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Computer use at schools and associations with social-emotional outcomes – A holistic approach. Findings from the longitudinal study of Australian Children

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ABSTRACT

In drawing upon cultural-historical theory, this paper reports on the use of computers in Australian schools where a holistic analysis was undertaken to explore the possible associations with social-emotional outcomes. By conducting a quantitative analysis framed around a conceptual model that used the concept of perezhivanie, it was possible to examine a sample of 3345 children (8–9 years old) who participated in the Longitudinal Study of Australian Children (wave 5) and to fill a gap in the literature on whether computer use has an influence on three social-emotional outcomes: self-concept, emotional problems and school liking. Findings suggest that Australian children are using computers in school in a very similar way, mainly practicing specific learning skills (e.g. maths and literacy) and rarely engaged in creative activities. In addition, findings reveal that overall computer use does not appear to have a significant impact on children's social-emotional outcomes. One exception, a small significant association between creativity and self-concept was found and further explored. Implications for practice and recommendations for future research are discussed.

1. Introduction

Computer use has been a standard school practice for more than twenty years now. Although the educational scenery is currently undergoing technological transformations with the wide spread use of new digital devices, such as tablets and other mobile tools, our view on how computers are used in schools is still blurred and fragmented suggesting that a more holistic study is needed. Technology is now a constant presence in children's lives. According to the Australian Bureau of Statistics (ABS) (2011; 2012) during 2008–09, nearly three-quarters of households had internet access, up from one in six a decade earlier, and 82.6% of households had access to computers in 2010–11 raised from 67.1% in 2005. Equally, the 'Frequencies Report' of the Longitudinal Study of Australian Children (LSAC) affirms that the vast majority of families (95.52%) have Internet access at home; 31.18% of children aged 8/9 years have Internet access at their own bedroom and the majority of parents have set rules for the time of internet access (82.68%) and type of internet websites their children visit (94.32%).

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Despite the growing role of technology in every aspect of children's lives the number of studies investigating the effect of this use on children's social-emotional development is disproportionate. That is, we know very little about children's emotional engagement with technologies, even though these qualities are evident in everyday life. In this paper emotional engagement has been conceptualised from a cultural-historical perspective as encompasses both the personal characteristics and the environmental conditions that an individual child experiences (Vygotsky, 1994). To support our research we draw upon the concept of perezhivanie for examining children's emotional engagement with digital devices. The concept of perezhivanie is discussed further below. Data about child engagement with digital devices and the scores of three social-emotional measures (self-concept, emotional problems, school liking) utilised in the LSAC are drawn upon. Specifically, we used data from the most recent release of the LSAC (wave five; 2014) because it had a specific focus on technology.

The goal of this paper is to examine the nature of children's engagement with technology from a cultural-historical perspective and to determine through a more holistic analysis, if children's use of digital devices is associated with their social-emotional development. The review of the literature will first provide a brief analysis of the study's theoretical framework. The next part of the literature review will critically report on studies around the use of technology and children's social-emotional development and attitudes towards school to identify existing gaps and limitations and assist in setting the parameters of the present study. The last part of the review will elaborate on the research gap and the aims of the present study.

2. Literature review

2.1. Cultural-historical theory

Perezhivanie is a Russian term that is difficult to translate into English but has been shown to be a powerful concept for studying emotions (Vadeboncoeur & Collie, 2013). Perezhivanie has been conceptualized as both a phenomenon and as a concept (see Veresov, 2014). The former captures the idea of emotionally experiencing a situation (e.g. Ferholt, 2010; 2015; Vasilyuk, 1984), whilst the latter focuses on perezhivanie as a unit of consciousness (e.g. Davis, 2015), as the unity of emotions and cognition (e.g. Vadeboncoeur & Collie, 2013), and as a unit of analysis (e.g. Bozhovich, 2009). These dimensions of perezhivanie charactertise in research the indivisible unit of personal characteristics and situational characteristics, thus constituting a holistic perspective for research. Particularly relevant to this study is the unit of analysis, which represents the essence of the child (personal characteristics), the environment (situational characteristics), and how the child is relating to their environment (perezhivanie). This holistic view is captured in this concept (Vygotsky, 1994) and has been increasingly drawn upon in research where emotions are studied (e.g. Roth, 2008).

Vygotsky (1994) argued that in research the analysis should always be from the point of view of the child's perezhivanie, because all the personal characteristics are present when determining the attitude to a given situation, such as when a child is using a digital device to support their learning or engagement in creative activities in the classroom. The unit is both outside the child as the concrete environment and also at the same time is how the child is experiencing that particular situation based on the child's own personal characteristics. This concept supports researchers by drawing their attention to how children emotionally experience and relate to technology.

Vygotsky (1994) argued that in one situation some constitutional characteristics of a child play a primary role, but in another situation there will be a different set of constitutional characteristics evident. For instance, in the situation of using computers for computational work a particular emotional quality or attitude to the situation may be evident, which could be different if children were engaged in creative and imaginative activities with the support of digital devices. That is, a different set of personal constitutional characteristics might be foregrounded. Personal constitutional characteristics are mobilized by the situation. These personal constitutional characteristics are laid down and crystalized within a given emotionally charged situation. But this does not represent the aggregate of constitutional characteristics, but rather different events will elicit different perezhivanie. As such, it becomes important to find the constitutional characteristics that have played a decisive role in determining the child's relationship to the given situation. It is argued by Vygotsky (1994) that each situation is always represented by a particular perezhivanie, and this perezhivanie is the unit of environmental characteristics and personal features.

Vygotsky argued that in the study of the child the main task of the researcher is to find the particular prism through which the environment is refracted. That is, to find the prism which best represents the refracted relationship between the child and the environment in a given situation. The method for this kind of study is to determine the unit of perezhivanie. The unit is the product of the analysis. The unit does not lose any of the characteristics of the whole (personal and environment). In our study, we were interested to determine the relationship between computer use and social-emotional outcomes. The concept of perezhivanie supported the goals of the research by giving the researchers a conceptual framework for making sense of the LSAC survey data in a holistic way, thus having the potential to add to the body of literature on the use of ICT, as is discussed in the following section. That is, based on a specific dataset (LSAC, wave 5) we sought to examine the personal characteristics of self-concept, emotional problems, school liking and the situational characteristics of computer use (environment) in order to determine if there were any links with social-emotional development.

2.2. Technology and associations with social-emotional outcomes

Research around the use of computers with children, has mostly concentrated on the positive impact that the use of computers has on children's academic-cognitive-intellectual growth (Attewell, Belkis, & Battle, 2003; Clements, 2002; Howard-Jones, Ott, van Leeuwen, & de Smedt, 2011; Kermani & Aldemir, 2015; Plowman & McPake, 2013; Plowman, McPake, & Stephen, 2010; Stephen & Plowman, 2003; Suhr, Hernandez, Grimes, & Warschauer, 2010).

A smaller amount of research exists in the social arena and has focused mainly on computer use and cooperative learning, social interaction and collaboration (Nussbaum et al., 2009; Zhong, 2011), peer/teacher interactions (Subrahmanyam, Kraut, Greenfield, & Gross, 2000) and gender equity issues (Brooker & Siraj-Blatchford, 2002; Freeman & Somerindyke, 2001; Heft & Swaminathan, 2002; Lau, 2000; Wartella & Jennings, 2000). The majority of research identifies benefits in the social development of children such as cooperation, patience, turn-taking, asking for help and waiting for directions.

Associations between emotions or self-characteristics and technology have not been the primary focus of research even though the role of emotions in learning experiences, motivation and learning achievement has been identified as a key element (Ainley & Ainley, 2011; Dai & Sternberg, 2004; Goleman, 1997; Linnenbrink-Garcia & Pekrun, 2011; Lottridge & Moore, 2009; MacFadden, 2005; 2007; Rosiek & Beghetto, 2009) and brain research (Caine & Caine, 1991; LeDoux, 1998) has emphasised the importance of a 'whole brain', capitalising on both cognitive and emotional skills to advance learning dispositions.

Recently a turn to a more holistic view on technology as captured in a contemporary digital literacy framework (e.g. Ng, 2015) has been observed. According to Ng (2015) digital literacy is encapsulated in three cycles (the technical, the cognitive, and the social-emotional) which are interconnected to underline the holistic development of digital skills (p. 130). However, in contrast to the Vygotskian perspective, the social-emotional cycle in this framework is more about the safety and the appropriate netiquette in online environments than the interrelationship between personal and situational characteristics.

Overall, research around the use of technology has given a clear prominence to the examination of cognitive outcomes (Jones & Issroff, 2005) and there is a need for a more holistic approach to children's technological endeavours, valuing equally cognitive and social-emotional growth. The following sections will examine the studies most relevant to this investigation focussing on emotions, self-concept and school liking.

2.2.1. Technology and emotions

Research in the emotional arena has received minimal attention. With the exception of a limited number of inquiries into children's emotions and attitudes towards new technologies (Hyson, 1985; Seng & Choo, 1997; Shade, 1994; Yelland, 1995) research on the relationships between emotions and technology has mostly concentrated on online environments (MacFadden, 2005; Zembylas, Theodorou, & Pavlakis, 2008), multimedia design (Chung, Cheon, & Lee, 2015; Um, Plass, Hayward, & Homer, 2012) and on older students or children with emotional and behavioural difficulties. Despite the different situational characteristics, the majority of this field of research has highlighted the significance of emotional engagement (personal characteristics) with any form of digital situation in boosting motivation, satisfaction and achievement.

An investigation of emotions in relation to computer use by children was undertaken by Astleitner and Leutner back in 2000. Their work was not only to observe and describe the positive or negative emotions that computer use elicited by children; it made a step forward by attempting to design computer activities (instructional technology) and strategies for 'teaching' students how to encourage positive feelings (sympathy and pleasure) and how to reduce negative ones (fear, envy, and anger) with the help of technology.

More recently, Sikhwari (2007) specifically examined self-concept, motivation and attitudes and concluded that they positively influence academic achievement but the participants were university students. Similarly, Zembylas, et al. (2008), have conceptualized emotions in relation to the self (individual reality) and in relation to the socio-political framework (situational reality) and have stressed the importance of forming an 'emotional climate that influences learning experiences … ' (p. 115) but this study was again with university students.

2.2.2. Technology and self-concept

Self-concept is 'one's conception of self' (Rodriguez, 2000, p. 358) and is considered by many psychologists as the cornerstone of both social and emotional development. A number of influences play an important role in the formation and development of self-concept. Cultural and social background, parents and child rearing practices, significant others, peers, teachers and school climate are among the major ones (Katz, 1995; Tarrant & Konza, 1994). There is considerable evidence to suggest that positive self-concept should be pursued by educators as an important outcome in itself (Humphrey, 2004, p. 347; Marsh & Craven, 2006, p. 46) and has a significant impact on students' emotional and behavioural well-being (Marsh & Martin, 2011).

Clements and Nastasi (1985) were among the first to examine the association of computer use (Logo program) with self-concept (including self-esteem and self-confidence) in a small sample of elementary children and found a positive association. Several years after that study, Jackson, von Eye, Fitzgerald, Zhao, and Witt (2010) also explored the association of technology use with self-concept and self-esteem taking also into consideration gender and race. They had a large sample of 500 children, 12 years old, and they asked five questions about the frequency of specific forms of technology: internet (emails; instant messaging), video games and cell phones. They suggested that there is a relation between technology use and self-

concept/self-esteem but they did not elaborate on that relation in the discussion of their paper instead they focus on the gender, race and household income differences that they found.

Similar constructs, such as self-competence; self-efficacy and self-esteem have been investigated by previous studies. Aesaert and van Braak (2014) examined ICT competence in elementary students (6th graders) employing a multilevel analysis underlining students' 'situational characteristics' (e.g. their class and school level; parental attitudes etc). Their findings suggested that young students feel competent in their use of ICT (digital information processing and communication). Consistently, Clark (2003) explored the direct impact of technology on 'self-efficacy', for students eight to 13-years-old. Clark suggested that with computer use students' computer self-efficacy and their self-efficacy in several other cognitive skills had increased. Steering in the same direction with younger children aged four to six, Hatzigianni and Margetts (2012) investigated the relationship of computer use with self-esteem and found positive associations.

2.2.3. Technology and school liking

Finally, school liking is considered as the positive or negative feelings children possess towards attending school (Harrison, 2004; Ladd & Price, 1987). Studies have revealed that positive attitudes and feelings towards school are a desired prerequisite for educational success and attainment (Dockett, Perry, Howard, Whitton, & Cusack, 2002; Ladd, Buhs, & Seid, 2000; Valiente, Lemery-Chalfant, & Castro, 2007). Most research focuses on enhancing academic motivation on specific academic tasks with the help of technology (e.g. with digital games, see for example: Papastergiou, 2009; Tüzün, Yılmaz-Soylu, Karakuş, İnal, & Kızılkaya, 2009). A study by Allan and Ainley (2000) explored the effect of computer use on the perceptions of 10-year-old children about their school environment. Results indicated that a child's sense of satisfaction and success with the computer was significantly related to their perception of their computing proficiency and also to their overall satisfaction with school, suggesting that the measures we have employed holistically in this study (self-concept, emotional problems, school liking) are worthy of attention.

2.3. The research gap

Subrahmanyan and colleagues back in 2001 underscored the need for studying the impact of computer and internet use on children's and adolescents' social relationships and psychological well-being (p. 26). In line with these concerns, more recently, Abbas (2009) conducted a review of studies (1995–2004) in the field of children's use of information technology and identified specific trends in the literature, such as: interaction with and uses of technology, information seeking activities and patterns, collaboration with designers and others. Abbas did not report any studies about children's social-emotional development. Abbas recognises this gap early on in her review (p. 931) and suggests for further studies to be undertaken to help us validate and synthesise existing findings so that a more comprehensive picture of how technology is impacting children's lives can be structured.

Research evaluating whether or not new technologies have the ability to benefit children's social-emotional development has been impressively scarce. Some of the studies occurred more than 15 years ago (Haugland, 1992; Hyson, 1985), when computer use was not as widespread as today. According to Wright (2001), some of the main reasons for this lack of research which we believe are still relevant today, are problems in the execution of research methodologies, the difficulty in recognizing and controlling a wide range of influencing variables, and the fact that new technologies are changing rapidly. Moreover, deeper reasons based on philosophical and political conceptions around education and on the longstanding dominance of cognitive psychology (Gardner, 1987; McGuinness, 1993) contribute to the neglect of this line of inquiry.

Overall, research in the field of ICT has repeatedly been characterised as mainly from the North American context, complicated, multidimensional, problematical (Abbas, 2009; Ernest et al., 2014) and mostly framed from constructivist theory (when indicated; see Bulfin, Henderson, Johnson, & Selwyn, 2014), and as our literature review has shown, individual rather than situational characteristics feature. Critiques on having methodological limitations, and more importantly being theoretically vague even though their topic is of great complexity have been made repeatedly (Bulfin et al., 2014). Our research seeks to take into account the problem of theoretical vagueness by drawing upon cultural-historical theory, notably the concept of perezhivanie, as the principle framework to guide the study design and to inform the analysis and discussion of the findings.

2.4. The present study

This study utilised a large, representative sample of children in Australian primary schools and conducted quantitative analysis as will be explained in the method section. Investigating children's specific computer use at their schools as reported by teachers and also the possible associations of that use with children's self-concept (Marsh, 1990), emotional problems (Goodman, 1997) and school liking (Ladd & Price, 1987) as understood through the lens of cultural-historical theory were the main aims of the study. Wave five is the first wave of longitudinal data that includes details on children's school use of computers and therefore no previous comparisons could be made.

Interestingly, only two other studies and one report, to the best of our knowledge, have concurrently explored similar variables and neither has drawn upon cultural-historical theory. Using the LSAC but with previous waves, Fiorini (2010) investigated the effect of home computer use on young children's cognitive and non-cognitive skills and concluded that non-cognitive skills (behavioural problems, relationships with others and emotional problems) were not significantly

affected. Similarly, Keane and Fiorini (2012) using the same dataset and method argued that children's non-cognitive skills are not affected by the allocation of children's time on computers and proposed that 'a combination of effective discipline with parental warmth and affection leads to better behavioural outcomes' (p. 30). However, and due to the limitations of the information provided by the dataset, researchers underlined the need for further consideration of how children are using the media (p. 31).

In the same line, the 2013 technical report of LSAC has a chapter (Mullan, 2014) on how children at ages 4–5 and 10–11 were using their free time during school and non-school days and associations with children's social-emotional well-being (emotional problems and temperament). Findings of this report coincide with previous studies on the negative association between time spent watching TV and emotional problems but found no significant associations with computer use when gender, family socio-economic position and region of residence were controlled for (p. 62). Data analysed in this report came from waves 1 and 4 (Kindergarten cohort) of LSAC and only describe activities outside school. The author of the report recognised the importance of children's activities on their psychological well-being and offers ideas for further investigations (pp. 68–69).

Overall, the limited research signals the need for further studies to address the issues of personality and socio-affective factors and their association with the widespread use of technology in our society (Allan & Ainley, 2000, p. 5; Hatzigianni & Margetts, 2012, p. 16; Rocheleau, 1995, p. 5). Attempting to diminish this gap and provide valuable insights, this study did not only focus on how frequently children were using computers at school and at home but also on the specific uses of computers at schools as reported by teachers. Furthermore, this study examined a large sample of Australian children as represented in the LSAC and has theoretically and statistically investigated the possible connections between situational (computer use) and three vital personal characteristics (self-concept, emotional problems, school liking) as will be explained in the method and results sections.

3. Method

3.1. Research questions

1) Is there a relationship between computer use and social-emotional outcomes as measured in the LSAC?
   1a) Is gender, age or parents' educational background a mediating factor?
2) What is the typology of Australian children aged 8–9 years using computers at school/home?

This study draws on data from 'Growing Up in Australia: The Longitudinal Study of Australian Children' Birth (B) cohort. LSAC is a nationally representative longitudinal study of child development funded by the Australian Government Department of Social Services (formerly the Department of Families, Housing, Community Services and Indigenous Affairs). LSAC uses a longitudinal cross-sequential design.

3.2. Sampling

Two cohorts of children (a birth cohort and a kindergarten cohort) were identified from Medicare records. Medicare Australia enrolments database (health insurance), is the most comprehensive database of the Australian population, particularly of young children. A two-stage clustered design was used where postcodes were randomly selected and children were randomly selected within each postcode. Stratification was implemented to ensure the number of selected children were proportionate to the total number of children within each state or territory. Biennial data collection commenced in 2004.

3.3. Participants

LSAC (B) cohort data collection ($n = 5107$) started in 2004 when children were 0–1 year old and subsequent waves of data have been collected every two years. Samples selected had higher socioeconomic position and were less likely to have language background other than English or Indigenous background. The current study used data from Wave 5 (8–9 years, $n = 4085$) and selected participants that had completed a self-report (for measuring self-concept and school liking) and also had a teacher report (rating emotional problems), resulting in a final sample of $n = 3345$.

3.4. Measures

Children's social-emotional development was assessed with the implementation of three widely used instruments at wave 5 (8–9 years): SDQ-I for Self-concept, SDQ for Emotional problems and SLAS for School liking. These measures as personal characteristics were conceptualised in our study from a cultural-historical perspective, where a relational understanding between these was theorised (see Fig. 1 below) so that a more holistic framework for thinking about emotional development could be determined. Children's computer use at school did not involve an existing measure. Instead, in order to identify how children were using computers at school, teachers answered nine questions as explained below. Together, these

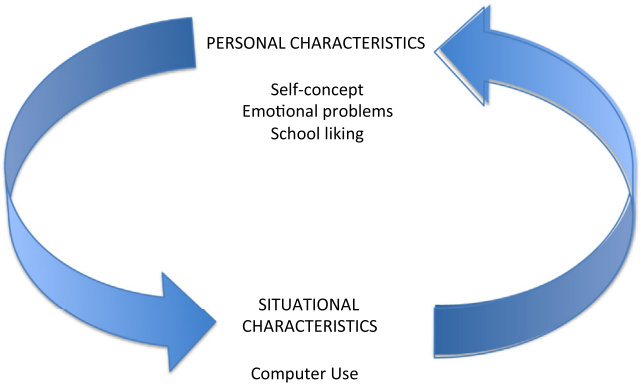

Fig. 1. A theoretical conception of the study design.

measures provide a more holistic view of computer use and children's development because they constitute the situational characteristics as shown in Fig. 1 in ways that we believe is in keeping with Vygotsky's (1994) concept of the unit of perezhivanie as previously discussed. As shown in Fig. 1, personal (self-concept; emotional problems; school liking) and situational characteristics (specific questions about computer use) are interrelated and are conceptualised holistically (Vygotsky, 1994) in this study, so that the results from any one measure can be considered in the context of other measures, thus allowing for greater insights into which combination of personal characteristics was being impacted the greatest in terms of computer use.

3.5. Personal characteristics as defined within this study

3.5.1. The self-concept measure

Theorists have strongly debated about self's nature and specific characteristics over the years. In the LSAC children's global and domain specific self-concept (peer self-concept) were measured with the Self-Description Questionnaire I (SDQ-I; Marsh, 1990). The global self-concept scale comprised eight items reflecting on children's overall self-evaluation (e.g., 'In general, I like being the way I am'; 'I can do things as well as most other people'). Peer social self-concept comprised eight items tapping children's specific self-concept in their social interactions with peers (for example: 'I make friends easily'; 'Other kids want me to be their friend'). This measure was rated by the participant children of the study who evaluated these items using a five-point Likert type scale (1 = false; 2 = mostly false; 3 = sometimes false; 4 = mostly true; 5 = true). The SDQ-I measure has been widely used and past research has shown good psychometric properties (Vershueren, Doumen, & Buyse, 2012). In the current study, the SDQ-I had a Cronbach's alpha of 0.78.

3.5.2. The measure of emotional problems

A focus on children's internalizing problems, including unhappiness, worries, anxiety, and fearfulness was given in LSAC and they were measured by the emotional symptom subscale of the Strength and Difficulties Questionnaire (SDQ; Goodman, 1997). This subscale consisted of five items tapping the extent to which the child exhibits each of these problems (for example: "Often unhappy, down-hearted or tearful"). This measure was rated by teachers, using a three-point scale (1 = not true; 2 = somewhat true; 3 = certainly true), with item scores summed to create mean scores and means were rescaled to be an integer between 0 and 10. The SDQ has shown satisfactory psychometric properties in previous studies for all subscales (e.g. Mieloo et al., 2012). For example, in a nationwide community sample study, teacher-rated SDQ had a Cronbach's alpha above 0.70 for all subscales and showed the most stable test-retest reliability (r = 0.73) compared to other informant such as parent-report (Goodman, 2001). SDQ has also been reported to show high convergent and predictive validity (Goodman, 2001). The emotional symptom subscale of the Strength and Difficulties Questionnaire that was used in this study achieved a high reliability of 0.80.

3.5.3. The measure of school liking

Children's attitudes toward school and the extent to which the enjoy school was measured by School Liking & Avoidance Scale (SLAS), adapted from the School Sentiment Inventory (Ladd & Price, 1987). This is a widely used measure and past research has shown good psychometric properties (Ladd & Dinella, 2009). This measure was rated by children. Children had to rate five items using a 3-point scale (for example: "School is fun"; "Like being in school") (1 = Yes; 2 = Sometimes; 3 = No) indicating the extent to which the enjoy attending school. Higher scores from this instrument indicate higher school liking. Previous studies have shown good psychometric properties (Ladd & Dinella, 2009; Ladd and Coleman, 1997). For example, in Ladd and Coleman (1997), school liking achieved high reliability of 0.87 in the fall and 0.91 in the spring. In our study, SLAS had a Cronbach's alpha of 0.82.

3.6. Situational characteristics as defined within this study

3.6.1. The measure of class computer use

To identify the use of computers at schools as reported by teachers, all the relevant LSAC questions referring to teacher practices were examined. The close-ended questions and possible answers were:

1. How many computers do you have in your class? (answer: number)
2. How many of these computers have access to the internet? (answer: number)
3. How often do you take students to the computer lab, if the school has computer lab(s)? (answer: no computer facilities available; once a month or less; two or three times a month; once or twice a week; three or four times a week; daily)
4. Children in your school have access to computers at school (either in the classroom or the lab)? (answers as above)
5. How often do children in your class use computers for the following purposes? To develop specific skills in academic areas (e.g. literacy, mathematics or science activities) (answers as above)
6. How often do children in your class use computers for the following purposes? To learn keyboarding skills (answers as above)
7. How often do children in your class use computers for the following purposes? For creative activities (e.g. design in visual arts, composing music, animation) (answers as above)
8. How often do children in your class use computers for the following purposes? For enjoyment (e.g. games) (answers as above)
9. How often do children in your class use computers for the following purposes? To access information (e.g. using the Internet to look for information) (answers as above)

In the current study, the Class computer use measure achieved a high reliability score of 0.84. In addition, to gain a more holistic perspective surrounding context in relation to the child's personal characteristics, two questions about the amount of time children were using computers at home ('Total number of electronic activities' – number of minutes for an average week at home) and whether children had access to the internet at home ('Internet access at home') as reported by parents (in their face-to-face interview) were included in the analysis to identify possible differences between teaching and home practices on children's social-emotional outcomes.

3.7. Analysis

The analysis was framed to bring together the outcomes of the statistical analysis so that both the personal characteristics (self-concept, school liking, emotional problems) and the situational characteristics (computer use questions) could be examined. To achieve this, the analysis undertook the following steps:

Correlations between quantitative variables were assessed by means of the Spearman's rho correlation coefficient. The choice of a non-parametric correlation coefficient was based on the fact that not all the examined variables were normally distributed. The association between categorical variables was tested with the Chi–Square test. Means' comparisons were performed with the ANOVA method followed by Turkey's test for multiple comparisons.

Hierarchical Cluster Analysis-HCA in combination with k-Means Cluster Analysis (Hair, Black, Babin, & Anderson, 2009) was performed in order to investigate whether a meaningful typology of the way student use the computer in class exists. The squared Euclidean distance was used as a measure of dissimilarity between students' computer use and the clusters' formation was based on the Ward's criterion (Ward, 1963). The significance level in all hypothesis-testing procedures was predetermined at $p < 0.05$. All statistical analyses were performed with the SPSS v.20.0.

4. Results

Vygotsky (1994) wrote that, "*the influence of environment on child development will, along with other types of influences, also have to be assessed by taking the degree of understanding, awareness and insight of what is going on in the environment into account*" (p. 343). This reading of Vygotsky's conception of perezhivanie, was also highlighted in our results because we found that only one specific type of computer use had an impact on the children's emotional development.

Table 1
Descriptive statistics of major variables of the data.

Variables/Scores	Minimum	Maximum	Mean	Std. Deviation
Class computer use	1.00	6.00	3.35	0.75
Marsh general-self scale	1.00	5.00	4.30	0.62
Marsh peer relations scale	1.00	5.00	3.94	0.79
SDQ total score	0	34	6.32	6.06
School liking (v2)	1.00	3.00	1.48	0.44

An examination of the descriptive data provides an initial view of the results. Table 1 presents mean values and standard deviations of the major variables of the study. The Class Computer Use Scale score ranged from 1 to 6 with a Mean Value 3.35 (*SD*:±0.75) showing a medium overall score of the participants. The Marsh Global-Self Scale score ranged from 1 to 5 with a Mean Value 4.30 (*SD*:±0.62) displaying a rather high score. Similarly high was the score for the Marsh Peer Relations Scale that ranged from 1 to 5 with a Mean Value 3.94 (*SD*:±0.79). The SDQ (emotional problems) Total score ranged from 0 to 34 with a Mean Value 6.32 (*SD*:±6.06) and the School liking scale (v2) score ranged from 1 to 3 with a Mean Value 1.48 (*SD*:±0.44) revealing both of them relatively medium to low scores.

Correlation analyses investigated all the possible statistically significant associations between the studied variables. Table 2 shows the Spearman's rho rank correlation coefficients between the Class Computer Use Scale and the other four scales (Marsh Global-Self Scale, Marsh Peer Relation Scale, SDQ Total Score and School Liking (v2). Results showed that the Class Computer Use Scale is not significantly correlated with the Marsh General-Self Scale, the Marsh Peer Relation Scale or the SDQ Total Score. There is a statistical significant negative correlation between the Class Computer Use Scale and the School Liking (v2), but at a very low level. This correlation, which can be also attributed to the size of the sample, is very weak and it can be characterized as not educationally important. In sum, results reveal the lack of association between the way the computer is being used (situational characteristics) in the school classroom and a series of scales measuring peer relations, school liking, and emotional difficulties (personal characteristics).

An additional set of correlation analyses was conducted between each one of the five items that constitute the Class Computer Use Scale and the other scales used in this study, in order to further examine any possible correlations regarding the way students use their computers in the class with the other scales. Table 3 displays the Spearman's rho correlation coefficients between the five Class Computer Use Scale's Items and the Marsh Peer Relation Scale, SDQ Total Score and School Liking (v2) scale. Results showed that some of the correlation coefficients were statistically significant ($p < 0.05$). For example, there were some very weak significant correlations between Item 1-Computers to develop skills and Marsh Peer Relations Scale, Item-3 Computers for creative activities and Marsh Peer Relations Scale, Item-3 Computers for creative activities and School Liking (v2), Item 4 -Computers for enjoyment and School Liking (v2), and Item 5-Computers to access information with Marsh Peer Relation Scale, SDQ Total Score and School Liking (v2). However, these correlations although significant, they were very close to zero and hence did not provide any valuable insight regarding the association among these items. These results also seem to confirm the lack of association between the way the computer is being used in the classroom (situational characteristics) and students' attitudes toward school (personal characteristics). Moreover, results did not reveal any significant correlation between the Class Computer Use Scale and the student's gender and age. In both cases Spearman's rho coefficient was almost zero.

Correlation analyses were also conducted for the variables: “Total number of other electronic activities - minutes for an average week at home” and “Internet access at home” with the Marsh General-Self Scale, Marsh Peer Relation Scale, SDQ Total Score (v2) and School Liking (v2) scale. In general, results did not show statistical significant correlations among the electronic activities per week at home and the internet access at home and the Marsh General-Self Scale, Marsh Peer Relation Scale, SDQ Total Score (v2) and School Liking (v2) scale. In two scores there was a significant correlation but at very low level, almost close to zero. The “total number of other electronic activities minutes for an average week at home” was correlated with SDQ Total Score (Spearman's rho $= -0.043$, $p = 0.011$) and the “Internet access at home” was correlated with SDQ Total Score (Spearman's rho $= 0.057$, $p = 0.001$).

In order to investigate whether a meaningful typology exists of the way students use computers in school, a Hierarchical Cluster Analysis was performed with k-Means Cluster Analysis (Hair, Anderson, Tatham, & Black, 1995) on the Class Computer Use Scale scores.

Cluster analysis revealed three main groups of students (clusters): C1 group with 3060 students (91.4%), C2 group with 226 students (6.8%), and C3 group with 59 students (1.8%). Table 4 displays the situational characteristics and the profile of each one of the three clusters. More specifically, Cluster 1 (C1) gathered the majority of the students of the current study. The profile of C1 reveals a relatively systematic use of computers in the classroom on a weekly if not a daily basis, and that is why it was named ‘*Frequent use*’. For example, in items 1 and 5 computers are used on a weekly basis for more than 82.5% and 67.9% of the students respectively. Cluster 2 (C2) included much fewer students. The profile of C2 shows a lower level of computer use in the classroom in comparison to the C1. For example, in items 4 and 5 computers are used a few times per month for more than 62.4% and 49.1% of the students respectively, while in items 2 and 3 computers are not available for more than 74.3% and 84.7% of the students. The profile of C2 shows a fairly adequate use of computers in the classroom and it was named

Table 2
Statistically significant correlation between the Class Computer Use Scale and the Marsh Global-Self Scale, the Marsh Peer Relations Scale, the SDQ Total Score and the School Liking (v2) scale.

Correlations	Spearman's *rho*	Significance *P*	Magnitude of association
Class computer use – Marsh general-self scale	0.011	0.519	Not important
Class computer use – Marsh peer relations scale	0.021	0.211	Not important
Class computer use – SDQ total score	−0.027	0.114	Not important
Class computer use – School liking (v2)	−0.048	0.005[a]	Very weak

[a] Not educationally important.

Table 3
Statistically significant correlation between each one of the five Class Computer Use Scale's Items and the Marsh Global Self and Peer Relations Scale, the SDQ Total Score and the School Liking (v2) scale.

Class computer use scale 5 items	Marsh global self scale	Marsh peer relations scale	SDQ total score	School liking (v2)
Item 1-Computers to develop specific skills	0.02	0.040	−0.026	−0.029
	$p = 0.195$	$p = 0.013$	$p = 0.125$	$p = 0.069$
Item 2-Computers to learn keyboard skills	0.04	0.009	−0.014	−0.017
	$p = 0.006$	$p = 0.576$	$p = 0.400$	$p = 0.285$
Item 3-Computers for creative activities	0.038	0.039	−0.009	−0.044
	$p = 0.016$	$p = 0.014$	$p = 0.588$	$p = 0.006$
Item 4-Computers for enjoyment	0.019	0.023	−0.007	−0.043
	$p = 0.236$	$p = 0.152$	$p = 0.686$	$p = 0.006$
Item 5-Computers to access information	0.038	0.036	−0.056	−0.035
	$p = 0.016$	$p = 0.029$	$p = 0.001$	$p = 0.028$

*Some of the above correlation coefficients are statistically significant ($p < 0.05$), but they do not have any educational importance since they are very close to zero.

'*Moderate use*'. Cluster 3 (C3) consisted of a small percentage of students and showed a very poor use of computers in the classroom. In almost all items there are no computer facilities available or computers are used very scarce for more than 70% of the students. This cluster (C3) was named '*Rare use*'. A more detailed profile of situational characteristics of the three clusters can be seen in Tables 7–11 in the appendix.

The clear and distinct profile of each one of the three clusters of situational characteristics is also confirmed by the mean scores each cluster has in the Class Computer Use Scale, as it is presented in Table 5. C1 has a mean score of 3.42, C2 has a mean score of 2.67 and C3 has a mean score of 1.58.

However, the three clusters C1 '*Frequent use*', C2 '*Moderate use*' and C3 '*Rare use*' do not seem to have difference among them when it comes to their mean scores regarding the Marsh General-Self Scale, Marsh Peer Relation Scale, SDQ Total Score and School Liking (v2) scale. Table 6 shows that the profile of situational characteristics of the three clusters is very similar regarding the other scales that are used in this study.

In addition, the three clusters of situational characteristics did not reveal any statistically significant differences regarding their students' gender distribution ($\chi 2\ (2) = 2{,}884\mu\ p = 0.242$) or the students' mean age (ANOVA $p = 0.784$). Similarly, the three clusters of situational characteristics were not statistically significant correlated with the father's or the mother's educational qualifications.

5. Discussion

This study aimed at exploring the use of computers by young Australians at the early years of school. Data came from the LSAC and are relevant to the Australian population and society. Based on a cultural-historical theoretical framework (as represented in Fig. 1) of the statistical analyses this study offers a rich portrait of how children use computers at the early years of school and examines possible associations with social-emotional outcomes. Overall, this study significantly contributes to lessening the gap in our knowledge about the use of technology and social-emotional links and successfully responds to the need for robust methodologies in this field of inquiry (Bulfin et al., 2014).

5.1. Children's use of computers in the early years of school

Findings focused on the situational characteristics suggest that the use of computers in Australian schools is very similar. The majority of teachers use computers to advance children's skills in specific areas (such as maths or literacy) and not for supporting children's imagination or artistic endeavours. Over 90% of students, gathered in the 'frequent use' group, implying that computers are used in parallel ways in the majority of Australian schools. The vast majority of students use computers on a weekly (once or twice) or even daily basis. However, what is more important than the frequency of use is the type of use. Students in the 'frequent' group mostly use computers for developing specific skills, such as literacy and maths and for locating information on the internet. This finding is in line with other similar studies even with younger children (Hinostroza, Labbé, & Matamala, 2013; Robinson & Sebba, 2010), and with a large study by Selwyn, Potter, and Cranmer (2009) who investigated the use of technology from English elementary students at home and school and concluded that: 'engagement with ICT is often perfunctory and unspectacular in both contexts' (p. 928). The least frequent use of computers was for creative purposes across all three groups. Even learning a very simple, lower level skill such as: 'how to use the keyboard', is much more frequent than using the computers for creative activities. This is an unexpected finding worth further exploration and is in contrast with all the relevant research in the field which underlines the importance of creativity for young children but also the affordances new technology has to offer in supporting creativity (Edwards, 2001; Fabricatore & López, 2013; Jamieson-Proctor & Burnett, 2002; Shawareb, 2011; Wheeler, Waite, & Bromfield, 2002).

In bringing together situational and personal characteristics, as realised through questions about enjoyment, computers were rarely used for 'enjoyment'. Students do not use computers for playing games in school or engage in other fun activities

Table 4
Profile of situational characteristics of the three clusters of class computer use.

Class computer use scale items	Cluster C1 ($n = 3060$, 91.4%)	Cluster C2 ($n = 226$, 6.8%)	Cluster C3 ($n = 59$, 1.8%)
	'Frequent use'	*'Moderate use'*	*'Rare use'*
Item 1 Computers to develop skills	• 82.5% -weekly to daily use • 17.4% -monthly use (1–4 times)	• 73.9% -weekly to daily use • 26.1% -monthly use (1–4 times)	• 22% -weekly to daily use • 74.6% -no computer available or once per month
Item 2 Computers to learn keyboard skills	• 41.9% -weekly to daily use • 58% -monthly use (1–4 times)	• 18.6% -weekly to daily use • 74.3% -no computer available or once per month	• 10.2% -weekly to daily use • 83.1% no computer available or once per month
Item 3 Computers for creative activities	• 30.1% -weekly to daily use • 69.8% -monthly use (1–4 times)	• 6.7% -weekly to daily use • 87.6% - no computer available or once per month	• 6.8% -weekly to daily use • 84.7% - no computer available or once per month
Item 4 Computers for enjoyment	• 34.5% -weekly to daily use • 64% -monthly use (1–4 times)	• 15.9% -weekly to daily use • 62.4% -monthly use (1–4 times)	• 28.8% -monthly use (1–4 times) • 62.7% - no computer available or once per month
Item 5 Computers to access information	• 67.9% -weekly to daily use • 30% -monthly use (1–4 times)	• 50.9% -weekly to daily use • 49.1% -monthly use (1–4 times)	• 13.6% -monthly use (1–4 times) • 81.4% -no computer available or once per month

on the computer. Again, the research around the educational usefulness of digital games (Gee, 2003; Rosas et al., 2003) but also of positive feelings such as enjoyment and interest (Ainley & Ainley, 2011; Naude, van den Bergh, & Kruger, 2014) is largely ignored and other, less captivating and less imaginative skills are promoted.

Details on how exactly children are using computers at home were inexistent in this wave of data. The only information provided was on the amount of time children were spending in using 'electronic devices' (separately from electronic games). However, in supporting the holistic view on technology, authors of this paper are cautious in comparing home and school use of technology as separate contexts. Authors see the use of technology as permeating everyday situations and contexts in line with the 'permeable' boundaries concept by Dyson (1997) and Selwyn's (2012) urge for investigating the micro/macro social and cultural experiences associated with technology.

Overall, our study reveals a rather conventional way of using technology instead of a project-based, independent inquiry or cooperative learning approach. A strong emphasis is placed on rote-learning, content-driven and teacher-directed activities and on a view of students as consumers rather than creators of knowledge.

5.2. Computer use and association with children's social-emotional outcomes

When bringing together situational and personal characteristics, the results did not reveal any significant or meaningful association among the class computer use and the instruments used to measure self-concept, emotional problems and school liking. Findings also suggest that there is not a significant association with children's access to the internet at home, the overall time spent using computers at home and children's social-emotional outcomes or attitudes toward school. The results also revealed that computer use was not differentiated regarding gender, age or educational background of students. These results are in line with previous Australian research from Fiorini (2010), Keane and Fiorini (2012), and Mullan (2014) who investigated previous waves of the same longitudinal study and concluded that the use of computers did not influence children's social-emotional development, but are not consistent with previous studies (e.g. Jackson et al., 2010; Aesaert & van Braak, 2014). Possible reasons for this inconsistency could be the different cultural contexts, the sample sizes and also the different methodologies and conceptualizations of measures. Data from children themselves and how they perceive the use of computers in their schools could also alter the results of this study. Nevertheless, more research (e.g. cross-cultural research) in this field will assist with further highlighting existing findings. Even though it is known that the same environment will elicit different perezhivanie by children because of the different constitutional characteristics of each child, the results of this study suggest that collectively class computer use has had a limited impact on children.

Although the statistical results did not reveal any significant associations with social-emotional outcomes, the cultural-historical analysis and the concept of perezhivanie enhances our understanding and assists in sketching a broader picture about the personal characteristics and environmental context when studying how children are using technology. By adopting a holistic perspective and considering how the same environment of computer use can play out differently, we found that the least frequent use of computers at school - the creative use - had a very weak significant association with children's global self-concept. This finding might contribute to the discussion about the ways of implementing technology in our schools. This finding also motivated an additional investigation of the literature which in turn revealed an unexpected gap. Research around the creative use of technology or the impact of technological use on children's creativity or creative thinking is limited. A number of projects on how technology can enhance creativity, problem-solving skills or higher-order thinking concur that there is a lot of potential for promoting all these skills with the infusion of technology in everyday learning from a young age (Jamieson-Proctor & Burnett, 2002; Shawareb, 2011; Wheeler et al., 2002). Similarly, associations between positive affect,

Table 5
Mean scores of the 3 Clusters in the Class Computer Use Scale.

Clusters	Class computer use scale mean scores
C1	3.4232[a]
C2	2.6717[b]
C3	1.5898[c]
Total	3.3401

*Means followed by different letters are statistically significant different at $p < 0.001$ according to Turkey's test.

Table 6
Mean scores of the 3 clusters regarding the Marsh General-Self Scale, Marsh Peer Relation Scale, SDQ Total Score and School Liking (v2) scale.

Clusters	Marsh general-self scale mean scores	Marsh peer relation scale mean scores	SDQ total score mean scores	School liking (v2) mean scores
C1	4.3[a]	3.9[a]	6.3[a]	1.5[a]
C2	4.3[a]	4.0[a]	6.2[a]	1.5[a]
C3	4.3[a]	3.9[a]	6.4[a]	1.4[a]
Total	4.3	4.0	6.3	1.5

*Means followed by common letter are not statistically significant different at $p < 0.05$ according to Turkey's test.

self-characteristics and creativity have been established (MacFadden, 2005; Um et al., 2012) and enhancements for cognition and higher learner efforts have been recognised but what is missing is studying a combination of the three: technology, social-emotional outcomes and creativity in children.

To the best of our knowledge, there isn't any available study investigating the link between creative uses of technology and its possible impact on children's social-emotional outcomes. Hence, there is a key gap in the literature, given the importance of creativity in education, the theories around its immense value for children's learning and development (Csikszentmihalyi, 1997; Gardner, 2001; Loveless, 2002; 2003), but also the increased demand for creative individuals in the future workplaces and economies (Craft, 2012; Fabricatore & López, 2013).

5.3. Computer use, creativity and cultural-historical theory

Delving into a more theoretical approach, Vygotsky pointed to the significance of creativity for children and for education (Vygotsky, 2004) and offers insights into how technology can enhance creativity which further clarifies our findings and opens up avenues for future research. Vygotsky (2004) defined creativity as being present everyday … 'whenever a person imagines, combines, alters, and creates something new, no matter how small … ' (p. 10) and argued that "imagination, as the basis of all creative activity, is an important component of absolutely all aspects of cultural life, enabling artistic, scientific, and technical creation alike" (p. 9). Imagination also plays a central role in the pedagogy of 'emotional scaffolding' (Rosiek & Beghetto, 2009). Efforts to adopt a holistic approach to development need to address emotional aspects of teaching and learning and will inevitably require paying greater attention to the role imagination and creativity plays in the academic curriculum.

In line with this claim and with the findings of this study, further research into the creative use of technology and its possible impact on social-emotional characteristics would be beneficial. Research questions on possible ways that creative use of technologies could positively or negatively impact children's self-concept (or other self-constructs) could lead future investigations with practical implications for software/app designers and teacher education programs. Vygotsky (2004) has argued that creativity is foundational to all human behaviour and activity. Using computers to support children's creative endeavours, would appear to be an important use of this resource in schools.

A plethora of projects have been completed in this fruitful field of technology and creativity mostly by creative labs around the world (see projects from Media lab of MIT, USA; Creativity Labs, CL, Indiana University, USA; Waag society, Institute for Art, Science and Technology, University Utrecht, Netherlands; Innovation and Creative Intelligence, ICI, University of Western Sydney, Australia; the laboratory for innovation in galleries, libraries, archives and museums, iGlam, University of New South Wales, Australia, and many others) with emphasis on the pedagogical/educational (Morrison, Ross, & Lowther, 2009; Wildflower schools project from the Media Lab: http://wildflowerschools.org/) or on the social dimension of creativity (Leach, 2001; Interconnections project from Creativity Labs: http://www.creativitylabs.com/popgrind.html). However, a limited number of creative projects has concentrated on the connections of technologies and social-emotional development (e.g Turkle, 2004, who examined the emotional attachment of 4–6 year olds with an animatronic toy, *Furby*; the *Mood-room project*, 2013–14 by the Institute of Art, Science and Technology, which focused on helping teenagers understand their emotions and become happier persons: https://waag.org/en/project/mood-room) regardless of the strong concerns about emotional bullying and isolation, especially for high school students and young adults (Turkle, 2005; 2012).

The general research has shown that computers can and do increase children's exposure to new things (direct and vicariously) when both situational and personal characteristic are considered. Vygotsky (2004) claimed that there is a

"mutual dependence between imagination and experience" (p. 17), and the implications for education in the context of the findings of this study, is that computers can broaden children's experiences and opportunities to creatively generate new meaning through the broad range of digital tools now available. In bringing together many different ideas in new ways, as occurs in a creative re-working or production in a classroom, Vygotsky (2004) argued that this process of gathering, isolating and elimination of traits "is extremely important in all human mental development; it is the foundation of abstract thinking, [and] the basis of concept formation" (p. 26). Computers are valuable tools for supporting these creative processes, and this would support the view that if teachers used computers for creative activity more, higher levels of conceptual development would also occur.

Vygotsky (2004) also argued that emotions represent an important association between imagination and reality:

> … every feeling, every emotion seeks specific images corresponding to it. Emotions thus possess a kind of capacity to select impressions, thoughts, and images that resonate with the mood that possess us at a particular moment in time (pp. 17–18).

Within a holistic system of concepts, Vygotsky (2004) also proposed that the intellectual and emotional spheres are equally needed for an act of creation. He states that, "feelings as well as thoughts drive human creativity" (p. 21). In the context of the findings of this study, Vygotsky's holistic conception gives possible insight into why it is that the creative use of computers was positively correlated to self-concept. In a cultural-historical reading of the findings of this study, imagination and creativity could also be emotionally realised, thus potentially supporting social-emotional development. Furthermore, a technological environment that embraces creativity could benefit the whole child, valuing intellectual and social-emotional growth equally.

6. Limitations

Wave five of LSAC is the only wave with data on the specific uses of technology in elementary schools and therefore no longitudinal comparisons can be attempted. However, in the future it would be useful to investigate whether the picture is altered provided that the same questions are posed again to the same cohort in two years' time. Moreover, even though the researchers did not have any power over the way the LSAC was designed and on how the questions were phrased or answered, they consider a limitation of this study the absence of children's input on how they use technology in their school.

Moreover, possible self-report biases from teachers (about the use of technology at schools) and also from children on assessing their own self-concept and school liking need to be taken into consideration and it is recommended that future studies supplement these measures with actual observations and interviews to enhance trustworthiness and triangulation of findings.

One more limitation of this study is that social-emotional outcomes are limited to the three measures LSAC utilised: self-concept; emotional problems and school liking. Although these measures proved very reliable and are considered fundamental for children's development, other important measures (e.g. self-esteem; self-efficacy; enjoyment; autonomy; self-regulation etc) would also be useful to be examined from future studies.

In regards to statistical analysis, cluster analysis, unlike other statistical procedures, is mostly used when we do not have any 'a priori' hypotheses and are still in the exploratory phase of research (Everitt, 1993). In line with this suggestion, this exploratory study employed cluster analysis to assist with the identification and description of specific groups of children and how they use computers in Australian schools. This type of analysis is person-centred and not variable-centred and is limited to offering mostly descriptive information and does not investigate any causal relationships (Jung & Wickrama, 2008).

7. Implications

Identifying the ways children use computers in the early years of school is the first vital step in understanding possible gaps and inadequacies and for designing: future research projects; technological interventions; and professional development programs for teachers. Approaching the use of technology in a holistic way, equally respecting the social-emotional and intellectual aspect of children's development could offer a better understanding of children's engagement with technological tools in their everyday lives. Drawing upon the concept of perezhivanie as a unit of analysis for examining the personal characteristics in the context of environmental situations, gives new ways of conceptualising and analysing quantitative and qualitative data more holistically.

Additionally, in this study a detailed typology was formulated showing that the situational characteristics of computer use in early school years support specific academic skills much more than for enhancing open-ended, future oriented, flexible and transferable skills, such as creativity (personal characteristics). Given the undeniable educational importance of developing creativity in early years, the technological affordances of most Australian schools and the increased demand for creative professionals in the labour market (Oldham & Da Silva, 2015), this finding is of immense concern for policy makers, teacher education programs and all educational stakeholders.

Being competent in the use of technology is one of the eight key competences for lifelong learning (European Commission, 2008) and one of the eight main learning areas of the Australian curriculum. The way this competence is perceived and strengthened needs to be revisited. Incorporating creativity in building a competent use of technology is essential. Teachers recognise the value of creativity and they understand its importance for 21st century students. However, they are struggling

with curricula demands and the emphasis on 'performativity' which has resulted in doing teaching 'algorithmic' (Nicholl & McLellan, 2008, pp. 595–596), technical and extremely controlled (Craft, 2003; 2012) leaving very limited space for creative endeavours.

Developing a holistic, systematic, theoretically sound, cost-effective and sustainable approach to professionally support educators has been the central recommendation of a number of studies on the integration of technology (Aubrey & Dahl, 2013; Ng, 2015; Rodríguez, Nussbaum, & Dombrovskaia, 2012). Teachers incorporate technology into their teaching in a limited manner (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Petko, Egger, Cantieni, & Wespi, 2015) and they may face specific barriers (such as: technology anxiety; lack of training; lack of ongoing support and others) that prevent them from integrating technology successfully in their everyday practice (Aldunate & Nussbaum, 2013). The role of ineffective leadership in the implementation of technology has also been underlined (Aubrey & Dahl, 2013). There is a pressing need for ICT innovations to be planned in a coordinated way to provide individual and collective professional development to teachers and also establish a network for information exchange between teachers. Recommendations for a mixture of bottom-up and top-down strategies (Petko et al., 2015) that would be useful in supporting teachers to effectively integrate new technologies in their programs, incorporate emotional and imaginative dimensions into their teaching (Rosiek & Beghetto, 2009) and thus enhance their students' experiences of ownership and creative involvement should also be taken into serious consideration by educational institutions and policy makers. Being informed on the exciting work that creative and innovative labs and institutions around the world are performing will also contribute to sparking students' interest and enriching teaching practices.

8. Conclusion

This study was framed by cultural-historical theory in order to explore relationships between the use of technology and children's social-emotional outcomes. Two key concepts from cultural-historical theory that helped explain the findings of this study in a holistic way where Vygotsky's dialectical concept of imagination and creativity, and his concept of perezhivanie. The theoretical challenge raised by Bulfin et al. (2014) in relation to the dearth of studies that are theoretically informed was taken up, and it was found that through taking a holistic perspective, it was possible to bring together the personal, situational and relational characteristics of computer use in the LSAC data. The personal characteristics that were identified (self-concept, emotional problems, school liking) were mobilized and understood by the situational characteristics (computer use questions), but always as a relational whole as is a key feature of working with the concept of perezhivanie.

Overall, the dearth of robust research around the use of technology and its possible impact on social-emotional outcomes is alarming since the presence of technology is increasing and is infused into children's everyday lives. This paper inspired by a holistic approach concludes with a question as it projects into the future: Conceptualizing both personal characteristics of emotions, imagination and creativity and situational characteristics of the use of ICT, is it possible to better understand the nature of digital devices as inspirational and transformative when the study design is routinely informed by theory?

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Appendix

Table 7
Class Computer Use Scale Clusters Profile regarding Item 1- Computers to develop specific skills

Class computer use clusters		Item 1- computers to develop specific skills						Total
		No computer facilities available	Once a month or less	Two or three times a month	Once or twice a week	Three or four times a week	Daily	
C1	Count	0	189	344	1623	555	349	3060
	%	0.0%	6.2%	11.2%	53.0%	18.1%	11.4%	100.0%
C2	Count	0	28	31	126	27	14	226
	%	0.0%	12.4%	13.7%	55.8%	11.9%	6.2%	100.0%
C3	Count	39	5	2	10	1	2	59
	%	66.1%	8.5%	3.4%	16.9%	1.7%	3.4%	100.0%
Total	Count	39	222	377	1759	583	365	3345
	%	1.2%	6.6%	11.3%	52.6%	17.4%	10.9%	100.0%

*$X^2(10) = 2225.41$, $p < 0.001$, Cramer's $V = 0.577$.

Table 8
Class Computer Use Scale Clusters Profile regarding Item 2- Computers to learn keyboard skills

Class computer use clusters		Item 2-computers to learn keyboard skills						Total
		No computer facilities available	Once a month or less	Two or three times a month	Once or twice a week	Three or four times a week	Daily	
C1	Count	1	1234	541	1111	87	86	3060
	%	0.0%	40.3%	17.7%	36.3%	2.8%	2.8%	100.0%
C2	Count	116	52	16	38	4	0	226
	%	51.3%	23.0%	7.1%	16.8%	1.8%	0.0%	100.0%
C3	Count	44	5	4	6	0	0	59
	%	74.6%	8.5%	6.8%	10.2%	0.0%	0.0%	100.0%
Total	Count	161	1291	561	1155	91	86	3345
	%	4.8%	38.6%	16.8%	34.5%	2.7%	2.6%	100.0%

*$X^2(10) = 849.94$, $p < 0.001$, Cramer's $V = 0.526$.

Table 9
Class Computer Use Scale Clusters Profile regarding Item 3- Computers for creative activities

Class computer use clusters		Item 3-computers for creative activities						Total
		No computer facilities available	Once a month or less	Two or three times a month	Once or twice a week	Three or four times a week	Daily	
C1	Count	2	1395	739	794	87	43	3060
	%	0.1%	45.6%	24.2%	25.9%	2.8%	1.4%	100.0%
C2	Count	150	48	13	13	2	0	226
	%	66.4%	21.2%	5.8%	5.8%	0.9%	0.0%	100.0%
C3	Count	39	11	5	4	0	0	59
	%	66.1%	18.6%	8.5%	6.8%	0.0%	0.0%	100.0%
Total	Count	191	1454	757	811	89	43	3345
	%	5.7%	43.5%	22.6%	24.2%	2.7%	1.3%	100.0%

*$X^2(10) = 2129.676$, $p < 0.001$, Cramer's $V = 0.564$.

Table 10
Class Computer Use Scale Clusters Profile regarding Item 4- Computers for enjoyment

Class computer use clusters		Item 4-computers for enjoyment						Total
		No computer facilities available	Once a month or less	Two or three times a month	Once or twice a week	Three or four times a week	Daily	
C1	Count	47	1109	850	850	119	85	3060
	%	1.5%	36.2%	27.8%	27.8%	3.9%	2.8%	100.0%
C2	Count	36	106	35	36	9	4	226
	%	15.9%	46.9%	15.5%	15.9%	4.0%	1.8%	100.0%
C3	Count	37	13	4	5	0	0	59
	%	62.7%	22.0%	6.8%	8.5%	0.0%	0.0%	100.0%
Total	Count	120	1228	889	891	128	89	3345
	%	3.6%	36.7%	26.6%	26.6%	3.8%	2.7%	100.0%

*$X^2(10) = 760.86$, $p < 0.001$, Cramer's $V = 0.337$.

Table 11
Class Computer Use Scale Clusters Profile regarding Item 5- Computers to access information

Class computer use clusters		Item 5-computers to access information						Total
		No computer facilities available	Once a month or less	Two or three times a month	Once or twice a week	Three or four times a week	Daily	
C1	Count	0	285	694	1403	413	265	3060
	%	0.0%	9.3%	22.7%	45.8%	13.5%	8.7%	100.0%
C2	Count	0	44	67	80	25	10	226
	%	0.0%	19.5%	29.6%	35.4%	11.1%	4.4%	100.0%
C3	Count	48	5	3	2	1	0	59
	%	81.4%	8.5%	5.1%	3.4%	1.7%	0.0%	100.0%
Total	Count	48	334	764	1485	439	275	3345
	%	1.4%	10.0%	22.8%	44.4%	13.1%	8.2%	100.0%

*$X^2(10) = 2752.37$, $p < 0.001$, Cramer's $V = 0.641$.

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