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Observing children when using computers with a focus on their self-esteem

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Children are born into a rich technological environment and by the time they attend preschool they already have accumulated a wide variety of technological experiences, skills and knowledge. This paper reports on part of a project undertaken in Melbourne, Australia, which had as a primary aim to explore the existence or not of a relationship between computer use and young (4–6 year old) children's self-esteem. Observing children's interactions with computers was one of the data collection methods utilised in this study. The twofold analysis of the observations, the findings related to self-esteem and children's interactions with computers are the focus of this paper and are considered to be interesting and useful for the early childhood educators.

Keywords: computers, self-esteem, early childhood, preschool education, participant observation.

INTRODUCTION

There is limited research investigating the influence of computer use on children's emotional and self-development. The present project examined young children's self-esteem, defined by Coopersmith (1981, 5) as the '…evaluation a person makes and customarily maintains with regard to him—or herself. Self-esteem expresses an attitude of approval or disapproval, and indicates the extent to which the individual believes themselves to be capable, successful, significant, and worthy'. Self-esteem is positively connected to a number of psychological, physiological and behavioural outcomes and its foundations are laid early in life (Brown and Marshall, 2001; Harter, 2006).

Definitions of self-concept, self-esteem self-confidence

Constructs like self-concept, self-efficacy and self-confidence are very similar to self-esteem and sometimes are confused. Self-concept is the whole picture of our self, including self-esteem, self-confidence, self-perceptions and other related values create our self-concept. The way we feel about our self and how close we feel to our ideal self-concept influences our self-esteem (Cast and Burke, 2002).

Projects that explore self-concept frequently include self-esteem parameters because of the interrelationship between the two constructs (Hymel, LeMare, Ditner, and Woody, 1999; Byrne, 1996).

Self-confidence has been defined as our belief in our ability to operate successfully in a particular task (Levine and Donitsa-Schmidt, 1998). While self-esteem has to do with attitudes towards ourselves, confidence relates to performance and tends to be much more superficial and

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of much more variable quality than self-esteem (Hannel, 2004). Related to self-confidence is the notion of self-efficacy (Bandura, 1995; 1997) which is defined as the confidence we have in our ability to perform the behaviour required to produce a specific outcome (Delcourt and Kinzie, 1993, 36).

Characteristics of self-esteem

Self-esteem as an essential aspect of selfhood begins to acquire importance near the end of the second year of life. Children at this age may already shape a personal belief concerning their *strong points* and their *weaknesses*, and around the third year children are in the position of predicting their failures and successes. These predictions can 'affect their willingness to try hard in the future' (Berk, 2006, 452).

During the preschool period children can become confused or even angry when they are unable to fulfil a task but most of the time they forget about their 'incompetence' easily and they keep on with something different. They have difficulties separating effort from ability in explaining their successes and failures (Stipek, Recchia, McClintic, 1992). Some children as young as 4 years old, do not try to the best of their abilities when they have to cope with a 'challenging' activity. They are likely to feel that they are 'not smart enough'. This can have a negative impact on their self-evaluation and they may report negative emotion after failure.

INFLUENCES

The direct and indirect environment that surrounds children plays a fundamental role in the construction of self-esteem and early years are particularly crucial in making that construction powerful and dynamic. Cultural and social background, parents and child rearing practices, significant others, peers, teachers and school climate are among the major influences (Katz, 1995; Tarrant and Konza, 1994).

Importance of self-esteem

Nurturing self-esteem (especially for children and adolescents) is considered profoundly valuable and essential for 'both individuals and society as a whole' (Cast and Burke, 2002, p. 1042). Recognising the value of a 'healthy' self-esteem but also being alert for signs of 'low' self-esteem in children is one of the key issues of early childhood education and is also critical with everyone who participates in children's lives (Jiang, 2000).

Children and adults who feel valued and loved by the significant people in their lives, are more likely to be happy, productive, creative, motivated, obedient, optimistic, relaxed, honest, responsible, reliable, and not afraid to be independent (Berk, 2006; Tarrant and Konza, 1994).

According to Walz (1991, 1) 'a person's self-esteem is a major determinant of what a person accomplishes and how fulfilled and rewarding a life he or she lives'. Educational benefits have also been noted (Cassidy and Conroy, 2006; Costa-Giomi, 2004; Humphrey, 2004). Self-esteem has been associated with academic achievement (Humphrey, 2004; Di Paula and Campbell, 2002), with specific academic subjects (Davies and Brember, 1999), and sports (Cassidy and Conroy, 2006).

There is considerable evidence to suggest that positive self-esteem should be pursued by educators as an important outcome in itself (Humphrey, 2004, 347). Research also shows that a positive self-concept and self-esteem is more important to academic success than a high IQ score, however, the empirical evidence is weak in some cases and further research is necessary (Baumeister, Campbell, Krueger, and Vohs, 2003; Emler, 2001).

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How can the use of computers promote self-esteem

Technology, when appropriately implemented, presents a new space for young children's exploration and discovery, offers challenging activities and responds to children's curiosity.

The developmentally appropriate use of computers is believed to have positive effects on children's sense of power and control, motivation, persistence, concentration, decision making, peer relationships and teamwork. When using computers, children feel they are imitating adults, especially those who are significant to them, and they feel very proud of themselves when they can display their accomplishments and receive appreciation and compliments for something 'only the grown ups can do' (Morrison, 1998; Delcourt and Kinzie, 1993). Additionally, computers respect children's learning pace and offer plenty of time to think and respond to questions (Anderson, 2000; Levine and Donitsa-Schmidt, 1998; Yelland, 1998). Autonomy and independence in learning is enhanced in this way and children are also given direct results and the chance to 'inspect' their achievements almost immediately (Lee and O'Rourke, 2006; Yelland, 2005; Kankaanranta and Kangassalo, 2003; Reynolds, Treharne and Tripp, 2003; Rivera, Galarza, Entz and Tharp, 2002).

While the above benefits are reported in numerous endeavours with computers and at the same time are considered important for establishing a high self-esteem, there is little scientific evidence for these associations with computer use (Haugland, 1992; Trotter, 1989).

Research on computer use and self-esteem

From the limited research on this topic, (Haugland, 1992; Trotter, 1989) an even smaller part is dedicated to young children. In most cases, this kind of research has involved the attitudes of older children towards computer use and many projects have concentrated on similar constructs like self-efficacy or self-confidence.

Previous studies (Trotter, 1989; Haugland, 1992; Primavera, Wiederlight and DiGiakomo 2001) exploring the connections between computer use and children's self-esteem have neglected among other things (for example they have examined only 'academic self-esteem' and children's voice was not taken into consideration) to 'observe' children when using computers. Observation is an informal assessment, yet very powerful in means of comprehending complex interactions and interpreting findings (Crosser, 2005). Additionally, the use of observation provides a way for educators to foster children's sense of self (Siraj-Blatchford, 1998; Pugh, 1996).

Observation is even more essential when young children are involved, because young children are often not able to report on themselves or provide answers to complex research questions. Children's learning and behaviour is multifaceted and in order to monitor what takes place, how the environment is enhancing (or not) children's development, how educators can promote individuality, identify critical complications and enrich provision for the future, observations play a crucial role (Pugh, 1996). Interactions and behaviours in front of the computer are of great interest to this study and observations were the natural vehicle to examine in depth those reciprocal actions.

RESEARCH DESIGN

This paper is drawn from a larger quasi-experimental, exploratory study which had as a primary aim to investigate the existence or not of a relationship between computer use by young children and their self-esteem as rated by children, parents and teachers using a pretest–post-test approach. The study followed a mixed methodology (qualitative and quantitative tools and analysis, purposely selected sample) and took place in 2006 in Melbourne, Australia.

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The participants

The participants of this study were fifty-two children (28 boys and 24 girls) from 44 to 79 months of age (M = 58.71, SD = 8.49), 5 teachers, the researcher (pre-primary teacher) and children's parents. The children were from two preschool classes and two preparatory (prep) classes (year prior to Grade 1). The researcher observed twenty four children who comprised the 'intervention group' (12 girls and 12 boys) and consisted of two subgroups:

- The intervention preschool subgroup (*Int_pre*): 12 children, preschool age 44 to 59 months old (M = 52.08, SD = 4.94)
- The intervention school group (*Int_sch*): 12 children attending prep class in a primary school, 60 to 73 months old (M = 65.08, SD = 4.07).

Because of the exploratory nature of the study and the need for investigating in depth (using a range of tools) rather than in quantity, the sample was purposely and theoretically selected rather than randomly (Jonassen, 2004; Gay and Airasian, 2003). Both intervention groups had access to computers in their schools. In preschool the computer was rarely used. Children in prep had access to their school's computer lab once a week and they were taught very basic things such was how to turn it on and how to use the keyboard. Nine of the 12 preschoolers and 7 of the 12 prep children also had access to computers at home. More than half of those children (11 of the 16) who had access to computers at home used the computer for less than an hour per week according to the information acquired by their parents (questionnaires before and after the intervention).

Children who did not participate in the intervention including those in the control group for the study were engaged in their everyday activities as normal without any special group activities taking place during the seven months of the intervention.

During the intervention, a set of 32 computer activities (four different educational software two 'open-ended' and two 'close-ended'—eight activities for each one—designed by the researcher) were implemented. Children worked with the help of their teacher, in small groups of three for the computer intervention activities. Preschool children participated in the intervention twice a week for 20-30 minutes each time (*Int_pre* group) and prep children participated once a week—45 minutes (*Int_sch* group).

The main aims of the computer activities were twofold. On one hand there was a 'technological aim' which was for children to learn the use of a new technological tool of the program (for example, the brush). On the other hand, there was also the 'cognitive—general aim' (for example, to learn about shapes), appropriate for children's age and supportive of the curriculum. In order to complete both aims, children needed to use the new tool to complete an activity (for example, learn to use the brush for making shapes).

To identify children's self-esteem and use of computers

To identify children's self-esteem, a range of methods was utilised including observation of children's interactions with computers, self-esteem tests completed by children, self-esteem tests completed by teachers, interviews with teachers and questionnaires with parents. However, in this paper, only the method of 'observation' is presented.

Observations aimed to identify children's participation, attitudes, emotions and self characteristics with a focus on self-esteem, while using computers. Written and video-recorded observations were conducted at the commencement, during, and at the end of the intervention period after children had used computers on a weekly basis for more than 7 months. Children interacted with computers in groups of three. During the written observations (second and third observation) the subgroups of children were sometimes different. During the video-recorded

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observations (one at the start and one at the end of the intervention), the subgroups were comprised of the same children so that comparisons could more easily be facilitated. The reason for this flexibility was for children to have the opportunity of exchanging experiences with different classmates, so that the dynamics of the group and the individuals would change and also minimise group effect.

Each observation lasted from 20–40 minutes, depending on how long groups of children took to complete their activities, how well they were cooperating and how much time was available before starting a new activity. All observations took place in the children's classroom or in the computer lab for the primary students and were conducted by the researcher (participant observations).

Because of the complexity of the interactions and the delicate nature of the project's topic, the researcher also recorded written observations of children's interactions with the help of an 'observation guide' (Appendix A), which was completed every time. The guide which involved categories for running records and generic ratings of particular behaviours was composed according to the project's aims and research questions, and helped to ensure consistent, specific and accurate focus across all observation sessions and at the same time not limiting the observations taken, as recommended by Jonassen, (2004) and Thomas (2003).

VIDEO-RECORDED OBSERVATIONS

As well as using written observations, a video camera was used to record a number of observations. Video recording is particularly helpful when 'some set of human actions is complex and difficult for a single observer to describe…' (Bauer and Gaskell, 2000, 103).

Other advantages of using video recording relate more to the analysis of data, as complex events are 'subjected to detailed and repeated scrutiny' (Silverman, 1997, 272). Recordings, unlike other qualitative or quantitative data, are 'open to the research community' at any time to examine the 'raw material' on which a large part of the analysis is based and which can also serve as a store of information for future, alternative or similar research proposals (Silverman, 1997, 272).

Children were informed about the video camera: that it would record their interactions with the computer and each other, and it was part of the researcher's project to learn more about computers.

In total, 28 participant observation sessions were conducted. Seven hundred and eighteen minutes (718 min.) of detailed observations were completed of which 388 minutes were video recorded.

The video-recorded observations of children's interactions with the computer as they engaged with the different types of software used in the intervention: two 'close-ended' ('Adiboo', 'Putt-Putt') and two 'open-ended' ('Paint', 'Kid Pix'), were 'transcribed' in the observational software: 'The Observer 5.0' (Noldus Information Technology, 2003). This software provided a powerful tool for the researcher to record and code everything that happened during each observation segment. The program helped the researcher in organising the video content. The first step involved making a 'configuration' of each observation. The configuration included the names of participants (subjects), codes of behaviour (concentrating, laughing) and the modifiers of behaviour (the intensity).

For example:

Time	Child	Behaviour	Modifier	Comment
16.04	Maria	Answered question	Right/	What was the

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After careful thought and based on Harter's recent views on characteristics of high self-esteem (Harter, 2006) and also having already administered the two self-esteem tests (pre-intervention—general and computer self-esteem rated by children) the researcher prepared a configuration where observations of children's interactions with the computer were coded within the following five interactional categories: physical/ neutral; negative; positive-self; positive-enjoyment; positive-total. These categories are summarised in Table 1:

TABLE 1
CODING OF THE OBSERVATIONS AND THE FOUR INTERACTIONAL CATEGORIES

Name of category	Example of behaviour
Physical – Neutral Interactions	The child moves body/ stands up/ looks around and other physical movements that children did while in front of the computer. In this category were also included comments children made for each other 'neutral' or irrelevant to the computer activities.
Negative Interactions	Problems with the mouse/ hesitation/ wrong answers/ negative comments on themselves and others and other interactions that were evident of children's difficulty, lack of confidence, lack of collaboration and any other 'negative' behaviours, while engaging with the computer.
Positive Interactions-Self	Behaviours that enhanced children's confidence on the computer, cooperation, leadership, initiatives, positive comments on their friends and on themselves, technological awareness and many other positive characteristics. In this category all the relevant with self-esteem behaviours were included.
Positive Interactions – Enjoyment	Laughter, singing, smiling, clapping hands, enthusiasm and all the signs of children having a good time while using the computer.
Positive Total (self + enjoyment)	In order to calculate means and make comparisons the two positive categories were summed.

Advantages of analysing the observations with this program were that the coding of behaviours was consistent for all participants in all observations and this enhanced reliability in the analysis.

CODING OBSERVATIONS

For the observations that were not video-recorded, the researcher made extensive notes and those notes were typed and printed so that they could be coded in a similar way to the video-recorded observations.

The coding for all observations was completed twice and included consultation with colleagues for validation purposes and to improve reliability.

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THE QUALITATIVE ANALYSIS OF OBSERVATIONS

This investigation was mainly focused on documenting confidence, independence, experimentation, free will, creativity and other attitudes related to high self-esteem (Harter, 2006) as children participated with the computer and each other. Therefore the qualitative analyses supported and illuminated the quantitative analyses which presented the numerical representations of children's interactions during computer use. The following examples (using pseudonyms) are only a few excerpts from observations of children.

POSITIVE INTERACTIONS (SELF CHARACTERISTICS AND ENJOYMENT)

Being able to *concentrate* for a long period of time, *persist* on their task and even make *predictions* was very common. Children would take very seriously what was happening on the computer and even though a period of at least five weeks intervened between observations, they could remember what happened in their first computer activity of the particular software. They were able to guess what would happen next and in a lot of instances they could also provide explanations why something happened. For example, when they had to make a cake to feed an animal they would all make predictions if the animal would like their cake or not. When the result was negative they would explain it and not be disappointed.

For example, one of the boys made a cake which a dog did not like and did not eat. The boy justified the disliking of the cake:

> 'he didn't like it because I put too many candles and because of Santa, I put Santa'.

Some of the most interesting positive accounts taking place were opportunities for children to be *creative*, to *try new things*, to *explore* and *experiment*. The following examples are inspiring:

Three boys (J, D, C) were working with 'Kid Pix' and one of them (J) drew a bridge and some trucks.

> D, who was after J, wanted also to make his own trucks and teacher asked him what else he would make. D thought for a minute and replied: 'a tunnel' and smiled. After a short conversation with the other two boys D also thought of making 'a train' that goes through the tunnel. C told D that only cars go through the tunnel but D insisted that trains do too. He drew the tunnel saying: 'I need to go round—round—round' and he made his tunnel.

In another instance, three girls (A, J, R) were working on 'Kid Pix' and J put the picture of a mermaid in her drawing.

> R asked J what the name of the mermaid was. J replied that she didn't know and teacher suggested to J to give the mermaid a name. J thought for a while and then turned to R and asked her to think of a name for the mermaid. R replied: 'princess'. J said that 'princess' was not a name. Meanwhile, A pointed to the screen and said that the mermaid was holding a fish. Teacher asked why. J replied: 'that's her brush for her hair' and that there was 'no body' to the fish (only the bones). Teacher reminded J that she had to find a name for her mermaid and that she could use the keyboard to type the name. J picked some letters. She wrote the name: 'Rostui' and teacher read it for them. J smiled and said 'ok' and that she also wanted 'Rostui' to swim. Teacher asked how. J replied that the mermaid had 'a fish tail' and therefore she could swim. After her comment J with the help of the other girls tried to find a way to make the mermaid swim.

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Cooperation between groups was also observed frequently. Children were willing to help their friends complete a task. At the start this could have been taking the mouse from them to complete the task themselves. But with the teacher's intervening and encouraging them not to take the mouse but point to the right tool or talk about it, children learnt how to solve little problems and help their friends in a more indirect way. They also started asking their friend's opinion about what to make, what colours to use, where to click the software and other important decisions that they had to make. It is also worth mentioning that children very often used 'we' instead of 'I' when performing a task.

An important aim of preschool and primary education is to encourage collaboration and working in teams (DETE, 2001; NAEYC 1996). The observations from this study suggest that having a small group of 3 to 4 children in front of the computer and with the appropriate activities could significantly contribute in achieving that goal.

The following example is only one of the instances where children worked together and helped each other: Two boys (D, C) and a girl (G) were working on 'Putt-Putt', where they had to help a small car find some lost circus animals.

D: Oh you need the papers (to C)
G: You are not allowed to go there, we need to get the papers (to C)
D: Go back there (pointing), you need to get the papers
D: Give the papers to the security (to C)
C: Which way I go, this way or that way?
D: You need to go back to where you went
D: There (pointing)
C: There?
D: No, no, ok, there, no there (pointing)
C: How are we going across?
D: You need to pick up the flo… (Pause) the umbrella

Finally, characteristics like: *initiative, confidence, independence, leadership, and success* were interrelated. There were many instances when children replied positively to a teacher's question if they could do something on the computer although it proved that they could not. They believed in themselves and they were not giving up. '*Giving up'* was one of the negative accounts that occurred very rarely in contrast to the developmental characteristics of this age. In the majority of situations they were able to do what they wanted or were being optimistic and believing that they could. There were many instances where teacher's or a friend's hand trying to help them was decisively removed.

A few examples of '*initiative'* were observed. In some cases children who were very talkative would give the impression to be the leaders but when their turn to handle the mouse and solve little problems arrived they were not always confident about what to do. In contrast, often the quietest children were more successful in accomplishing tasks. Other signs that could be interpreted as 'initiative' were when children would take the mouse from a child to give it to someone else, without asking the teacher, just because they knew that it was that child's turn and it was the 'fair thing to do'. In other instances they would try to find the right tool, or how to use that tool, or the solution to a problem on their own without asking for help from their teacher. They also reached a point when they would take the initiative to use the keyboard, write their names, and exit the program and other technological functions without 'consulting' with the teacher.

Apart from initiative, another characteristic of a positive self-esteem is '*confidence'* which was also evident in a lot of instances during the observations. Some examples of children being confident are outlined:

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Three children were playing a game in 'Adiboo', where the main aim was the control of the mouse with a racket and a ball. C has the mouse and talked to himself:

C: I can do it better
(The other two children tell him that he is not good at this game)

C: I am good. I am good later.
He lost another ball and laughed.

Three children were engaged with 'Putt-Putt':

D has the mouse and said: I did it, now he [putt-put]) is going to eat the ticket, and at the same time C told the teacher how much they have achieved.

G had the mouse and he had to make the same mask as the one the program presented. After having worked on it for a while he said:

G: 'How does that look?' smiling and very proud. 'That's the same', and he left the mouse satisfied with himself for the next child to have a turn.

The teacher explained to three girls that they could use all the tools they knew and:

R said: I know everything
J also said: Me too.

A girl tried a new activity, a jigsaw, in 'Adiboo' and said:

J: Look what I have done (to AN).

She is trying to fix the jigsaw after a while she said:

J: That's all right and that's all right, I just have to fix that… This time we will work it out—really

The most frequent comment that children made when they were proud and successful of what they have done, was 'we did it', clapping their hands, laughing and being excited about their achievements. It is often quite hard to communicate with words, feelings like pride and confidence, from children's eyes and faces. Regularly, children's friends were the ones who encouraged them, helped them and boosted their self-esteem. For example:

C talked to the teacher about how P clicked the right keys for his name and at the same time said to P: 'well done' and clapped his hands. C was very excited and said: 'we can win' and A also said to P: 'way to go P'.

EM talked about the rule they had to follow in a game. They were able to see the picture only 3 times. All three children are talking about what G should do:

EM: Yes, yes, G you got it!

Noticeably, even when children realised that they were wrong or unsuccessful, they were not disappointed, they would simply smile.

The positive interactions included *enjoyment*, *smiling*, *laughing*, *enthusiasm* and other happy feelings. The children's enthusiasm was evident throughout the computer activities. Children were very

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eager to work on computers. Some children were more enthusiastic than others and their enthusiasm was 'transferred' to the other children as well.

Negative interactions

During the observations the researcher also recorded negative incidents, such as arguments, fights about mouse turn, hesitation, mouse control difficulties, wrong answers to specific technological questions and others. Two examples, one for '*not knowing'* a technological tool; and another one of '*hesitation'* are given:

> Three children were exploring Paint: Teacher asked CA how he was going to draw a mouth. CA didn't reply. CA asked the teacher: 'Can I colour it in?' Teacher replied 'yes' and asked CA what tool he should use. CA didn't know the answer. Teacher told him to try and find the right tool and CA after two unsuccessful attempts he found the right tool.

> Three children were working with Adiboo. Teacher has told them that they could choose to do whatever they liked since it was their last activity with Adiboo. CG suggested to P to 'cook something'. P didn't reply to CG instead he asked the teacher 'Can I put cheese?' teacher replied that he could do whatever he wanted. CG told P to put chocolate. P didn't listen to CG and again asked the teacher if he could put another ingredient.

However, those negative accounts (first observation: M = 7.83; M = 6.27 for *Int_pre* and *Int_sch* respectively) were not very frequent. Negative accounts were quite limited by the third and fourth observation (M = 6.91; M = 2.58 for *Int_pre* and *Int_sch* respectively).

PHYSICAL-NEUTRAL INTERACTIONS

Neutral characteristics, such as movements of children's bodies, standing up, looking around, commenting to themselves or others, were also documented during the observations in order to create a complete picture. For example:

> R making sounds 'mmmm' looking at the voice recorder.
> G is shaking his head like saying 'no'.

THE QUANTITATIVE ANALYSIS OF OBSERVATIONS

Children's interactions with computers were quantified so that the researcher could have a picture of the dominating interactional category for each child in each occasion, and also estimate possible differences in computer interactions pre- and post-intervention (Table 2). The aim in the analysis of observations was not to compare the two intervention groups. The aim was to identify any differences in the percentages of physical-neutral, negative and positive computer interactions between the four observations of each group.

At the end of the coding of each observation, the observational software provided some basic statistical analysis. Descriptive analyses including frequencies, means and percentages for each interactional category were calculated for children in the preschool (*Int_pre*) and school (*Int_sch*) intervention groups. Results are summarised in Table 2. The sum of each category (physical-neutral; negative; positive-self characteristics and positive-enjoyment) for each child for each observation was calculated and entered in SPSS for statistical analysis. The two positive categories,

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self and enjoyment, were summed to create a total positive category.

The total accounts of each observation recorded by the observer varied between groups and depended mainly on the amount of time that the observation lasted. In general, the observations lasted longer in the preschool intervention group (*Int_pre*) because of the flexibility of the preschool program (as explained in the research design chapter). The greater amount of time that each observation lasted was the main reason why the children in the preschool intervention group had higher mean scores of total accounts.

As can be seen from Table 2, for the first observation the mean percentage (*M* %) of children's positive interactions was greater than the one calculated for the negative or physical-neutral interactions. The percentage increased (more than doubled) even more in the following observations for both intervention groups. While the mean percentage of negative interactions showed an increase in the second observation (both groups) and third observation (only for the preschool intervention group—*Int_pre*), the percentage decreased significantly (from 16.79% to 3.76%) in the fourth observation near the end of the intervention period. This suggests that children's self-esteem was enhanced (more positive interactions—less negative).

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TABLE 2

MEANS, PERCENTAGES, STANDARD DEVIATIONS AND RANGE OF PHYSICAL-NEUTRAL, NEGATIVE AND POSITIVE INTERACTIONS OF CHILDREN'S OBSERVATIONS

	Interactional Categories																		
Group	**Physical-Neutral**					**Negative**					**Positive Total (self+ enjoyment)**					**Total accounts**			
First observation: seven weeks after the start of the intervention																			
	M	***M %***	***SD***	**Min**	**Max**	***M***	***M %***	***SD***	**Min**	**Max**	***M***	***M %***	***SD***	**Min**	**Max**	***M***	***SD***	**Min**	**Max**
Int_pre	20.92	28.09	7.89	5	35	7.83	10.93	4.17	2	15	45.58	37.42	15.95	25	83	74.33	20.43	47	**113**
Int_sch	25.00	40.00	8.59	17	48	6.27	8.81	5.47	0	14	32.55	28.52	11.32	18	52	63.82	21.18	36	**107**
Second observation: 14 weeks after the start of the intervention																			
Int_pre	2.45	8.23	1.69	0	5	5.64	16.19	5.06	0	14	23.27	75.56	8.12	11	36	31.36	10.95	12	**50**
Int_sch	2.83	14.20	2.29	0	7	3.00	13.21	2.21	0	7	15.25	72.57	7.30	5	27	21.08	9.65	8	**35**
Third observation: 21 weeks after the start of the intervention																			
Int_pre	5.00	12.54	2.49	2	9	6.91	16.79	3.85	1	14	29.00	70.66	9.70	13	42	40.91	11.91	18	**58**
Int_sch	6.42	12.00	4.18	0	14	2.58	5.39	1.83	0	7	40.50	82.60	16.18	21	69	49.50	19.85	21	**82**
Fourth observation: 29 weeks after the start of the intervention																			
Int_pre	14.00	19.93	11.44	4	43	3.00	3.76	3.35	0	11	55.08	76.30	25.27	25	94	72.08	32.48	37	**138**

Note. M% **is the mean of the percentage of each kind of interaction (physical/ negative/ positive) in relation to the total accounts in each observation**

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To identify if there were statistically significant differences in children's interactions with the computer at the start of the intervention and at the end, one-sample dependent *t*-tests were computed due to the dependent nature of these variables. These results are presented in Table 3.

TABLE 3
SIGNIFICANCE OF DIFFERENCES (ONE SAMPLE *T-TEST*) BETWEEN THE FIRST AND THE LAST OBSERVATION OF CHILDREN'S COMPUTER

INTERACTIONS

	Int_pre			***Int_sch***		
Interactional Category	**Difference %**	***t* – test *T***	***Df***	**Difference %**	***t* – test *T***	***Df***
Physical-	**- 29.04**	**-2.43***	**11**	**-68.65**	**-10.19*****	**21**
Negative	-65.59	-4.93***	11	-90.57	-.71	21
Positive Total	103.90	6.96***	11	189.62	9.65***	21

Note. The differences were calculated between the percentages (*M* %) of Table 2.

Minus indicates a decrease in scores.

**p < .05 **p < .01 ***p < .001*

These differences were statistically significant for all interactional categories for the preschool intervention group (*Int_pre*) and for the physical-neutral and positive interactions for the school intervention group (*Int_sch*) in post-intervention. The difference between the means of the negative accounts was not statistically significant for the intervention school group (*Int_sch*) but there was a decrease larger than 90.00%. Overall, the increase of positive accounts for both intervention groups was impressive and in most cases statistically significant.

These results were congruent with the results from the self-esteem tests rated by children before and after the interventi`on. A small portion of those results (Table 4) is presented in this paper to highlight the similarities and triangulation of data used in this study.

When comparing the computer self-esteem score pre- and post-intervention for the intervention and non-intervention groups it can be seen that the intervention group presented the largest increases (Table 4) and the difference was statistically significant according to the one sample *t*-test ($t = 2.67$, $p < .05$). However, while the change for computer self-esteem was statistically significant in the intervention group, the difference in post-intervention mean scores was not statistically significant between the intervention and non-intervention groups.

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TABLE 4
MEANS, STANDARD DEVIATIONS, RANGE AND SIGNIFICANCE OF DIFFERENCES (ONE SAMPLE *T*-TEST) FOR COMPUTER SELF-ESTEEM BY INTERVENTION AND NON-INTERVENTION GROUP IN PRE- AND POST-INTERVENTION

Difference between periods (one sample *t*-test)

	Pre-Intervention					Post-Intervention						
				Range				Range		Difference	*t*- test	
Group	***n***	***M***	***SD***	**Min**	**Max**	***M***	***SD***	**Min**	**Max**	**%**	***T***	***Df***
Intervention	24	38.75	6.28	20	47	42.96	3.53	36	49	10.86	2.67*	23
Non-Intervention	28	38.61	6.33	19	50	38.54	5.05	30	47	-0.18	-.04	27

Difference between groups (independent *t*-test)

	Pre-intervention[a]			Post-intervention				
Group	**Mean Difference**	***T***	***df***	**Mean Change[b]**	***SD***	**Mean Difference**	***t***	***df***
Intervention	-.14	-.08	50	4.21	7.70	-4.28	-1.88	50
Non-Intervention				-.07	8.51			

[a] The *SD* is reported in the one-sample *t*-test pre-intervention

[b] Mean change was calculated by subtracting the mean of pre-intervention from the mean of post-intervention

LIMITATIONS

Although the triple role of the researcher (researcher, teacher, observer) helped the researcher in many instances, (for example, making it easier for parents and children to trust her and consent to the research and also ensuring the other teachers felt comfortable), it was simultaneously very demanding in terms of making a sincere effort to be as unbiased and as objective as possible. By recording her reactions during the observations, keeping a diary of her thoughts and feelings during the research, cooperating with the other teachers who were doing the computer activities and also coding the observations twice with the help of the principal investigator and another colleague, the researcher believes that she acted to the best of her intentions to minimise personal impact on the study's results.

DISCUSSION

The present study employed the qualitative tool of observation to collect data in its attempt to provide a more complete picture of children's computer use and self-esteem. Detailed qualitative analyses coded twice and descriptive statistics (mean scores and t-tests—Tables 2, 3 and 4) of the observations of children's interactions during computer use revealed that the majority of the accounts observed in the final observation at the end of the intervention period for both intervention groups were positive (confidence, initiative, independence, cooperation and others) and moreover the increase was statistically significant. The findings suggest that children's cognitive abilities (technological awareness, solving problems, concentration, and creativity) and characteristics of high self-esteem (confidence, collaboration, independence, pride) were amplified at the end of the intervention. These findings provide support for other studies, which have reported that 'cooperation', 'enthusiasm', 'concentration' were the behaviours and characteristics observed when children used computers (Brooker and Siraj-Blatchford, 2002; Heft and Swaminathan, 2002; Anderson, 2000).

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In addition, the personal characteristics indicative of low self-esteem (such as giving up, hesitation, fights, asking for help and others) almost disappeared at the last observation. The results from the study's observations lend support to results from other studies in young children which demonstrated that children approach computers with confidence and they are not afraid to explore new things (Ellis and Blashki, 2004; Kankaanranta, and Kangassalo, 2003; Bowman and Beyer, 1994).

Overall, the tool of observations proved to be very useful in this study for acquiring a broader picture of children's engagements with computers. Future research is needed in the area of emotional and self development of children of all ages in association with ICT implementations (Bolstad, 2004; Stephen and Plowman, 2003; Cuban, 2001; Downes, Arthur and Beecher, 2001) and the tool of observation is believed to assist in reaching reliable results.

Finally, observations are a powerful tool in the hands of teachers which may assist them better 'integrate' technology in their everyday curriculum and evaluate 'what technology is good for young children' (Pittman 2003, 270). Moreover, teachers also need to be aware of the social and emotional dimensions of ICT implementations (Pittman, 2003) as part of a holistic approach to education.

CONCLUSION

This exploratory investigation has extended the arena of study around technology by providing an evidential basis for claims relevant to the positive influences computer use has on children's self-esteem. The interpretation of results can be a vehicle for further discussion and reflection. This study also provides a platform for more research to be conducted in a rather unexplored field, combining technology and emotional – self development. A new window to exploring broader dimensions of technology which are crucial but have been overlooked up to now is opened and awaits attention.

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APPENDIX A

The Observation guide of children's computer interactions

Children's group:…….. Teacher:…… Date:…… Time:……

Software:……Activity:……

A	PHRASES/ WORDS ABOUT:	CHILD 1	CHILD 2	*CHILD 3*
A1	The Computer			
A2	The Software			
A3	Him/Herself			
A4	His/Her friends			
A5	The Teacher			
A6	Other			

	Do they express enthusiasm /laughter/ concentration/ dedication	Do they look bored / uninterested/ looking around	Do they seem to help their friends/ proximity with others/ closeness/ talking to them
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
CHILD 2	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
CHILD 3	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
	Do they listen to their friends' comments/	Do they make comments about their friends?	Do they make comments about themselves?
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
CHILD 2	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
CHILD 3	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
	Do they try out new/unknown things?	Do they wait for their turn?	Do they make mistakes?
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
CHILD 2	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
CHILD 3	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
	Do they seem confident?	Do other children ask them for help?	Do they look /ask the teacher for help?
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
CHILD 2	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
CHILD 3	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
	Do they seem to be the 'leaders' of the group?	Other comment	Other comment
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
CHILD 2	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
CHILD 3	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

1: very little/never, 2: little/a few times, 3: more/ sometimes, 4: much more/most of the times, 5: the most/always

Researcher's comments

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