
GIRL 7:	Boing, boing, boing. G. I'm up to G now. Yep. *(self-monitor/repetition and declarative planning)*
GIRL 8:	Press on the G one (points to the screen, tries to take over the mouse, moves forward) *(directing partner's actions)*
GIRL 7:	I can't! Because I don't know where it is (referring to the cursor) *(exclaiming) (providing information)*
GIRL 8:	Oh, move it a bit ... *(suggesting ideas and providing information)*
GIRL 7:	Oh, there it is.
GIRL 8:	Now, press on the G. *(directing partner's actions)*

GIRL 7 was distracted by the noise behind her, while her partner positions herself closer to the screen/ mouse device)

GIRL 7:	Where is that, where is that?
GIRL 8:	There (points to the screen)
GIRL 7:	Press on the hand? *(sharing control)*
GIRL 8:	Yep, so you get to see her (/head moves/dances to the music playing)) *(showing pleasure)* Press on there again. Press on it again. Where are you going? *(directing partner's actions) (asking for information/explanation)*
GIRL 7:	I don't know where we're going. H. The letter H. Yes (answering to the prompt) *(providing information)*
GIRL 8:	Press that, press that (pointing to the screen) *(directing partner's actions)*
GIRL 7:	Where, where is the ...
GIRL 8:	Press on that (pointing to the screen) *(directing partner's actions)*
GIRL 7:	I can't, I can't find the little ... *(exclaiming)*
GIRL 8:	I'll show you (leaning to her right, trying to take over the mouse device from her partner) *(correcting others)*
GIRL 7:	Oh, there, I know, I know where it is (prevents her partner from taking over the mouse) *(defending control and defending competence)*
GIRL 8:	Press, um, Old Granny, press on the Old Granny *(directing partner's actions)*
GIRL 7:	No, I want to press on H, H, boing, boing. *(disagreeing with partner and declarative planning)*
GIRL 8:	We know a lot of H in our house ... *(providing information)*
GIRL 7:	We've already, oh ... *(providing information)*

GIRL 8:	We haven't done this one. Press here (pointing to the screen) *(providing information and directing partner's actions)*
GIRL 7:	Okay, where's the point, where's the point, can't find the point ... *(exclaiming and showing displeasure)*
GIRL 8:	Well, move that, move that ... (referring to the mouse) *(directing partner's actions)*
GIRL 7:	Oh, that's the way. *(providing information*

It should be noted that the teacher chose both children, thereby eliminating free choice of partner. This situation may have contributed to the lack of cooperation exhibited between the children. Even so, Girl 8 exhibited a high frequency of giving guidance and asking for information/explanation from Girl 7. For example, by asking her partner if she wanted to go to another screen or game, Girl 8 made a cooperative gesture in handling the computer task collaboratively. However, it should be noted that Girl 8's manipulating behaviour may have contributed to the irritation displayed by Girl 7. Girl 8 appeared to be very assertive and persistently insisted on making her own decisions as to which actions to take. The fact that the teacher chose the dyad may have led to the conflict observed in the handling of the computer. Furthermore, this situation may have also served to inhibit collaborative interactions among the children.

4.8 Summary of the findings

This chapter reported the findings of the observational study and the context of the study. Informal interviews were conducted with the classroom teacher and the children. An overview of the location of the study, the physical setting of the preschool, and the general perceptions of the classroom teacher towards computers and their integration into the early childhood classroom were discussed. Twelve children were involved in the observational sessions and the data collection, and the findings were presented in six target cases. All interaction patterns exhibited by these children were identified and calculated descriptively across six target cases. The frequencies of occurrence of the interaction patterns identified within each target case were also presented in this chapter (see Table 1).

4.9   Results pertaining to research questions of the study

Research Question (RQ) 1

RQ 1: *What are the patterns of collaborative interaction exhibited by five-year-old pre-primary children whilst engaged collaboratively with the computer?*

Overall, there were 243 interactions exhibited by twelve five-year-old pre-primary children, over a period of three weeks of observation. Directing partner's actions was the most frequently occurring interaction pattern (23.0%). Other interactions exhibited included: providing information (19.8%); asking for information/explanation (10.3%); self-monitor/repetition (9.5%); declarative planning (7.0%); disagreeing with partner (6.2%); showing pleasure (6.2%); suggesting ideas (3.7%); defending control (2.9%); showing displeasure (2.5%); terminal response (1.2%); defending competence (1.2%); correcting other (1.2%); accepting guidance (0.8%); and sharing control (0.8%). Directing other's actions was exhibited in relation to their partner who was in control of the mouse. All the interaction patterns exhibited by the children were presented accordingly to their respective cases (see Table 2).

Research Questions (RQ) 2 and 3

RQ 2: *What factors facilitate collaborative interaction of five-year-old pre-primary children whilst engaged collaboratively with the computer?*

RQ 3: *What factors inhibit collaborative interaction of five-year-old pre-primary children whilst engaged collaboratively with the computer?*

Interaction patterns observed within all cases involved a continual process of an integrated turn taking system for control over the computer. The children's discourse reflected the successive efforts to gain physical control of the mouse device and share the technology with their partner. Children's differential levels of computer competencies within the peer group were reflected in the range of social behaviours

they displayed and the amount of control over the technology and the success of accepting suggestions and ideas from their collaborative partners. Even so, some of the collaborative partners exhibited different interactive patterns, thus reflecting the diversity of their social relationships, social configurations, and social goals. Based on the observation of all six cases, these variables were identified as possible factors, that may facilitate or inhibit the collaborative interaction of five-year-old pre primary children whilst engaged collaboratively with the computer:

- Social relationships between collaborators

- Social goals of each child

- Social status hierarchies among the children

- Developmental appropriateness of the computer program

- Task structure of the computer program

- Turn taking system applied by the teacher

- The physical setting of the computer environment

- Prior experience and computer competency of children

- Interest in and attitude towards computer

The interaction patterns of all six cases differed significantly across and within dyads. Furthermore, individual behaviour patterns within each case were found to be equally diverse. Common patterns were seen across four of the six cases (Cases 2, 3, 5 and 6). The children appeared to be using each other as resources, with a high level of requesting and providing information across partners. The ensuing discussion chapters explore these selected cases for in-depth analysis. Further descriptions of the interaction patterns exhibited by the children are discussed.

CHAPTER 5

DISCUSSION

5.1 Introduction

This chapter discusses the findings of the in-depth analysis of young children's collaborative interactions whilst engaged with the computer. Six pairs of children are chosen for analysis. The qualitative informal interview data gathered during the research undertaking is discussed in relation to the verbal and nonverbal interaction patterns exhibited by the children. The discussion commences with an examination of patterns arising in four cases (Cases 2, 3, 5 and 6), with particular attention to the way these interaction patterns reflect the type of interaction presented by previous research. The discussion then focuses on the factors that may inhibit interaction whilst children are engaged in an educational computer environment. The discussion will conclude with an examination of how early childhood educators may incorporate and integrate computer-mediated tasks and activities into the early childhood classroom.

5.2 Analysis of interaction patterns of four cases (Cases 2, 3, 5 and 6)

The results of six observational sessions conducted during the course of this research have given valuable insight into the collaborative interaction patterns of a small group of pre-primary children whilst engaged with the computer. The information provided has been coded into exclusive categories and presented as tables in percentages where appropriate. These findings will be discussed in relation to similar past and current studies. Vygotsky's (1978) perspective of sociocultural theory

emphasises prerequisite development, which requires interaction and the presence of support from a more skilled partner. Social interaction in the form of cooperative dialogues between children and more knowledgeable members of society is necessary for children to acquire the ways of thinking and behaving that make up a community's culture (Van der Veer and Valsiner, 1991). The findings of Case 2 and Case 4 suggest that even with minimal or no adult assistance, children exhibit many constructive patterns of interaction whilst working on computers.

5.2.1 Scaffolding elements and conflictual interaction

The elements of scaffolding between children were also observed. Scaffolding is a term that is most often applied to Vygotsky's theory of learning, in which it is believed that cognitive development in children occurs through the interaction of a child with more capable members of the same culture, such as adults or more knowledgeable peers. These people serve as guides and teachers for the child, providing information and support necessary for the child to grow intellectually. Even so, conflicts may arise within these interactions as exhibited by Girl 4 (in Case 3) and both Girl 7 and Girl 8 in Case 6. Mercer (1994) suggests that when conflict arises between children whilst they are engaged in collaborative interaction at the computer, disputational talk may occur. According to Mercer (1994), disputational talk displays the speakers challenging other speaker's views, or actions, without attempting to justify their challenge by building on previous utterances, or offering no information. In a certain context, Teng's (1997) terminal response category of interaction pattern supports the features of this negative behaviour. However, Mercer (1994 & 1999), emphasized that the features and characteristics of these verbal interactions are representational of the children's social mode of thought.

5.2.2 Exploratory talk and negative behaviour

According to Vygotsky (1978), at any given point in cognitive development there are certain problems that children are on the verge of being able to solve. Whilst some of these can be solved independently by a learner, others are outside the learner's capabilities and can only be solved under 'teacher' guidance or in

collaboration with a more advanced peer. At this point, the child is working in the 'zone of proximal development' (Vygotsky, 1978). Hence, within this zone of proximal development, Mercer (1994) suggested that collaborative, computer-based activities, which generate a substantial amount of exploratory talk, would help to further the aim of appropriate computer integration. Teng (1997), however, classified terminal response as one of the interaction patterns of negative and anti-social behaviour. Even so, none of the children in the current study exhibited any form of aggressive physical behaviour during the observation. Hence, anti-social behaviour was not observed during the course of this research. However, the findings of this study also indicated that the classroom teacher emphasised social and emotional development and cooperative behaviour among the children observed.

5.2.3 Software type and negative behaviour

In discussing sociocognitive theory, Lomangino, et. al (1999) stressed the importance of collaboration involving the expression of disagreement in terms of alternative perspectives in order to be effective. Some children expressed disagreement with their respective partners, but not always in a manner that facilitated their collaboration. Conflictual patterns of interaction of these children were represented by the interaction patterns of disagreeing with partner, which occurred 15 times out of a total of 243 interactions (6.2%). It was found that the interaction patterns occurring in the study being reported here reflect these exchanges, and support the findings of the SLANT project. Furthermore, both the SLANT and the study being reported here used a closed (close-ended) computer software program *Concept Kate*, and *Cyber Grannies*, where it has been found that discrete, serial, 'closed' problem-solving tasks generate very little extended, continuous discussion of any kind (Mercer, 1994).

5.2.4 Type of interaction pattern and physical setting

Insights into types of interaction were highlighted in Teng's (1997) study of six five-year-old Taiwanese children. The researcher identified 20 interaction patterns, and further categorised them into pro-social behaviour, anti-social behaviour, and neutral behaviour. The categories of interaction pattern were as follows: observing, showing pleasure, accepting guidance, seeking guidance, positive physical behaviour,

terminal response, problem-solving, giving orders, empathising, refusing to share, blaming the others, exclaiming, rejecting guidance, requesting, negative physical behaviour, sharing, showing displeasure, imitation, and calling. It is acknowledged that the study being reported here employed certain characteristics of these interaction patterns, in identifying the collaborative interactions of twelve five-year-old pre primary children in Australia. Categories of terminal response, giving guidance, showing pleasure, and showing displeasure were incorporated into the charting process of pattern identification.

Teng (1997) argued that the findings of her study provided a rich, full, and detailed understanding of young children's social interactions in a computer learning environment. However, as Teng observed six children only, in a non-naturalistic educational computer environment, the findings lack generalisation to a more naturalistic early childhood classroom environment. Moreover, several studies (Fisher, 1991; Hadlock & Morris, 1985; Clements, 1994) have all concluded that children's developmental gains resulting from using appropriate software are significantly greater when the computers are in the classroom than when they are in a computer laboratory. Davies and Shade (1999) support this argument by emphasising that: (1) children receive limited exposure to the computers in laboratories; (2) computer laboratories tend to use drill software while more tool-oriented software is used in the classroom; and (3) there is less collaboration and peer tutoring in a laboratory setting.

Moreover, Lomangino, et al. (1999) also conducted their study in a separate media centre, where children left their classroom to work at the computer. The researchers argued that the centre was not an artificial setting for studying children's use of computers within the school, as the children had routinely left their classrooms to use computers in the media centre, both individually and in small groups (Lomangino, et al., 1999). Even so, in discussing the appropriateness of separating the computer from the classroom environment, Bredekamp and Rosegrant (1994) stated that:

"Pulling children out of the group into a computer laboratory demands rigid scheduling and takes away the other rich options from which children may choose. In kindergarten, preschool, or child care settings, if computers are used, they should be one of many classroom activity choices. In these settings, the teacher's role mirrors the role played in many other learning situations ... the teacher creates the environment in which children become aware and explore, and then acts to support their exploration and inquiry in many different ways. The children and the teacher learn something new together as they engage in the process of learning. The teacher does not have to be an expert but instead is a co-constructor of knowledge with children (p.60).

Therefore, it may be the case that positive interactions and appropriate developmental gains of children occur to a greater extent when computers are in the classroom, and integrated across the curriculum. As cited in Davies and Shade (1999), "computer laboratories are not across the curriculum; they are across the hall" (p.5).

5.3   Factors facilitating and inhibiting interaction patterns

This section discusses three variables involved in the present study. The variables are as follows: (1) the classroom teacher variable (including teacher's educational and philosophical beliefs and practice); (2) software variable (close-ended developmentally appropriate software); and (3) children variable (including children's computer competency and attitude towards computer, and personal relationship between collaborators). As this study focused on the range of behaviours displayed by children working together on the computer, four cases were purposively selected for an in-depth analysis. Case 2 and Case 4 illustrate a wide range of positive interactions, while Case 3 and Case 6 on the other hand, demonstrate conflictual sequences between the collaborators. Overall, these four cases were selected for their wide range of interactive patterns of behaviour. It is recognised that these four cases do not represent the entire range of children's behaviour exhibited. The aim of the study is not to generalise the four target cases to all Australian children's experiences, but instead, to offer valuable insight and understanding of the diverse experiences children have while working collaboratively on the computer.

5.3.1 Teacher variable

In reflecting on a local perspective, the findings of the study being reported here are compared with the findings of Trinidad (1992). Trinidad (1992) explored the interaction process of pre primary children, in relation to their social and cognitive outcomes in a computer learning environment. Trinidad (1992) examined how children's learning and development can be understood within the social contexts in which the learning takes place. Trinidad's study took place at three Perth metropolitan pre primary centres using personal computers, concept keyboards and different educational computer software, as suggested by the Education Department of Western Australia (EDWA). The classroom teacher in the study being reported here, believed, like Trinidad, that the children would not experience any loss (educationally) if they were not exposed to the computer in the classroom. Indeed, the following examples illustrate her views:

> *Only have this computer this year. Its used as a tool. It is used like the block corner, the play-doh table. If the child never goes to the computer for the whole year, it doesn't worry me... (S2a)*

> *I think lots of them have got computers at home, so, you know, when you come here, and you've got all these facilities, you know and they're only five (year olds), sometimes they really like playing with the blocks, or the 'play-doh', or painting or you know, we have so many resources here, so many wonderful things ... (S3a)*

Moreover, according to Trinidad (1992), as children's cognitive and social development is already occurring at or near the maximum rate in the enriched environment found in both pre primary centres and primary schools, additional input from computers has no significant effect on the children's overall development. This notion is supported by other studies (Lomangino, et al., 1999; Nicholson, et al., 1998; Teng, 1997; Shade, 1994; Clements & Gullo, 1984; Clements, 1985; Clements & Nastasi 1988; Miller & Emihovich's, 1986). It is also argued that the computer-based learning activities did not contribute to an increase in the measured cognitive and social development of children at preprimary and Year 1, nor did Software Type 2 (for example, the open-ended discovery-based software) produce greater cognitive or social development than Software Type 1 (for example, the drill and practice

software) (Trinidad, 1992). According to Shade (1994), drill and practice software was reputedly claimed by previous studies (see Clements, 1994; Clements & Nastasi, 1992; Clements, Nastasi & Swaminathan, 1993) to have less effects on social and cognitive development in children. Drill and practice had resulted in children being more likely to engage in competition, avoid the exchange of ideas, become more dependent on the teacher for help, and become bored with paper and pencil tasks (Shade, 1994). However, Lomangino, et al. (1999) and Nicholson, et al. (1998) argue that positive findings have also been found, in relation to an increase in social interaction, including but not limited to turn-taking, peer tutoring and increased verbalisation. As asserted by Lomangino, et al. (1999, p.224):

"...children were involved in complex social work as they composed with peers on the computer screen. Children sought to gain attention and approval from peers, mark their uniqueness, and manipulate and/or maintain their relationships with others. Within each group, children's talk and interactions with the computer reflected distinct social agendas."

However, composing activities were seldom a routine in early childhood classrooms. Although pre primary children may indicate their readiness to read and write, activities involving composition and group work are usually only organised when they are in primary schools (Lomagino, et al., 1999). Even so, this current teaching trend should not inhibit early childhood educators from encouraging children in collaborative activities, particularly at the computer. Hence, more studies of children's positive collaborative interactions are needed to ascertain how they may be best utilised to achieve educational goals in learning and to enhance appropriate social skills.

5.3.1.1 Role of teacher in computer environment

In discussing the role of the teacher in the computer environment, a growing body of research argues that the teacher's role has been typically and vaguely defined, although often perceived as essential (Mevarech & Light, 1992; Mercer, 1994; Mercer, 1999; Lomangino, et al., 1999). In this study, the classroom teacher's computer management strategies were seen to affect the way the children interacted with each other. The turn taking system required the children to share, observe and help each other whilst working together at the computer. The children were exposed

to the computer through peer modelling, peer clarification, teacher modelling, and self-exploration. Parents were involved in introducing new computer programs to some of the children, so that they became the experts who could teach the program to others. Shade (1994) and Haugland (2000) argued that most children exhibit a more positive interaction in an enjoyable environment, provided by equitable access and appropriate computer management strategies. In the current study, peer and teacher assistance did not augment the children's access to the computer. The children were frequently denied help from the teacher in using the computer programs. The classroom teacher expected the children to help each other in solving any problem encountered with the computer. However, it is interesting to note that all children involved in this study required minimal or no assistance in handling the technology. It is believed that due to their existing experience and knowledge, and high competencies in computer skills, little help in handling the computer was needed. Thus, this would seem to justify the classroom teacher's decision to rely on the children to teach themselves and others to use the computer program after an initial introduction from a parent.

5.3.1.2 Role of teacher in classroom computer management

In relation to the classroom teacher's management of the computer in the pre-primary classroom, it is found that the teacher's beliefs and educational philosophy determined her classroom management and instructional practices. This philosophy and attitude towards the computer proceeded from her educational background, teaching experiences, and personality. Having used computers in the classroom for less than two years, and having no particular formal educational and technical knowledge of the technology, the classroom teacher appeared to be quite uncomfortable using the computer. Bracey (1994) suggests that it takes four to six years for teachers to feel sufficiently comfortable using educational technology to make changes to their teaching. However, as reported earlier, the teacher did not regard the computer as an 'actual' teaching tool. Thus, this may indicate the lack of emphasis given to applying the technology in the early childhood classroom. Although the teacher was new to educational technology, she was open to learning to use the *Cyber Grannies* program, and investigating the educational content of the software. In

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addition, the teacher participated in introducing developmentally appropriate educational computer programs to the preschool, by purchasing software through parents of a pupil. The researcher noted an increase in interest exhibited by the teacher as a result of the research study. A veteran of thirteen years in an early childhood classroom, the teacher had a warm and caring personality. Her behaviour in the classroom disclosed a love of children and a passion for teaching. She sincerely believed in the children's ability to learn, but not only through the help of computer technology. Thus, she accepted the unexpected. As demonstrated in the following example, the teacher would permit the children to use the computer at any time of the day:

> "And then we go outside, but when they're outside, I mean when they're outside, if somebody really wants to go on the computer, they can come over, I don't really mind, but they don't want to, they would much rather be outside playing than inside here on the computer" (S10)

5.3.1.3 Teacher's educational beliefs and practices

The teacher believed in structure and as a consequence organised the classroom, set rules and offered guidelines. Valuing respect and independence, the teacher taught the children to cooperate, reason democratically, and share resources. She gave the children choices and acknowledged their voice in decision making. In conclusion, this teacher's management and integration of classroom computer use was evidenced as a conscious and continuous effort to make the computer accessible to all children. However, due to a lack of educational computing knowledge, computer anxiety and a lack of appropriate resources, the children were provided with little encouragement in group cooperation and collaboration, whilst working at the computer. These factors may have reduced the amount and quality of social interaction exhibited in relation to the computer activity. With less collaborative interactions and learning activities at the computer, the computer activity may have been less enjoyable, relevant and meaningful to the children's holistic development.

5.3.2 Software variable

As discussed by Mercer and Fisher (1992), typically, teachers attribute the failure or success of classroom computer activity to "good" or "poor" programs, but

the procedures and outcomes of any computer-based activity will emerge from the talk and joint activity of teacher and pupils. According to the authors, the same software used by different combinations of teachers and pupils on different occasions will generate distinctive activities, which may operate to different time scales, generate different problems for pupils and teachers, and different learning outcomes. However, the most defining influence on the structure and outcomes of a computer-based activity will be that of the teacher (Mercer & Fisher, 1992). As demonstrated in the current study, the teacher's main responsibility is to ensure that children's computer-based activity experience contributes to their education. Mercer & Fisher (1992, p.354) stressed that "the responsibility cannot be delegated to even the most sophisticated software, or to the children themselves". The authors conclude that there is a need to evaluate and describe the ways that teachers attempt to "scaffold" children's learning with computers, which may enable educators to help teachers to perform that role more effectively and also contribute to the design of more "classroom-friendly" software.

5.3.2.1 Interaction pattern and software type

According to Crook (1991), different software encourages different types of interactions and learning outcomes amongst students. For example, Johnson and Johnson suggested that verbal interactions between students when using simulation software facilitates higher-order thinking, as students readily interact with peers to solve problems (Johnson & Johnson, 1989; Sherwood, 1990). In the context of word processing it has been reported that collaborative writing environments encourage students to find solutions to a range of writing problems, largely through extensive discussion (Johnson & Johnson, 1986; McMahon, 1990); whilst others have reported that students are able to work longer, and develop a better understanding of the writing process when working cooperatively on a writing task (Schwartz, Vand der Geest, & Smit-Kreuzen, 1992). Furthermore, Clements and Nastasi (1988) have suggested that a 'richer Computer-Assisted-Learning (CAL) environment' is likely to produce a greater frequency of quality interactions. CAL (simulation and word processing software) is chosen by many teachers as the focus for computer-based learning and at least one major evaluation of computer use in primary and high

schools, lists these software packages amongst the most frequently applied (Mercer, 1999; 1993; Wegerif & Mercer, 1999; Wegerif, 1996). However, previous studies suggest that software applications in early childhood classrooms differ from those at elementary levels.

In Trinidad's (1992) study, ethnographic data were gathered, and provided insight into the way children interact with the computer, software type and each other, encouraging individual learning styles. According to the researcher, the children were observed to be task orientated and cooperative when using the computer for both Software Type 1 (drill and practice software) or Software Type 2 (open-ended, discovery-based software) and on several occasions individual children were given the opportunity to acquire and practise learning strategies with peers and adults. Furthermore, Jackson and Kutnick (1999) claimed that there is evidence that the structure of the computer task does indeed affect dialogue among users of the software. Thus, Trinidad (1992) concludes that exposure to the computer-based learning environment gave children an opportunity to interact with the computer, peers and adults in a context that facilitates social interaction. The amount of social and interpersonal cooperation, and the encouragement to socialise while they are using the computer are due to the interactive environment provided by the computer and appropriate software (Trinidad, 1992). Hence, the positive forms of social interaction occurring in the current study are seen as the effect of positive relationships between the children. This phenomenon is graphically demonstrated in Cases 2 and 5, pro social behaviours were observed to be more apparent, as represented by the higher frequency of positive guiding interactions (directing partner's actions and asking for information/explanation) whilst using *Cyber Grannies: A Vocabulary Adventure* software.

5.3.2.2 Developmental appropriateness of software

If computer software is going to be truly enjoyable and playful, it must have characteristics similar to those of other materials found in the early childhood classroom. Traditional toys and equipment require virtually no adult instruction and limited adult interaction for youngsters to actively engage them in their play. The uses

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of these play materials is self-evident or easily learned through the child's manipulation of the object (Escobedo, 1992). Some claim that most computer software available for young children requires considerably more instruction and adult interaction than these more traditional play materials (Haugland & Wright, 1997).

Cyber Grannies: A Vocabulary Adventure (an educational software program with problem solving tasks embedded in a narrative framework and limited options given to users), was evaluated and selected on the basis of a review score of 8-10 on the Haugland Developmental Software Scale (Haugland, 1999). This program was further categorised as a developmentally appropriate drill and practice software package. When first introduced into the classroom, most software must be explained by the adult and later, additional assistance is frequently needed to avoid frustration on the part of the child (Clements & Nastasi, 1992). However, in the current study, children required little or no assistance and help, either from the researcher or the teacher. The content of the *Cyber Grannies* permits children to operate the program from the beginning (main screen), throughout until the end. Moreover, voice prompts and instructions from the program itself appeared to 'scaffold' children.

There was no indication of children becoming anxious to leave at the end of using the program. This finding also supports the existing literature which indicates that technology, with the use of developmentally appropriate software, might increase the attention span of young children (Clements & Nastasi, 1993; Haugland & Wright, 1997; Wright & Shade, 1994). Children's liking of the program, especially its use of coloured three dimensional (3D) graphics and enjoyable music, was obvious. The children's various verbal and non-verbal expressions, body movements, and responses to the computer prompts suggested that they were enjoying themselves. Using the program aroused almost all children's curiosity as indicated by the data on the verbal sequences. Almost all children in the classroom raised their hands when the teacher announced "Some children are going to work at the computer with Mohamad, and you can choose a friend to play with you" , even in the third week of data collection. These are indications that children are motivated to use the computer and computer technology can be another enjoyable way to get children interested in learning. It is also argued that gender preferences for software (the *Cyber Grannies*) did not exist in

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the current study. This may have been due to the small number of subjects involved in this study. However, as enunciated by Shade (1994), girls tended to respond more positively to the more developmentally appropriate software, whereas boys were more excited about the low level, more competitive drill and practice software.

Young children in the early childhood classroom are typically non-readers. Yet, the findings of the current study showed that the use of the program helped Boy 3 and Boy 4 (in Case 5) to learn the words in the alphabet and the construction of a sentence (the letter B). Henniger (1994) suggests that computer verbalisation, and children's speech capability can readily be extended to simple instructions for appropriate computer use, which might improve the child's ability to independently use the program. Thus, it is argued that extended and repeated use of such a program is necessary to enhance learning.

5.3.3 Children variable

Insights into children's interaction patterns, and their attitude towards computer, came from two sources. The first was the observation sessions and children's responses recorded from interviews with the researcher. The observation sessions of the study being reported here confirmed the view that in general children find computer-based activity enjoyable and they did not appear to experience the enforced lack of continuous face-to-face contact (as they sat together, facing the computer screen) as a deterrent to animated conversation. These findings support the views of Mercer (1994) and Lomangino, et al. (1999). It is the contention of the study being reported here that children collaborated more effectively when they had agreed upon a system for turn-taking and sharing control of the tool. Moreover, when children had a mutual understanding of their task and positive attitudes toward exploring the content of the computer program, enjoyable and educational experiences were enhanced. However, Mercer (1994) argued that if the children were to work effectively in dyads or small groups, with relatively infrequent teacher intervention, they must be helped to understand precisely what it is expected of them, and why these expectations are being set.

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5.3.3.1 Interaction pattern and children's play component

Based on the suggested categories of behaviour employed by Gillies (1997) and Lomangino, et al (1999), the interaction patterns of Boy 2 appear to inhibit positive cooperative interactions. Conflictual responses exhibited by Boy 2's partner demonstrated a lack of cooperation in jointly exploring the content of the computer program. Interestingly, the emotional responses of Boy 3 and Boy 4 (as seen in Case 5) and Girl 2 and Girl 3 (as demonstrated in Case 2) seemed to be exhibited in an enjoyable environment. The interaction patterns across cases were also compared with the interactions of much younger children (aged two to three years old). Jones and Liu (1997) conducted an investigation of the interaction of young children within a computer multimedia environment. The children's desire to explore the content of the computer program was evident and similar to the findings of the current study. Most of the interaction patterns seemed to stem from the novelty and excitement provided by the new program. However, Jones and Liu (1997) argued that purposeful interaction with the computer probably will not occur until children are older (two and a half, to three years of age). Even so, the interaction patterns of the twelve children in the study being reported here, clearly demonstrated that play was perceived as the most important component in children's interaction.

Escobedo (1992) emphasised that when children learn to use computers, they depend on play and its components (exploration, manipulation, experimentation and mastery of appropriate skills) just as they do when they learn about other play activities. Hence, the implication of the study being reported here, is that the children would interact in a more collaborative manner if the environment permitted play and all its components (exploration, manipulation and experimentation, and mastery of appropriate skills) within the content of the program. Moreover, as cited in Shade (1994, p. 204):

> "Good software, that is deemed developmentally appropriate, may require scaffolding for children to become relatively proficient and independent users in a short period of time. Whereas children can use drill software with almost immediate success, it takes a little longer to realise the benefits of developmentally appropriate software".

Neo-Vygotskian sociocultural theory posits three distinctive and contrasting theoretical perspectives on computer use in education (as shown in Figure 1). In discussing tertiary education and computer usage, McLoughlin and Oliver (1998) emphasised that learning around computers is a social activity where learners share resources, talk, discuss ideas and collaborate. McLoughlin and Oliver (1998, p. 134) further the argument by stating that:

> "The quality of learning around computers is not entirely dependent upon the interface between learners and the technology. Instead, it is related to the whole social climate of the classroom and the opportunities created for interaction and 'exploratory talk' between participants in the learning process"

Mercer (1999) states that in a conversational sequence of exploratory talk, the collaborators engage critically but constructively with each other's ideas; knowledge is made publicly accountable; and reasoning is visible in the talk. However, these conditions are not to be found in most five year olds. Moreover, this explanation is not compatible with some recent studies of computer-based learning by Shade (1994), Lomangino, et al (1999), and Nicholson, et al (1998). Shade (1994) reported that the children in his study exhibited little or no negative emotion (fear, sadness, disgust), nor confrontational behaviour when working with computers, regardless of software appropriateness, social condition, gender, or age. Thus, the integration of communication into computer tasks has to undergo a certain process, which consists of reciprocal relationships between: (1) group and collaborative tasks; (2) generalisations of different solutions; (3) discussion, change of perspective; (4) group interaction/evaluation and feed back; and, (5) externalisation of thought through language (McLoughlin and Oliver, 1998).

Collaborative learning represents an attempt by educators to capitalise on human orientation toward social interdependency in order to facilitate learning. Use of the group learning process is based on the belief that individuals learn better when they learn together (Haugland & Wright, 1997). Although research generally supports such an assumption, Nastasi and Clements (1991) claimed that some types of group processes are more effective than others and different types of collaborative interactions may facilitate different aspects of learning (for example, rote

memorisation against higher-order thinking). As mentioned earlier, general reference to collaborative interactions refers to the individual action of one child that is directed at another (for example, talking to another child, responding to a question, gesturing) (Brown, Odom & Holcombe, 1996). In operational terms, collaborative interaction refers to patterns of discourse exhibited by five-year-old children whilst using educational computer programs in a classroom environment. Based on a study by Mercer (1994) and the system for Observation of Children's Social Interactions (SOCSI) by Brown, Odom & Holcombe (1996), and the work of Nastasi & Clements (1993), three categories of interaction were chosen to code these interactions in the current study. The categories were as follows: (1) disputational talk; whereby speakers challenge other speakers' views, but without attempting to justify their challenge by building on previous utterances or offering new information; (2) cumulative talk; whereby speakers contribute to discussion by taking up and continuing a previous speaker's utterances, without explicit comment; (3) exploratory talk; whereby hypotheses are proposed, objections are made and justified, and new relevant information is offered. However, Nastasi & Clements (1993) classified collaborative behaviour as cooperative work, turn taking, self-directed work, seek or wait for teacher attention, and off-task behaviour.

5.4 Other factors influencing interaction patterns across cases

Table 8 illustrates the dominant interaction patterns employed by the subjects in the study reported here. As highlighted previously, the interaction patterns differed significantly across and within the collaborative groups (see Table 8). The children of Case 2 and Case 5 demonstrated a positive environment for collaboration. In contrast, Case 3 and Case 6 demonstrated the interaction patterns of conflictual behaviours, which may inhibit collaborative interaction among children.

Table 8

Dominant interaction patterns employed by the children throughout interaction

Case 2 Girl 2 and Girl 3	Asking for information/explanation Providing information/explanation	Directing partner's actions
Case 5 Boy 3 and Boy 4	Asking for information/explanation Providing information/explanation	Directing partner's actions
Case 3 Boy 2 and Girl 4	Directing partner's actions Providing information/explanation	Terminal response Defending control
Case 6 Girl 7 and Girl 8	Directing partner's actions Providing information/explanation	Terminal response Showing displeasure Defending competence

According to Webb, Ender & Lewis (1987), exchanging information, giving help and explanations, asking questions, seeking context clarification and elaboration are common features of student interaction of the four Behaviour State categories: (1) cooperative behaviour (task-oriented behaviour including listening); (2) non-cooperative behaviour (defined as negative social behaviour); (3) individual non-task behaviour and confusion (non-participation in group activities or the group task); and (4) individual behaviour (task-oriented, but working alone). However, some studies claimed that young children's cooperative behaviour may be inhibited by concurrent social and cognitive demands of working on task collaboratively (Daiute, 1992; Daiute & Dalton, 1993). The findings of the study being reported here support this view, as demonstrated by the negative responses and frequent level of disagreement exhibited in Case 6. The fact that children had to demand and seize control from their peers has important implications for the effective functioning of collaborative activities in early childhood settings.

5.4.1 Children's social goals and associating factors

Lomangino, et al. (1999) revealed that peer collaboration is not necessarily an equitable arrangement, and stratification processes often occur, resulting in status orders in which group members have differential relative status. Furthermore, Dembo

and McAuliffe (1987) suggest that high status children are more likely to participate in the group, act like facilitators, give, receive, and request help, and respond negatively to help from lower status children. Dembo and McAuliffe (1987) also revealed that children designated as high status showed higher rates of social interaction and social initiative behaviour. The findings of the study being reported here support the claims of both studies. High status children appear to initiate and offer guidance to their partners (for example, displaying interaction patterns of directing partner's actions, suggesting ideas and providing information). These interactions were demonstrated by exhibiting high frequencies of positive behaviour (as illustrated in Cases 2 and 5).

As indicated in the findings of the study being reported here, children's relative status among peers appeared to be associated with their preexisting computer competencies and attitudes, and mutual friendships among collaborators. However, as all subjects have similar high socio-economic backgrounds, stratification of types of social behaviours among children was not clearly evidenced. The fact that children from low socio-economic backgrounds often have limited access to computers and thus less computer competencies, has important implications for the effective integration of computer technology into early childhood settings. Hence, modelling how to share control of the computer technology may be particularly important for those young children, who have limited social skills (Lomangino, et al, 1999). Dauite and Dalton (1993) suggest that providing assistance may reduce the difficulties in transfer of control and may also facilitate inclusion of low status members, who are less likely to have the power to secure a turn.

It is concluded in the study being reported here, that there is a need to investigate interaction patterns of children from low socio-economic backgrounds, in relation to their potential to effectively collaborate while engaging at the computer. The relative social status among children while collaboratively engaged at the computer, may also provide useful information for teachers to support all children's success within these activity settings.

5.5 Summary

This chapter has examined the findings in relation to three research questions, which guided the study:

1. What are the patterns of collaborative interaction exhibited by five-year-old pre primary children whilst engaged collaboratively with the computer?

- Sixteen interaction patterns were identified (see Table 7);
- a total of 244 interactions were exhibited by 12 children;
- two cases demonstrated meaningful and positive collaboration between children. Patterns exhibited in Case 2 (dyads of Boy 3 and Boy 4) and Case 5 (Girl 2 and Girl 3) indicate collaborative interactions may occur in an enjoyable and friendly environment.
- two cases indicate negative behaviour and possible non-collaborative interaction. Case 3 (Boy 2 and Girl 4) and Case 6 (Girl 7 and Girl 8) demonstrated patterns of disagreement and possible conflictual situations between children

2. What factors facilitate collaborative interaction of five-year-old pre-primary children whilst engaged collaboratively with the computer?

- Developmental appropriateness of software;
- preexisting computer competency between children;
- preexisting positive attitude towards computer;
- mutual friendship between collaborators;
- social goals of each child;
- appropriate structure of enjoyable learning environment;
- mutual understanding of turn-taking system;
- positive non-isolated physical settings of the computer environment.

3. What factors inhibit collaborative interaction of five-year-old pre-primary children whilst engaged collaboratively with the computer?

- Non-developmentally appropriate software;
- lack of computer competency between children;

- negative attitude (on the part of both children and teacher) towards computer and learning;
- sense of competition between collaborators;
- social goals of each child;
- inappropriate structure to promote enjoyable learning environment;
- no mutual understanding of turn-taking system;
- isolated physical settings of the computer environment.

In sum, the effects of using a developmentally appropriate software package in a pre-primary classroom appear to be overwhelmingly positive. Consistent with previous research (Mercer, 1999; Lomangino, et al., 1999; Nicholson, et al., 1998; Haugland & Wright, 1997; Littleton & Hakkinen, 1999; Crook, 1991), the children in the current study enjoyed using the computer and did not fight over it. Although the initial enthusiasm waned somewhat as the computer program became integrated into the classroom routine, the children remained interested and involved with the computer throughout the course of the study.

The discussion has served to highlight both collaborative and non-collaborative patterns of interaction exhibited by twelve pre-primary children, whilst engaged in an educational computer environment. Factors that may facilitate or inhibit these interaction patterns were also discussed. These have in turn revealed the existence of important links between three ma variables of the study: the teacher, the children and the technology (hardware and software). The findings indicate that in accordance with Vygotsky's theoretical perspective, when children use computers collaboratively, development will occur when partners have different levels of competence and interact positively in dialogue that includes questioning, providing elaborated responses, and instructing. The themes that have arisen throughout this discussion chapter have directly shaped the ensuing conclusion chapter.

CHAPTER 6

CONCLUSION

6.1   Introduction

In conclusion, this study found that dyads composed of children who would not normally work or play together, did not exhibit collaborative interaction during the course of exploring and working on the selected developmentally appropriate computer software. However, collaborative interaction emerged and was reinforced between the members of dyads who were initially perceived as being capable of working together. Even so, dyads of children who responded and exhibited negative behaviour were seen as non-collaborative, and perceived as inhibiting the occurrence of collaborative and cooperative interactions. Mutual friendships and popularity may influence and facilitate the levels of collaborative interaction between members of the dyads. The teacher's educational philosophy and beliefs towards computer usage in the early childhood classroom were also believed to either facilitate or inhibit collaborative interaction. Task structure, the nature of the software and the physical setting of the computer environment may also contribute towards facilitating and/or inhibiting young children's collaborative interactions, whilst working in dyads on the computer.

Although generalisations from single class, and single event observations are limited, this study exposed the nature of interaction patterns exhibited by twelve five-year-old pre-primary Australian children, whilst collaboratively working together at the computer. The current findings support previous research outcomes on interactive patterns of children's interactions (Mercer, 1994; Shade, 1994; Teng, 1997;

Nicholson, et al., 1998; Lomangino, et al., 1999; Mercer, 1999; Keogh, Barnes, Joiner, & Littleton, 2000). Such studies indicate that the qualitative dimension of the exhibited social behaviours represent the children's desire to work cooperatively and collaboratively, with mutual understanding of turn taking and sharing control of the technology. Nastasi and Clements (1993) support the notion that social and motivational processes mediate the effects of collaborative problem solving in an educational computer environment. In designing the learning environment to integrate cooperative structures and computer technology in ways that foster the development of higher-level thinking, educators should choose software that is more likely to foster conflict resolution, effective motivation, and higher-order thinking computer-assisted/based instructional software (Nastasi & Clements, 1993). However, Jackson and Kutnick (1996) demonstrated that teachers and researchers should not accept group work as the favoured grouping method for all computer-based activities. Instead, they should question the pedagogic intent of the assigned task and ascertain whether individuals, pairs or larger groupings of pupils are most appropriate. Furthermore, as indicated in Wegerif, Mercer, and Dawes (1999), the kind of ability involved in individual non-verbal reasoning, is mediated by social interaction. In addition, compatible with the sociocultural position, success at any cognitive task is a situated achievement in which many contextual factors may contribute a part.

As all the children in this study came from the same classroom, their preexisting relationships undoubtedly affected their interactions. The computer environment should be structured to engender collaboration, self-selection of problems, and exchange of information between collaborators (Nastasi & Clements, 1993). Overall, the efficacious use of an educational computer environment, which integrates technology and collaborative learning, depends on multiple factors related to structuring of task-related and social-process variables (Nastasi & Clements, 1993; Mercer, 1993, 1999). Furthermore, sociocognitive conflict, or at least argument, may represent a valuable condition for progress in peer interaction situations (Littleton & Hakkinen, 1999). Moreover, Crook (1995) emphasised settings that afford concrete manipulation and experimention. As cited in Crook (1995, p.546), "ideally, an individual's interaction with the problem domain might be witnessed by peers, who

thereby more easily enter into collaborative engagement. Computers may have a special potential in creating such settings for joint activity".

6.2   Implications

"A common view, held by teachers, software designers and education technology researchers, is that the nature of any computer-based learning activity is almost entirely defined by the software. Teachers typically attribute the failure or success of any activity to 'good' or 'poor' programs" (Mercer & Fisher, 1992).

Research has clearly demonstrated that computers provide children with some unique and important avenues for learning (Haugland, 2000). The findings of this study and the professional literature suggest ways of integrating computers into the early childhood classroom. In the current study, the teacher's classroom computer management and instructional practices were evidenced in the turn taking system and the reliance on the children to share the technology. Software appropriateness was seen as the determinant factor for success in utilising computers with young children. The similarity in findings between the current study and previous studies suggest that early childhood educators have placed a high priority on the characteristics of developmentally appropriate software. Haugland and Shade (1994) surveyed the status of computer integration in early childhood classrooms, including the hardware utilised, educator perceptions of the software market, how educators select software programs, and future directions for the software industry. A total of 112 administrators, early childhood teachers, college/university faculty members, curriculum specialists, business representatives and students were surveyed at an Annual Conference of the National Association for the Education of Young Children (Haugland & Shade, 1994). According to their report, seventy-nine percent of respondents utilised computers with young children 3 to 5 years of age, with 53 percent having 3 or more years of computer experience with young children. Burgess and Trinidad (1991) reported that the use of home computers in Australia indicates that between 30% and 60% of children have a computer at home before they begin formal schooling, and that it is this access to a computer at home that influences

young children's understanding and awareness of the technology. Downes (1994), as cited in Downes and Fotouros (1995) claimed that in South West Sydney alone, more than 35% of children had more than one television, a VCR, a computer and dedicated game playing machine such as Super Nintendo.

Downes and Fotouros (1995) identified and discussed the principles which guide the design of computer-based learning environments for children throughout their preschool and primary years. The researchers concluded that the wider social context, the current policies and practices of specific education systems, the child's family background, and knowledge about how children learn, are the factors contributing towards the effective planning of computer-based learning experiences for young children. The findings of the current study have drawn several implications for the integration of computers into the early childhood classroom. It is also suggested that the design of the educational computer environment may integrate collaborative structures and computer technology in a way that fosters the development of prosocial behaviour. Developmentally appropriate software is believed to both provide and require, some form of scaffolding before very young children (aged 4 to 5 years old) can become independent users. Partners with differing skills and competencies can therefore provide each other with the skilled assistance needed to extend the other's competence. Furthermore, this study acknowledged the roles of the skilled partner and learner, which may alternate during a collaborative activity, depending on the activity's demand for different competencies. According to Vygotsky's (1978) perspective of learning, the skilled partner provides tasks which lie within the learner's zone of proximal development and provides enough support to allow the learner to succeed. As a result of the assistance, the child learns to internalise the processes offered by the skilled partner, so that the nature of what is learned, and the cognitive development which results, will be determined by the environment in which the learning takes place. Thus, as indicated in the current study, an enjoyable and friendly-conflictual educational computer environment (as demonstrated through exploratory talk) may provide the appropriate environment. The role of the teacher in providing such an environment is also acknowledged. Teachers should introduce environments that are structured to engender collaboration, self-

selection of problems, and the reciprocal exchange of information between partners. As suggested by Nastasi and Clements (1993), for older children, provision of social feedback may be necessary, whereby the student-elicited feedback might be preferable to automatic external feedback from the computer or the teacher. Teachers' monitoring of student's interactions might also highlight the need for the development of effective conflict resolution strategies, or perhaps if necessary, teacher intervention.

In reflecting on the local perspective of Western Australia, the implications of this study are threefold. Firstly, in relation to educational policy and practice at the pre primary or preschool level; secondly, in relation to the management of computers in early childhood classrooms; and thirdly, in relation to the process of integrating computer technology into early childhood classrooms.

6.2.1 Implications for educational policy and practice

In relation to educational policy and practice in Western Australia, "using a computer earlier does not necessarily cause any added advantages to children's overall development, therefore those children who are not exposed to computer-based learning experiences in early childhood classrooms are not necessarily disadvantaged" (Burgess & Trinidad, p.19). Moreover, as indicated in the Table of State Education Department of Technology Initiatives (Trinidad & Leighton, 1998), the Education Department of Western Australia (EDWA) is targeting a ratio of 1:5 computers to students in secondary schools, and a ratio of 1:10 in primary schools. No indication was given of government initiatives and funding for the acquisition of computers in early childhood centres. As cited in Burgess and Trinidad (1997, p.20):

"With the prominence of technology in our homes and in our schools, computer based learning activities should be worthwhile experiences used to achieve educational goals. However, with the changes of Education Department policies and funding, the constant competition for resources (both material and human), the speed of change of electronic communications, and the amounts of time and money which need to be invested by the school, means using computer based activities in the early years is not an easy decision to make" (p.20).

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Based on the current limitations, the introduction of computer facilities to early childhood centres is seen as the sole responsibility of the pre-primary or preschool centres. Hence, with a lack of resources and funding, it is suggested that early childhood educators use the combined efforts of their centre's administration, parents and teachers, to make provision for the integration of computer technology into the centre. However, in relation to low socio-economic status (SES) centres, these efforts might be insufficient. With existing financial constraints, and lack of resources, the low SES early childhood centres msy be left behind in integrating computer technology. It is the responsibility of the Education Department, through each local primary school to ensure that every five-year-old at'ending pre-primary anywhere in the state has access to, and instruction on, computer technology, with developmentally appropriate software programs.

6.2.2 Implications for classroom computer management

The second implication of this study is primarily concerned with the management of computers in early childhood classrooms. As demonstrated by the findings of the current study, the classroom teacher had employed a turn taking system that required the children to be paired. These dyads were expected to assist each other during their turns. Moreover, the children were asked to use the audio headphones to minimise noise that might be generated by the computer and distracting to others working at other activities. Forman and Cazden (1985) and Trinidad (1994) argued that establishing rules such as two children only using the computer at one time and children working together to help each other at the computer, encourages young children to be aware of other children's needs and also to act as peer tutors, offering the necessary scaffolding to those children who might need it. Furthermore, equitable use of the computer can be facilitated by the teacher putting into place systems such as that employed by the classroom teacher, as cited in Burgess and Trinidad (1997, p.19-20):

"If the computer is set up as a free-choice activity, the teacher can use a 'sticky dot record chart' to monitor children who monopolise the computer and redirect if necessary. Children who use the computer place a sticky dot next to their name, then the teacher can see those children who have not used the computer. These children can be encouraged to use the computer by pairing them with a suitable partner".

Thus, the findings of the current study support the notion that, in the process of integrating computer technology into early childhood classrooms, high priority should be given to computer management, in the form of a fair and equitable collaborative turn taking system and monitoring of computer usage.

6.2.3   Implications for children's social interaction

The third implication arising from the current study, stems from the insights gained into the children's social interactions. There is a vital need for teachers to model effective prosocial ways for children to engage in collaborative interactions. Children's effectiveness at negotiating control of the computer, turn taking, and sharing their enjoyment and pleasure, should be maintained in a positive environment with productive exchanges. Teachers also need to monitor and assist children to negotiate control by modelling such behaviour as how to share control on the computer, request information from peers, acknowledge other's requests, and incorporate ideas from all participants. As asserted by Lomangino, et al (1999), children who have limited social skills may need to be shown how to share the computer. This may reduce transfer control and facilitate inclusion of low status members, who are less likely to have the power to secure a turn (Lomangino, et al., 1999).

Although the findings of the current study exhibit partial sequences of collaborative interactions only, they do demonstrate that young children can scaffold each other's learning and at the same time, exhibit positive prosocial behaviour. The results and findings of this study are encouraging, since many educators value the process of collaboration. Young children's social relationships, their social goals, the developmental appropriateness of the software, task structure, turn taking system, and

physical setting of the computer environment will influence the interaction patterns and levels of participation during the process of collaboration. Hence, by monitoring and maintaining adequate computer management in the classroom, teachers can help children develop positive interaction patterns during collaborative activities on the computer.

6.3   Recommendations for future research

Whilst this investigation has revealed the nature and patterns of collaborative interaction of twelve pre-primary Australian children, while engaged at the computer, it is important to remember that the study is only a small-scale exploration of this phenomenon. Therefore, it is not possible to generalise the study's findings to all centres everywhere. It would be useful to replicate the study with a larger sample size, and indeed a more diverse sample (for example, children from low socioeconomic status (SES), and children from diverse cultural backgrounds) in order to determine whether or not the findings of this study are representative of larger populations of young children.

The scope of the research could be extended in a number of ways in order to provide a new perspective on the existing findings. Research could be undertaken with children collaborating with more partners (collaborators) to determine whether the interaction patterns would differ or remain similar to the current findings. A variety of management patterns could be trialed to determine which were the most effective. Studies on children from various computer competencies and social skills may also provide significant outcomes. Factors found to be facilitating or inhibiting collaborative interactions of young children whilst engaged at the computer may also be hypothesised to gain statistically significant relationships. This study has highlighted some significant issues in relation to the links between young children's social behaviours (exhibited through their interaction patterns) and the factors that appear to facilitate or inhibit such behaviours. Further research needs to be undertaken to determine the degree to which these factors alter the interaction patterns of young

children whilst engaged collaboratively in an educational computer environment. Also, it is recommended that research be conducted with children from different cultural backgrounds in order to establish what they perceive as being culturally appropriate in terms of software packages.

Finally, in view of the emphasis placed upon a drill and practice software package in this study, this research investigation needs to be replicated with an open-ended (for example, word processing program) software and a more structured task, in order to determine whether or not they differ in facilitating children's collaborative interactions. Research of this nature would include identification of various forms of educational software (including graphics software, subject area software, multimedia software, microworld software, and content/theme software) which may provide valuable insight on how integration of computers into the classroom is similar to the use and integration of other typical early childhood materials and activities.

The findings of this study have been examined and discussed in relation to the broader sociocultural and sociocognitive contexts that shaped and produced the interactions of the children. These social behaviours, particularly the collaborative interactions, did not always reflect accepted developmental theory. This highlights the need for research which investigates the relevance and suitability of neo-Vygotskian and Piagetian theories, in a range of socially and culturally diverse early childhood settings.

In conclusion, whilst the findings of this study are representative of a small group of five-year-old pre-primary children in Western Australia, the interaction patterns identified are likely to be representative of young children's social interactions in a range of educational computer environments and pre-primary settings. Computers are here to stay. Computers have enormous potential as well as limitations. As it has been discussed throughout the last two chapters, computer technology can be a powerful tool for learning. By integrating computer technology through appropriate strategies, and promoting and modelling prosocial behaviours,

teachers can help children develop positive interaction patterns during collaborative activities on computer. As concluding remarks, Davies and Shade (1999) stated that:

> "Simply having a computer in your classroom is not curriculum integration, and simply learning about computer or teaching computer literacy is not integration. In order to truly make the computer a working part of the classroom, the children must perceive the machine as a useful tool for accomplishing their own goals. In the adult world, the computer is used as a means, rather than as an end; for young children to develop the same perception, the teacher must thoughtfully and carefully consider how to use the technology in the curriculum, so that the children come to understand that the computer is one of many materials available and potentially useful for accomplishing personal goals" (p.11)

and,

> "Make having a computer in your classroom like the Samba school Papert describes in his 1980 book, *Mindstorms* where everyone is a teacher and everyone is a student" (p.19).

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APPENDICES

APPENDIX   I

CONSENT LETTERS

Pre-primary school Principal's Agreement

Dear Sir/Madam,

As a Masters student of Edith Cowan University, I am seeking your permission to involve your pre-primary centre in a research project during which I will be observing how young children interact with three developmentally appropriate computer software programs. The three software programs will be presented to the class as honorarium for the children's involvement. The children will only be observed while they are using the computer. No other classroom activity will be observed. In respect of children's and parents' rights to privacy, parents may choose to permit their children to be observed either with or without the assistance of video recording.

Research in early childhood education has acknowledged the potential of developmentally appropriate computer software programs to stimulate and enhance the holistic development of young children. Collaborative computer-based activities can encourage co-operation among children, even with minimal adult assistance. It is important for pre-primary teachers to develop an understanding of how best to promote positive and collaborative interaction patterns and behaviours of their students.

The purpose of my project is to identify five year old children's collaborative social interaction patterns while using the computer.

Parents of the participants will be personally contacted by the researcher and written permission obtained for their children's participation. Copies of agreement documents are enclosed. All data collected will remain confidential, the school will not be identified, and the children's names not divulged.

I will be grateful to receive your agreement as soon as possible and I thank you in anticipation. Should you need any further information you can contact my Supervisor, Dr. Dawn Butterworth at 08-92738462, or alternatively you also may contact the Chairman of the Ethics Committee of the University, Mr Rod Crothers at 08-92738170.

Yours sincerely,

MOHAMAD IBRANI SHAHRIMIN
Student ID: 2005534
Masters of Education (Coursework & Research Thesis)
Desk No. 10, Post Graduate Suite A, Room 1.113, Building 1,
Edith Cowan University, Churchlands Campus
Contact telephone number: 08- 93873486

Participants' Parent's Agreement

Dear Mr/Mrs ....,

As a Masters student of Edith Cowan University, I am involved in conducting a research project in your child's/children's pre-primary centre and I am seeking your agreement for ....'s participation.

The project involves observing five year old children's social interaction patterns exhibited while working with developmentally appropriate educational computer software programs. The observations will be conducted during the normal daily classroom activities for a period of 3 weeks and no interference with normal classroom activities will occur. The children will only be observed while they are using the computer. No other classroom activity will be observed. In respect of your children's and your rights to privacy, you may choose to permit your children to be observed either with or without the assistance of video recording (please refer to the enclosed Consent Form Letter).

By giving your children opportunities to explore the wonders and benefits of educational computer software, we will be in a better position to make learning experiences more interesting, enjoyable and fruitful for ....

All data will remain strictly confidential. Children's names will not be used and the pre-primary school will not be identified. Your child is free to withdraw from the study at any time without penalty.

I would be grateful if you would sign the agreement slip in the Consent Form Letter below and return it to the classroom teacher as soon as possible, please. If you would like to discuss the project further please let me know so that we can arrange a suitable time that is convenient to you, or alternatively you can contact me by telephone. Should you need any further information you can also contact my Supervisor, Dr. Dawn Butterworth at 08-92738462, or alternatively you also may contact the Chairman of the Ethics Committee of the University, Mr Rod Crothers at 08-92738170.

Yours sincerely,

MOHAMAD IBRANI SHAHRIMIN
Student ID: 2005534
Masters of Education (Coursework & Research Thesis)
Desk No. 10, Post Graduate Suite A, Room 1.113, Building 1,
Edith Cowan University, Churchlands Campus
or
E 101/25, Herdsman Parade, 6014,
WEMBLEY, Western Australia
(08) 93873486

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To,

Mohamad Ibrani Shahrimin
E 101, 25 Herdsman Parade,
6014 WEMBLEY
Western Australia

> **Form No. (..........)**

> **Participants' Parent's Agreement**

I give my permission for ....to be included in the above

classroom activities. I agree to let the researcher observe my children:

(please tick ✓ in appropriate box)

1.	*WITH the assistance of a VIDEO RECORDER*	☐
2.	*WITHOUT the assistance of a VIDEO RECORDER*	☐

I also understand that any information will be treated with the strictest confidence and

that I am free to withdraw my child from this study at any time.

Signature: ....

Parent's/Guardian's Name: ....

Date: ....

General Agreement for Whole Class

Dear Mr/Mrs ....,

As a Masters student of Edith Cowan University, I am involved in conducting a research project investigating five-year-old children's collaborative interaction patterns exhibited while working with developmentally appropriate educational computer software programs. The observations will be conducted within their normal daily classroom activities for a period of 3 weeks and no interference with normal classroom activities will occur. The children will only be observed while they are using the computer. No other classroom activity will be observed. In respect of your children's and your rights to privacy, you may choose to permit your children to be observed either with or without the assistance of video recording (please refer to the enclosed Consent Form Letter).

By giving your children opportunities to explore the wonders and benefits of educational computer software, we will be in a better position to make learning experiences more interesting, enjoyable and fruitful for all children.

All data will remain strictly confidential. Children's names will not be used and the pre-primary school will not be identified. Your child is free to withdraw from the study at any time without penalty.

I would be grateful if you would sign the agreement slip below and return it to the classroom teacher as soon as possible, please. If you would like to discuss the project further please let me know so that we can arrange a suitable time that is convenient to you, or alternatively you can contact me by telephone. Should you need any further information you can also contact my Supervisor, Dr. Dawn Butterworth at 08-92738462, or alternatively you also may contact the Chairman of the Ethics Committee of the University, Mr Rod Crothers at 08-92738170.

Yours sincerely,

MOHAMAD IBRANI SHAHRIMIN
Student ID: 2005534
Masters of Education (Coursework & Research Thesis)
Desk No. 10, Post Graduate Suite A, Room 1.113, Building 1,
Edith Cowan University, Churchlands Campus
or
E 101/25, Herdsman Parade, 6014,
WEMBLEY, Western Australia
(08) 93873486

To,

      Mohamad Ibrani Shahrimin
      E 101, 25 Herdsman Parade,
      6014 WEMBLEY
      Western Australia

| Form No. (..........) |

| Participants' Parent's General Agreement |

I give my permission for ....to be included in the above

classroom activities. I agree to let the researcher to observe my children:

(please tick ✓ in appropriate box)

1.   *WITH the assistance of VIDEO RECORDER*   [   ]

2.   *WITHOUT the assistance of VIDEO RECORDER*   [   ]

I also understand that any information will be treated with the strictest confidence and

that I am free to withdraw my child from this study at any time.

Signature: ....

Parent's/Guardian's Name: ....

Date: ....

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APPENDIX II

GUIDING INTERVIEW SCHEDULE

Samples of Initial Guiding Interview Schedules

A. Guiding Interview Schedule (Participant: TEACHER)

1. How important do you think computers are to young children's learning today?
2. How do you incorporate the computer into your curriculum?
3. What arrangements for access to the computer have you made?
4. What software packages do you have?
5. Have you acquired any software packages in the last year? If so, why did you choose these packages?
6. What sort of criteria do you use in selecting appropriate packages?
7. Do you carry out any evaluations of the packages?
8. If yes, how do you evaluate the packages?
9. Which are the most popular computer packages? If so, why?

B. Guiding Interview Schedule (Participants: CHILDREN)

1. Do you like working on the computer?
2. If yes, what do you like most about it? If no, why not?
3. Which programmes do you like best? Why?
4. Do you have a computer at home?
5. What do you do on the computer at home?
6. When do you usually use the computer at home?
7. Do you use it by yourself or with your daddy/mommy/brothers/sister/friends?
8. Do you like it best by yourself or with someone else?
9. Are you allowed to play on the computer as much as you like? At home? At school?
10. At pre-primary, do you have any friends that you like to work with on the computer? If so, who are they? Why?

APPENDIX III

Data Collection and Data Analysis Instruments

VIDEO TAPING RECORD

Observation No [   ]   Dyad: Male-Male/Male-Female/Female-Female

Date [ ][ ][ ]   Name: [   ]
[   ]

Time [   ] to [   ]

Activity :

[   ]

Observation No [   ]   Dyad: Male-Male/Male-Female/Female-Female

Date [ ][ ][ ]   Name: [   ]
[   ]

Time [   ] to [   ]

Activity :

[   ]

INFORMAL INTERVIEW RECORD

Interview No. [   ]   Reference No. Dyad/Group: [   ]

Date [ ][ ][ ]   Name: [   ]

Time [   ] to [   ]   [   ]

Discussion/ :
Comments

[   ]

Interview No. [   ]   Reference No. Dyad/Group:

Date [ ][ ][ ]   Name: [   ]

Time [   ] to [   ]   [   ]

Discussion/ :
Comments

[   ]

Interview No [   ]

Date [ ][ ][ ]

Time [   ]

Interviewee : [   ]

A. Guiding Interview Schedule (Participant: TEACHER)

Ideas/Comments/Reminders	Questions
	1. How important do you think computers are to young children's learning today?
	2. How do you incorporate the computer into your curriculum?
	3. What arrangements for access to the computer have you made?
	4. What software packages do you have?
	5. Have you acquired any software packages in the last year? If so, why did you choose these packages?
	6. What sort of criteria do you use in selecting appropriate packages?

	7. Do you carry out any evaluations of the packages?
	8. If yes, how do you evaluate the packages?
	9. Which are the most popular computer packages? If so, why? Additional questions (10-15) 10. Do the children talk about their favourite program? I mean, they are using 4 (packages)here, right?
	11. Do they choose (the packages) by themselves?
	12. So, the playtime will be...
	13. So, do you think they have the chance to play with the computer...more than one hour?
	14. And they have the chance to choose their partner, ...they're in pairs, are they?

	They have one hour to do that, I mean, do you allow them to use computers for more than any specific time?
	(Other important comments)

Interview No.

Date

Time

Interviewee :

B. Guiding Interview Schedule (Participants: CHILDREN)

Ideas/Comments/Reminders	Questions
	1. Do you like working on the computer?
	2. If yes, what do you like most about it? If no, why not?
	3. Which programmes do you like best? Why?
	4. Do you have a computer at home?
	5. What do you do on the computer at home?

	6. When do you usually use the computer at home?
	7. Do you use it by yourself or with your daddy/mommy/brothers/sister/friends?
	8. Do you like it best by yourself or with someone else?
	9. Are you allowed to play on the computer as much as you like? At home? At school?
	10. At pre-primary, do you have any friends who you like to work with on the computer? If so, who are they? Why?
	(Other important comments)

List of Social Behaviours Employed by Children Throughout Interactions

1. Observation of 5 Year Old Taiwanese Children's Social Interactions (Teng, 1997)- 20 Positive & Negative Behavioural Strategies

Prosocial Behaviour - 10 codes
Antisocial Behaviour - 7 codes
Neutral Behaviour - 3 codes

Prosocial Behaviour	Sharing	Requesting	Giving Guidance	Seeking Guidance	Accepting Guidance	Empathizing	Showing pleasure	Problem-solving	Imitation	Positive physical behaviour

Antisocial Behaviour	Refusing to share	Terminal response	Rejecting guidance	Giving orders	Blaming others	Negative physical behaviour	Showing displeasure

Neutral Behaviour	Observing	Calling	Exclaiming

2. Observation of First Grade Children's Collaborative Composing Interactions (Lomangino, Nicholson & Sulzby, 1999)

List of social behaviours:

Directing others' behaviour and turns	Correcting others	Defending self	Defending control
Negotiating the turn-taking process	Declarative planning	Defending idea	Sharing control
Providing information	Acknowledging other's behaviours	Complimenting others	Seeking peer attention
Suggesting ideas comparisons	Negotiating the turn-taking process	Directing partner's actions	Making social
Evaluating others' product	Requesting a turn	Evaluating partner	Declaring competence
Requesting an explanation	Asserting a turn	Monitoring mistakes	Self-monitor/repetition
Returning group to task focus	Defending competence	Opposing partner	Disagreeing with partner

3. Observation of First Grade Children's Collaborative Composing Interactions (Nicholson, Gelpi, Young & Sulzby, 1998)
(relationship between open-ended software and gender)

List of social behaviours:

Directing others' behaviour and turns	Correcting others	Defending self	Defending control
Negotiating the turn-taking process	Declarative planning	Defending idea	Sharing control
Providing information	Acknowledging other's behaviours	Complimenting others	Seeking peer attention
Suggesting ideas	Negotiating the turn-taking process	Directing partner's actions	Making social comparisons
Evaluating others' product	Requesting a turn	Evaluating partner	Declaring competence
Requesting an explanation	Asserting a turn	Monitoring mistakes	Self-monitor/repetition
Returning group to task focus	Defending competence	Opposing partner	Disagreeing with partner
Defending control (of their turn)	Using collective "we"	Threatening partner	Sharing control of
Declare a plan to partner	Declare lack of knowledge	Concede to partner	technology with partner

4. Observation of 7 Year Old Australian Children's Social Interactions Whilst Working on LOGO tasks in gender pairs (Yelland, 1994)

Asking for information/explanation	Asking for a proposal	Making supportive comments
Offering information/explanation	Offering a proposal	Independent moves
Disagreeing with the information/explanation	Agreeing with the proposal	Tension release
Ignoring the information/explanation	Disagreeing with the proposal	Non task or incoherent language
Deferring to the information/explanation	Ignoring the proposal	
Deferring to the proposal		

5. Observation of Year 5 (9-10 years old) Australian Children's Social Interactions (Wild, 1996) - Metacognitive components of children's interactions (significant proportion of the verbal interactions)

Applying strategies	Monitoring performance
Planning approaches	Questioning
Using verbal heuristics	Allocating roles
Combining strategies	Allocating resources

6. Observation of Pre-Kindergarten Children's (3-5 year old) Use of Multimedia Technology - Summary of Verbal Expressions & Interactions (Liu, 1996)

List of verbal behaviours:

Recognizing the story immediately
Expressing various forms of understanding as to how to proceed
Gaining confidence in using the program
Expressing their frustration at the video clips, as the video clips are too short
Showing their likeness of program

Being curious and asking questions
Not understanding that clicking on the same button would play the same video clip
Being absent-minded

Operational Definitions of Collaboration (Dillenbourg, 1999):

The adjective "collaborative" is represented by four aspects of learning:

1. A situation is characterised as collaborative, if peers are
   i. more or less at the same level of and capable of performing the same actions
   ii. have a common goal
   - both have a distinct degree of symmetry in the interaction that occurs, which includes: symmetry of action, the same range is allowed to each agent (Dillenbourg & Baker, 1996); symmetry of knowledge, in which agents possess the same level of knowledge (or skills of development);and symmetry of status, where agents have a similar status with respect to their community (Ligorio, 1997).
   iii. work together

2. The interactions that take place between the group members, are defined by three criteria:
   i. interactivity
   ii. synchronicity
   iii. negotiability

3. Processes characterised as collaborative, i.e. the internalisation process;

4. The effects of collaborative learning.

Initial Coding Scheme Based on the Application of SOCSI

System for Observation of Children's Social Interactions (SOCSI) - 15 Behavioral Strategies

	Affiliatives affection (Af)	Calling (Ca)	Comments (Co)	Complimentary statement (CS)	Gestural communication (GC)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

(continued)

Object aggression (AGO)	Personal aggression (AGP)	Physical assistance (PA)	Play noises (PN)	Questions (Q)

(continued)

Questions (Q)	Requests command (RQ)	Role assignment (RA)	Suggestions (S)	SG

System for Observation of Children's Social Interactions (SOCSI) - 12 Social Goals

NO	Aggression (AG)	Assistance (AS)	Attention (AT)	Comfort-support (CS)	Information seeking (IS)	Information providing (IP)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

(continued)

NO	Object-related (OR)	Other action (OA)	Pretend play (PP)	Self-action (SA)	Stop-action (ST)	Cannot see or hear (N)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Notes/Remarks:

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APPENDIX IV

Classroom Timetable and Activities

CLASSROOM TIMETABLE AND ACTIVITIES

MONDAY

8.45 am	Greet children
8.45-9.05 am	Puzzles/Maths Activities/Book Corner
9.05-9.30 am	Mat time - Calendar/News/Discussion for current topics
9.30-10.30 am	Inside activities
10.30-10.40 am	Pack Away/Wash hands
10.40-10.55 am	Fruit time
10.55-11.35 am	Outdoor play
11.35-12.00 am	Outdoor play
12.00-1.00 pm	LUNCH/REST
1.00-1.20 pm	Library
1.20-2.00 pm	Activities
2.00-2.30 pm	Outdoor play
2.30-2.45 pm	Music
2.45-2.55 pm	Story time
2.55-3.00 pm	Collect bags/shoes
3.00 pm	Home time

TUESDAY

8.45 am	Greet children
8.45-9.05 am	Puzzles/Maths Activities/Book Corner
9.05-9.30 am	Mat time - Calendar/News/Discussion for current topics
9.30-10.30 am	Inside activities
10.30-10.40 am	Pack Away/Wash hands
10.40-10.55 am	Fruit time
10.55-11.35 am	Outdoor play
11.35-12.00 am	Outdoor play
12.00-1.00 pm	LUNCH/REST
1.00-1.25 pm	Mat time
1.25-1.45 pm	Music
1.45-2.00 pm	Language
2.00-2.50 pm	Perceptual Motor Program
2.50-3.00 pm	Collect bags/shoes
3.00 pm	Home time

WEDNESDAY

12.15 pm	Greet children
12.15-12.40 pm	Puzzles/Maths Activities/Book Corner
12.40-1.05 pm	Mat time - Calendar/News/Discussion for current topics
1.05-2.05 pm	Inside activities
2.05-2.15 pm	Pack Away/Wash hands
2.15-2.30 pm	Fruit time
2.30-2.45 pm	Music
2.45-2.55 pm	Story time
2.55-3.00 pm	Collect bags/shoes
3.00 pm	Home time

THURSDAY

8.45 am	Greet children
8.45-9.05 am	Puzzles/Maths Activities/Book Corner
9.05-9.30 am	Mat time - Calendar/News/Discussion for current topics
9.30-10.30 am	Inside activities
10.30-10.40 am	Pack Away/Wash hands
10.40-10.55 am	Fruit time
10.55-11.35 am	Outdoor play
11.35-12.00 am	Outdoor play
12.00-1.00 pm	LUNCH/REST
1.00-1.25 pm	Mat time
1.25-1.45 pm	Music
1.45-2.00 pm	Language
2.00-2.50 pm	Perceptual Motor Program
2.50-3.00 pm	Collect bags/shoes
3.00 pm	Home time

FRIDAY

8.45 am	Greet children
8.45-9.05 am	Puzzles/Maths Activities/Book Corner
9.05-9.30 am	Mat time - Calendar/News/Discussion for current topics
9.30-10.30 am	Inside activities
10.30-10.40 am	Pack Away/Wash hands
10.40-10.55 am	Fruit time
10.55-11.15 am	Music
11.15-11.25 am	Story time
11.25-11.30 am	Collect bags/shoes
11.30 am	Home time

APPENDIX V

Cyber Grannies: An Animated Vocabulary Adventure
Software Package

Quick Tips

✦ If a granny is speaking and you want to stop her, just press the spacebar on your keyboard. The granny will stop talking and will disappear from the screen.

✦ You can also press the spacebar to stop an animation, except during an activity.

✦ When you click the door to exit an alphabet world, Atoz appears to lead you to the next letter or back to the alphabet screen. You can press the spacebar to interrupt Atoz and display the alphabet block.

✦ From the alphabet screen, you can press a letter on your keyboard to go directly to any of the alphabet worlds.

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An Animated Vocabulary Adventure

Cyber grannies

Windows
&
Macintosh

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Playing *Cyber Grannies*

After you choose Start on the opening screen, an alphabet screen appears and Atoz the kangaroo welcomes you. The alphabet screen is the doorway to the alphabet worlds. There are 26 different worlds, each represented by a letter on a block.

Exploring an alphabet world • When you enter an alphabet world, the granny who works there will greet you. She ll go away while you explore. Each of granny s worlds is filled with many fascinating objects for you to click and explore.

Getting help • If you need help at any time, just click on the bells that are throughout the worlds. *Shortcut: Press F6 to ring the help bell.*

Playing the activities • Each alphabet world has an activity that is designed to help your child learn important skills and concepts. If you can t find the activity, click the bell and the granny will give you a hint.
When you enter an activity, the granny explains it and helps you get started. Before you begin, select the level of difficulty you want by clicking a juggling Atoz. The more balls Atoz is juggling, the more advanced the activity.

Moving between alphabet worlds • When you are ready to leave an alphabet world, just click the door. Some worlds have different types of doors, perhaps a gate or a porthole. If the room you are in does not have a door, explore another room and look for a door there. When you click the door, Atoz appears to guide you to the next alphabet world. *Shortcut: Press F7 to go to the alphabet screen and choose another letter.*

Printing • To print a screen shot, make sure a printer is set up, then press F5.

Quitting • Return to the alphabet screen and click the quit button.
Shortcut: Windows: press ESC. Macintosh: press Command+Q.

Activities List

In each alphabet world, there is a fun-filled activity for your child.

Activity name	Click object to start	How to play	Skills Learned
A Coloring		Paint the image by clicking a color and then clicking an area of the picture	Art
B Balancing the Scale		Level 1: Balance the scale by clicking the matching number of objects. Level 2: Balance the scale by adding weights.	Measurement, addition
C Counting Game		Level 1: Count the items when granny quizzes you. Level 2: Add or subtract when granny quizzes you.	Counting, addition, subtraction
D Dominoes		Click the dominoes that are the same.	Matching, understanding the concept of same
E Egghead		To make a funny face, click on the egg where the parts of the face should go.	Creativity, identifying parts of the face.

Activity name	Click object to start	How to play	Skills Learned
F Maze Game		Click and drag the fox to help him find his way through the maze.	Problem solving, spatial reasoning
G Guessing Game		Click the picture that finishes the sentence Granny reads.	Logic, object recognition, reading
H Hat Game		Find the hat that fits the character you see.	Attribute, matching
I I.D. Game		Drag the photo to the identification card it matches.	Matching the physical attribute to the adjective
J Jigsaw Puzzle		Drag each puzzle piece to the correct location.	Problem-solving, visual discrimination, analysis
K Spelling Game		Level 1: Click a key to match the letter that is spoken. Level 2: Click the keys to spell the name of the object in the picture.	Letter recognition, spelling, vocabulary
L Lasso the Leprechaun		Click the leprechauns as they pop up in the windows.	Hand-eye coordination

Activity name	Click object to start	How to play	Skills Learned
M Marbles Math		Put the correct number of marbles in the mug.	Counting (1 to 5), addition
N Number Game		Count the notes as they move across the screen.	Counting, musical note patterns
O Opposites Game		Level 1: Click the picture that is described. Level 2: Click the pictures that are opposites.	Comparing objects, learning the concept of opposite
P Pipe Maze		Open the taps to get the water to the bucket	Problem-solving, spatial reasoning
Q Quiz		Click the Granny who answers the question correctly.	Comprehension, deductive reasoning
R Raccoon Race		Click the objects that the granny names before the raccoon reaches the finish line.	Listening skills, problem-solving, language skills
S Sound Game		Click the picture that matches the sound you hear.	Sound-object associations, categorization
T Hidden Picture		Click the triangle shapes to discover the hidden picture.	Shape recognition, distinguishing parts from the whole

U Memory Game	Click the tiles to find matching pictures.	Memory, concentration
V Video Game	Click a videotape to play it in the video machine.	Story-telling, Joke-telling, fantasy, humor
W What time is it?	Level 1: Click the picture that matches the time on the watch. Level 2: Click the watch to set the time to match the picture.	Telling time, time concepts
X Xylophone Game	Click the xylophone keys or use your keyboard to play a song.	Music, composing rhythms and songs
Y Connect the Dots	Level 1: Connect the dots by clicking them in numerical order. Level 2: Connect the dots by clicking them in alphabetical order.	Drawing, letter and number recognition
Z Animal Game	Level 1: Click the first letter of the animal s name Level 2: Drag the animal pictures into alphabetical order.	Ordering objects, spelling, animal names

If you have problems running the program, first try cleaning the CD. Remove any fingerprints and dust using a clean, soft lint-free cloth dampened with water or a CD-cleaning solution. Avoid using tissue or other paper products, which may scratch the CD. Check all basic computer connections.

If a message tells you there is not enough memory to run the program:
Cyber Grannies needs at least 8 MB of system memory (RAM). If your computer has the minimum configuration, close any other applications that are running and turn off all unnecessary extensions.
Game speed is very slow.
Your screen may be set to thousands of colors or more. *Cyber Grannies* runs best in 256 colors. Also the minimum hardware required to run *Cyber Grannies* is a 486 SX/66 MHz computer with a double-speed CD-ROM drive. If your computer meets this requirement, close any other applications that are running; make sure you have the latest Windows video drivers for your graphics card; if your computer has a turbo switch to increase speed, make sure the switch is on.
You do not hear music, sound or speech.
Check that your computer power is on; make sure your speakers are turned on; make sure your speakers are properly connected to your computer; turn up the speaker volume (if there is no volume control on the speakers, look for a volume wheel on the back of your computer; make sure your sound card is Windows-compatible and properly installed.
The game does not fill the screen.
For maximum window size, make sure the display mode is set to 640 x 480. (See your computer s manual for information on changing the display settings).

If you cannot solve your problem you can contact us:
Phone: 1-877-858-8652 (Monday through Friday 9 a.m. to 5 p.m. E.S.T.)
Mail: Kutoka Interactive Inc. 405 Sherbrooke Street East, Suite 500, Montreal, Quebec, Canada H2L 1J9
e-mail: info@kutoka.com
World Wide Web: www.kutoka.com