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**“Kindling the Flame¹” – Exploring the potential of ICT to
spark creativity and Love of Learning in Irish Primary School
Pupils**

Rosaleen Carley Greene
B.Sc Information Technology (DCU)

A Research Dissertation submitted
in partial fulfilment for the degree of
Masters of Science in Technology Management
Of the National University of Ireland Galway

Sept 2008

Supervised by

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Final Project/Thesis Submission

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Abstract

Creativity is essential for the holistic development of the learner, fostering an individual who espouses confidence in learning, who values close collaboration with peers and significant others, and who is inspired to engage in life-long learning. Such an individual is well-equipped for the challenges of the 21st Century.

This dissertation explores the potential of ICT to spark this creativity and enthusiasm in Irish Primary School Pupils. Despite the existence of common ICT standards as defined by NCCA and NCTE, there is no consistency in the way ICT is configured in schools and integrated into the Irish primary school curriculum.

A comparative study was employed involving two schools at opposite ends of the ICT spectrum (determined by the provision and usage of ICT and priority given to ICT). The study used multi-method triangulation (students, their teachers and parents) involving several research methods to capture the multi-faceted aspect of this thesis. It focused on the creative impact of ICT on the Arts.

The findings indicate that higher spectrum pupils demonstrate greater creativity and collaborative engagement through ICT activities which in itself leads to more effective learning. Furthermore, ICT facilitated active engagement by the child in his/her learning experience. This contributed to fun and enjoyment in the learning process fostering greater enthusiasm for learning.

This thesis concludes that the role of the teacher as a collaborative partner is key to achieving the potential of ICT to spark creativity and enthusiasm and, furthermore, that he/she needs support in achieving the desired benefits.

“New technologies may lead to new concepts of play and learning in which ICT is much more than the ‘benign addition’ referred to by Cuban (op. cit.), especially as new ways are found of conceptualising ICT so that the term does not simply denote standard computers. These shifts in thinking may lead to technologies that can encompass participation by practitioners, parents and children in different learning spaces and promote discovery, delight, curiosity, creativity, self-expression and pleasure in learning’

Plowman and Stephen 2003

1. Introduction

1.1. Chapter Introduction

This opening chapter of the thesis looks at the background to the research and the rationale for undertaking it. It firstly outlines the current thinking on ICT in the Irish primary school curriculum and its deployment in the classroom. This is discussed in the context of the goals of the Irish education system and how they have evolved to their present state. It looks at the role played by computers, and technology in general, in the classroom setting against the backdrop of the ongoing debate/concerns on the appropriateness of computers in children's lives. It asks if new ways of conceptualising technology can reinforce or hinder the development of the core values espoused by our education system. It then offers new perspectives on the way forward in building on the strengths of our education system in fostering the development of well-balanced, moral, self-confident young adults well-equipped to face tomorrow's challenges. The chapter concludes with a summary of the thesis structure and how it intends to answer the thesis' primary research question: can new ways of conceptualising ICT spark creativity and love of learning among our children?

1.2. Goals of the Irish Primary Education System

The Primary School Curriculum was developed by the NCCA (National Council for Curriculum and Assessment) under the auspices of the Department of Education and Science and launched in 1999. It identifies three primary aims:

- To enable each child to live a full life as a child and to realise his or her potential as an unique individual
- To enable each child to develop as a full human being through living and co-operating with others and so contribute to the good of society
- To prepare each child for further education and lifelong learning.

(NCCA, 1999)

This vision has been adopted by primary schools throughout the country and embraced by the primary stakeholders - teachers, unions and parents.

The INTO handbook for parents stresses the importance of parents preparing children for learning by creating a positive attitude towards learning, encouraging curiosity, fostering self confidence and self-esteem, encouraging good listening skills, learning how to be sociable, independence, respect for others and empathy.

1.3. Rationale behind the deployment of IC T in the primary school classroom

The Primary School Curriculum promotes the use of ICT to enhance teaching and learning across the curriculum. The Introduction to the Primary School Curriculum states:

Technological skills are increasingly important for advancement in education, work, and leisure. The curriculum integrates ICT into the teaching and learning process and provides children with opportunities to use modern technology to enhance their learning in all subjects.

(Primary School Curriculum, 1999, p. 29 cited in NCCA 2004)

In the context of the aims of the Primary School Curriculum, ICT is seen as playing a supportive role which offers ‘unique opportunities for learning’ (NCCA 2004).

Information and Communication Technologies (ICT) offer teachers and children educational tools and resources which extend their learning environment. When used to support the aims, principles and objectives of the Primary School Curriculum, these technology tools have the potential to augment and transform classroom learning and teaching.

(NCCA 2004 Chapter 1 Pg 1)

1.4. The desktop computer: a ‘benign’ addition or creative force?

However noteworthy the aims of introducing ICT in the classroom, can the same be said for its actual deployment? Do ICT tools as currently employed in the classroom spark ‘active learning’, ‘collaborative learning’, motivation, curiosity and creativity – fulfilling the vision of the curriculum to ‘prepare each child for further education and lifelong learning’ (NCCA 1999). There is a strong body of consensus which argues that computers in the classroom have

only served to make the established 'traditional' didactic mode of instruction more entrenched. As Cuban notes, the 'technological innovation' that was the computer has become 'reinvented into a benign addition' (2001: 67). The objective of this study, therefore, is to explore the deployment of ICT in the Irish classroom situation, whether it facilitates or hinders the child's learning experience and contributes to his/her overall development as a full human being.

1.5. Biographical Motivation

The motivation for this research stemmed from the researcher's interest in ICT in general and what benefit, if any, it confers in an education setting. As the parent of three pre-school children, the most beneficial type of primary education has become an important consideration for the author. The researcher is keen to explore how the deployment of ICT in the classroom can achieve the objectives of the Primary School Curriculum and the potential benefit it offers in sparking creativity and a love of lifelong learning.

1.6. Research Questions

This study seeks to answer three interrelated research questions - one principal question and two supporting questions. The primary question is:

- Do innovative ways of using ICT in the Irish Primary School classroom spark creativity and love of learning among our children?

To answer this question, it is necessary to establish:

- The kind of learning required to support creativity
- The factors that mediate the degree of creativity

1.7. Definitions

1.7.1. What constitutes Technology in a school setting?

'ICT is often narrowly construed as consisting mainly of desktop computers. However, the range of technologies available now and in the near future provides opportunities for a more radical transformation of teaching and learning relationships and activities than desktop computers alone would provide' Plowman and Stephen (2003). This study looks at the impact of a wide range of technology tools viz. camcorders, digital cameras, whiteboards,

interactive toys among others, to explore their impact on the educational development of children.

Tondeur (2007) provides a useful pointer to categorising computer use in the classroom. Based on his research in Flemish Primary Schools, three types of educational use in primary education could be identified: 'basic computer skills', 'computers as an information tool', and 'computers as a learning tool'. This research will focus on the latter two as they represent the educational uses of computers. In these two categories, computer use is considered a 'general support tool'. This point was borne in mind in framing the research methodology and also in designing the various research questionnaires.

1.7.2. What is meant by effective learning in an ICT context?

This is addressed by Tondeur et al (2007) who defines three levels of ICT competency: The first focuses on supporting the learning process, e.g. 'Computers as a learning tool'. A second cluster encompasses technical competencies, where pupils are able to use the computer, peripheral equipment, the technical system, and software.' According to the Ministry of the Flemish Community, Department of Education (2004), it is preferable to develop these competencies while embedding computer use into subject-related learning activities. A third cluster of competencies contains the social and ethical dimension of the application of ICT (e.g. 'to be able to cope in a responsible manner with the new technology'). Tondeur *et al.* (2006) point out that currently teachers in Flemish primary education principally stress the acquisition of technical ICT skills. ICT competencies focusing on the learning process and social and ethical components reflect lower priority levels". In the Irish Primary School Curriculum, using ICT in teaching and learning may be approached in three ways: 'Learning through ICT', 'Learning with ICT' and 'Learning about ICT' (NCCA 2004). With the exception of 'Learning through ICT' approach, the objectives of each approach are closely aligned with those of the Flemish education system discussed above. 'Learning through ICT' involves teachers and children using ICT to transform the process of teaching and learning, learning in new ways (NCCA 2004). The NCTE provides

support for teachers in 'Learning about ICT' and 'Learning with ICT' through a range of measures. For the purposes of this study, the author considers that the 'Learning through ICT' approach merits greater priority, being a function of higher creativity and more effective learning.

1.8. Chapter Summary

Can new ways of conceptualising ICT spark creativity and love of learning among our children? If so, is the Irish education system well positioned to reap the benefits of our investment in ICT? To begin to answer these and the other research questions, the thesis now looks at the relevant literature and what information/conclusions other researchers have uncovered in relation to approaches to ICT in the classroom to enhance the learning experience for children.

2. Review of the Literature

2.1. Chapter Introduction

This chapter presents the review of the literature section of the thesis. It investigates how much previous research has been done in this area. The studies reviewed here were selected based on their relevance in helping to address the research question: can new ways of conceptualising ICT spark creativity and love of learning among our children? It also identifies the methodological requirements to be adopted. This part of the review helps to furnish ideas for promoting learning in different learning spaces.

2.2. Creativity

2.2.1. What is Creativity?

The notion of Creativity is a complex one. It is a notoriously difficult quality to define and even more difficult to assess.

There is a wide variety of definitions of creativity to be found in the literature. The following definition adapted from Boden (2001:95) incorporates the attributes of novelty, usefulness and value, which are fundamental to many of these:

Creativity is the ability to come up with ideas which are novel and innovative, and which are useful or valuable in some way.

Riley (2004) describes human creativity as being dispersed across many domains and activities and is expressed in a rich variety of modes and mediums. Craft (2000), in devising a framework for creativity incorporating people, processes and domains, attempts to reflect this diversity. Craft's framework attempts to demystify creativity as the preserve of very gifted creators and geniuses, regarding it rather as a 'natural' part of life. His view of creativity is based on the concepts of 'possibility thinking' and 'little c creativity' exhibited by all individuals rather than just by the gifted few.

Creativity is further refined by de Bono (1990) as the result of a process, while creative thinking is described as a process. A result can only be admired, he says, but you can learn to use a process. 'Lateral thinking' is the name de Bono has coined for this approach to creative thinking. In advocating the

implementation of his CoRT programme in the Irish primary school curriculum, de Bono argues that “We need to teach [children] *how* to learn, not *what* to learn”. He believes that teaching of thinking skills should form the basis of all learning. “Teaching thinking skills is like software for the mind” he adds.

2.2.2. Role of ICT in Creativity

In this context, it is useful to explore the role ICT can play in kindling creativity. Access to technology cannot in itself deliver creativity, but it can provide opportunities for interaction, participation and active demonstration, which can help to encourage creativity (Loveless, 2002:15). In addition, technology often provides opportunities to experiment and take risks without the potential for serious outcomes; this makes it less daunting to take risks with totally new ideas (Craft, 1997:11; Loveless, 2002:15).

The following are some of the ways highlighted in the research literature which show how new ways of conceptualizing ICT can kindle the spark of creativity and a love of learning in our children:

- Enriching the learning experience
- Fostering collaboration
- Engendering enthusiasm for learning and discovery

In framing this research, it was decided to focus on the Arts as a medium through which children can express the greatest creativity and which offers the greatest potential to be enhanced by ICT. This is underlined by Cordes and Miller (2000):

“Children are born artists. They are naturally creative — eager to sing, dance, pound rhythmically on tabletops, act out great dramas from their own shared imaginations, and design masterpieces with sand, shells, stones, logs, clay, paint, crayons, or any other material that’s handy. Even as they enjoy the creative process, they are integrating and expanding a wide range of intellectual, emotional, and social skills. Because the arts both enliven and illuminate everything they touch, they provide powerful motivation and

powerful insights for students and teachers. Studies have found, for example, that children have more positive attitudes about school and do better in subjects such as spelling, writing, mathematics, and social studies when their classes include and incorporate the arts”

2.2.3. Theme 1 - Enriching the learning experience

2.2.3.1. Enhancing the Role of Narrative in Learning/Creativity

A narrative can be defined as a particular way of telling a story; the story being a representation of events, people and objects (Mulholland & Collins, 2002).

Narrative is considered by many as a primitive function of human psychology, lying at the heart of human thought. Fusai et al (2003) emphasise the role of narratives in children’s learning processes: ‘Through storytelling, children learn to express themselves and make sense of the external world’. As such it has an important role in learning, and is used in education in a number of ways. According to Gjedde (2004a), teachers often use narrative in order to gain students’ interest and to motivate them. Teachers also use narrative as a means of contextualising learning. The creation of narratives by students is beneficial to the students’ cognitive process of constructing meaning and understanding (Gjedde, 2004a; Mullholland & Collins, 2002). The value of the narrative process as a useful tool of meaning construction is taken up by Bruner (1990). The representation of experience provides a frame, which enables humans to interpret their experiences and one another. As Bruner (1990) points out, developing a narrative competence is for children the privileged and primary way to enter in the culture.

According to Decortis and Rizzo (2002:416) ‘constructing stories is a type of playing that involves mobilising the storyteller’s imagination and finding original ways to convey narrative intentions’. Through story-telling the student can learn to express himself in a creative manner. The creation of a narrative can therefore be considered as a creative design process (Sharples 1999:60).

To enhance the role of narrative in supporting the children’s learning experience, many new computer mediated tools have been developed.

According to Decortis and Rizzo (2002:416), however, few environments satisfy user expectations in the areas of spontaneity, stimulating imagination and interaction with the environment. Both Fusai (2003) and Decortis and Rizzo (2002:416) evaluated POGO, a set of distributed tools that allow children to create stories by connecting their physical and the virtual worlds, and found that the tools supported the social nature of narrative construction and transformed the activity into a creative, productive and stimulating experience. *POGO* aims at supporting the development of young children's narrative competence by providing them with the opportunity to express themselves through different media channels to integrate their physical experience with the virtual world of their imaginations. The system is computer-based but the system is a more intuitive one replacing the standard keyboard, mouse and screen. In so far as possible, the aim is to use an 'invisible computing' approach where children can relate their narrative experience with little or no instruction. According to Fusai (2003), it facilitated a rich sensorial interaction where the physical and affective elements of children's realities were explored, analysed, decomposed and recombined in new and exciting ways.

With significant relevance to this study is the multi-sensorial experience afforded by POGO. Through different media, children could narrate their experience in a multitude of ways. In order to re-create this enriching experience, children and their teachers could explore the potential of various ICT tools common in the classroom e.g. camcorders, music software.

Another key issue to emerge in Fusai's study was the opportunity for 'intersubjectivity' – the ability to enter into another state and to understand other perspectives. This fosters the ability, not alone to empathise with others but, to better understand the context within which the story is placed. This enables greater appreciation of culture and the historical significance of events.

The opportunity to develop or enhance one's emotional language is another key aspect to emerge from POGO. Self-expression facilitates a better understanding of one's feelings and strengths thus boosting self-confidence.

2.2.3.2. Enhancing the Role of Creative writing in Learning/Creativity

“Children want to write” (Graves 1983 cited in Sefton-Green and Sinker 2000).

Sefton-Green discusses children’s natural desire to express themselves creatively through writing in the context of the National Literacy Strategy in the UK. He argues that this creativity has been hitherto sublimated by an induction into the structures of privileged forms. The emphasis is on learning form, structure and technical vocabulary. Spelling, grammar and handwriting are highlighted and foregrounded as the skills to be developed and the product disappears into a tool for the achievement of these aims. Thus the creative process of the production of written texts in English is much more easily seen as a means to an end of producing functionally literate children.

There is a long-held awareness of the importance of allowing children the freedom to choose topics and to express their creativity. However, children have rarely received feedback at school level on the creative content of their work that would assist them in developing an ability to convey their chosen meaning and to reflect on this meaning. This message is echoed by Riley (2004): “Literacy in the form of text construction involves the use of linguistic knowledge and creative processing to generate communicable linguistic constructions with specific outcomes for relevant purposes. In primary phase literacy lessons, the outcomes are determined by learning objectives designed to raise literacy attainment.”

To address this imbalance, many researchers have explored ways in which innovative uses of ICT for literacy can support the creative process.

Vass (2002) looks at collaborative creative writing, which he defines as a ‘metacognitive activity’ to investigate which features of friends’ collaborative dialogue contribute to greater learning efficiency. Using his findings and drawing on contemporary neo-Vygotskian theory, with its focus on learning and development as social processes, Vass hopes to identify a computer tool which supports these collaborative writing activities. “It has been suggested

that creative writing differs from scientific problem solving in the sense that it is an unstructured activity with no fixed goals or clearly specified and ordered stages (Sharples, 1999). It involves both content generation (engagement) and reflection (reviewing, contemplation and planning), and relies on ‘affect-linked thinking’: the ‘*deliberate re-creation of emotional experience in the mind*’ (Sharples, 1996 p. 134).” He elaborates further defining it as ‘the use of language to reflect upon, explore and express one’s own experiences in a unique, imaginative but meaningful way’ (Vass: 109). The main finding from this study was the revelation that ‘the friendship pair’s discourse was described as reflecting more ‘collective thinking’ (a key feature differentiating it from the acquaintance discourse) which was regarded as an advanced form of mutual engagement and the possible key to productive collaboration in the context of creative writing’. This was accompanied by the use of ‘musing and acting out’ – reflecting ‘affect-linked thinking’ described above, a characteristic absent in the acquaintance discourse.

The implications of Vass’s study to this research are twofold:

In order to achieve more effective learning, the ICT systems deployed in the classroom need to facilitate collaborative activity. This corresponds with the discussion/research performed around the area of collaborative skills (see Section 2.7 below). There would appear to be an argument for allowing children to form their own groups when engaging in such activity to maximise the learning experience. This calls for minimal intervention from the teacher who should act merely as a mentor/guide to ensure smooth progress.

It highlights the importance of a vehicle to allow children to express their emotional experience. This point is borne out by the POGO studies discussed earlier. Similarly, the freedom to form their own groups when engaging in such activity needs to be encouraged in a classroom environment. In these situations, children delegate responsibility for the different activities and organise their own turn-taking arrangements.

Riley et al (2004) looks at the effects of ICT-based concept mapping intervention on creativity in literacy tasks. This study refers to creativity as

'little c creativity' in terms of 'processes' involving imagination, creating possibilities that adapt or innovate situations (Kirton 1989), 'seeing' connections and relating things involving 'possibility thinking'. While Riley's small scale study does not provide conclusive evidence for linking concept mapping connectivity with creativity, it does appear to provide a stable framework in which to structure writing and to scaffold information. Riley's study provides evidence to support the introduction of new technologies into educational practice. "ICT-based concept mapping and graphic representational software provide innovative tools through which creative and effective practices that have educative value can be developed."

Another point requiring consideration is the finding that the successful development of innovative uses of ICT for literacy seemed to be linked to greater proficiency in ICT by the literacy coordinator or where the ICT coordinator took responsibility for planning the ICT elements of literacy (Waite 2004). This has implications for the sort of training needed by teachers. Would more creative teaching ideas emanate when the teacher is freed from concerns about 'how' so they can concentrate on 'what'? Responses to the questionnaire in Waite's study did not highlight creativity as encouraged by ICT but he attributes this to the possibility that the skills element of ICT is still dominant. The most powerful impact of ICT revealed by this study was an increase in the motivation of the pupils (87.3% agreeing). Some reported that drill and practice tasks were translated from tedious to desirable activities by using the computer. This finding has important implications for the future development of ICT in teaching as pupil response has been shown to be influential in changing pedagogy.

2.2.3.3. Enhancing the Music Composition and Appreciation Experience

Music is an art form deeply rooted in human nature (NCCA). Its value as a profoundly satisfying area of individual and shared experience, fostering a deep sense of well-being is recognised by the NCCA. Music offers lifelong opportunities for the development of imagination, sensitivity, inventiveness, risk-taking and enjoyment – important attributes in sparking creativity.

According to the NCCA, children of all ages and abilities have potential in music, and music education celebrates individual differences among them. Drawing on Gardner's Multiple Intelligences theory (Gardner 1983), the NCCA acknowledges that each child's musical expression and responses to musical experience are valid, and recognises the importance of fostering and valuing his/her creations and innovations in musical compositions. Musical activity, alone or with others, contributes to the child's developing creativity and self-esteem. It develops the child's creativity and uniqueness by engaging the child's listening and responsive skills, providing an avenue for self-expression through performing and composing activities.

The NCCA acknowledges that the child's understanding and experience of music can be broadened and enriched in various ways through the use of information and communication technologies (ICTs). The music curriculum provides vast opportunities for the development and application of musical concepts and skills through the use of ICT and likewise, many programs that encourage active listening, musical playing and meaningful composing can heighten the relationships between the *Listening and responding*, *Performing* and *Composing* strands of the curriculum. Multimedia technology offers high-tech support for a range of graphic, textual and sound sources which can greatly enhance understanding in music. Through using CD-ROMs or the internet, children have opportunities to see and hear various instruments, especially those which may not be readily accessible for them in their own environment, such as lesser-known orchestral instruments or traditional instruments from other countries. Children can experience the delight of exploring sound through electronic media, acquiring skills and concepts at their own rate, recording their improvisations and compositions, and reviewing their work alone or in collaboration with others.

Hinostroza et al (2002) conducted a study in Chilean schools exploring the impact of ICT on music composition. The project started in 1999 and aimed to foster students' creativity and allowed students, especially those who had a 'limited musical ability', to explore and/or investigate the music composition process. Due to the lack of real musical instruments available at the school, the

teacher decided to use a piece of software with which the students composed music. During the lesson the teacher supported the students' work, teaching them about music theory and solving technical problems with the software. She worked with each student individually and promoted a horizontal teacher-student relationship. Students were free to work, not only during the lesson, but also at home or at any other place where computers were available. At the end of the project, students produced a CD with the piece of music produced.

The main innovative characteristics of this project which are of relevance to this study are:

- the teacher changed her traditional role and organised activities in the classroom that allowed the free circulation of students promoting a horizontal teacher/student relationship. In this role, the teacher is seen more as a facilitator;
- the project enabled students to take more responsibility for their own learning, insofar as the use of ICT tools created the conditions for independent learning and autonomy.

2.2.4. Theme 2 – Fostering Collaboration

Collaboration and co-operation play a key role in shaping one's personal development, socialisation and integration in one's own culture. This is underlined by Kolakowski: "Our inner integration is the result of consorting with others, of trust and friendship; it is not the result of the self-focused, monadically isolated void of the ego." (Kolakowski 1990 cited in Hall 2004).

A number of studies have been performed exploring the impact on creativity when children are collaboratively engaged with their peers and significant others in various ICT settings. These studies draw heavily upon the works of Vygotsky (1962) which view human learning and development as fundamentally social processes, embedded in the immediate and wider context and mediated by cultural tools and artefacts. Staying with Vygotsky, a common thread running through these studies is the relevance attached to the children's Zone of Proximal Development (their ZOPD/ZPD), which he first coined. Brown (1992) describes ZPD as "a learning region that learners can

navigate with aid from a supporting context . . . [and] defines the distance between current levels of comprehension and levels that can be accomplished in collaboration with other people or powerful artefacts”. According to this theory, a child performs at a higher developmental level of abstraction and performance with a knowledgeable and skilled partner than she would achieve independently (Ryokai 2003).

Studies by Scott et al (2003) ‘focused on understanding children’s interactions when engaged in synchronous collaborative activities in a variety of collaborative settings’ with a view to providing insights into designing flexible software and hardware that facilitates ‘face-to-face collaboration’ among students. Scott emphasises that ‘Face-to-face collaboration with classmates or friends is an important part of children’s daily lives’. An analysis of these findings produces interesting results of particular relevance to this study:

It revealed that children exhibited significantly greater physical engagement both with the game and with each other in the paper-based exercise relative to the computer-based sessions. Scott concludes that ‘this lack of physical engagement may impact on the overall effectiveness of the collaboration, through decreased user performance, motivation, and naturalness of interactions’ This point is also borne out by Fusai et al (2003) who describes how: “the desktop computer metaphor can be a barrier for learning. Students are constrained to a screen, their movements are restricted to mouse clicks, and sensorial interaction is restricted to passive visual and auditory stimulation” (2003: 178). This has implications for the suitability of the desk-top computer as it is currently used in the classroom to foster learning. Scott et al propose extending ‘existing technological infrastructure in schools (mainly personal computers)’ to enable multiple children to interact with the computer. They propose the use of ‘peripheral devices such as styli, joysticks and mice’ to achieve greater co-operation and collaboration

Another key issue to emerge is the children’s preference for collaborative activity of any type – paper-based or computer-based – as opposed to working on their own. Scott et al have shown that ‘children enjoy working on

technology that supports cooperative activities. Additionally, their study asserts that collaborative technology can foster social interactions, such as increasing assistance between collaborative partners (Stewart *et al.*, 1998), which have been shown to provide positive academic and social benefits (Johnson *et al.*, 1981; Hymel *et al.*, 1993).’ They conclude that ‘this emphasises the need for more flexible technology that can support a variety of activities, without hindering the human–human interaction that is essential for any collaborative activity’.

The importance of “structuring collaborative learning experiences” is recognised by Druin et al (2003). This study explored ‘shared navigation... within the framework of a digital library interface for children’. Children’s behaviour using software, called Searchkids, was analysed. This study shows that different interfaces may be more appropriate in supporting different aspects of children’s collaboration experience. For educators, it is critical that they understand that there are trade-offs in what different technologies can support. The learning outcomes they are striving for should dictate what technologies are appropriate for use in the classroom. In regard to designing new collaborative technologies for children, it appears that interfaces that enforce collaboration may only be supportive of some learning experiences. On the other hand, non–enforced collaborative interfaces may better be able to support the process of collaboration, but not necessarily the outcomes. Druin et al suggest that this may mean that technologies, that have options for both conditions of collaboration in a classroom, need to be designed. .

Stanton et al (2003) explored children’s talk and interaction via KidPad, a collaborative authoring tool designed for children along the lines advocated by Druin et al – focussed on process, not on product. They are used to highlight “collaborative patterns of behaviour such as symmetry of ideas, equity of control and action, parallel or co-operative work as well as reciprocity and elaboration of ideas” (Stanton et al :232). Previous studies into the use of multiple input devices with paired users have highlighted reduced task completion times (Inkpen *et al.*, 1999) and increased frequency of interactions between partners (Stewart *et al.*, 1998). However, the nature of collaborative

interaction is important in determining if the collaboration will be beneficial to the learning process. In particular, previous research has highlighted certain types of 'educationally important' talk (Wegerif & Scrimshaw, 1997) and suggested that co-construction of ideas, and repairs following misunderstandings, indicate highly productive collaborative interaction. Collaboration in this context involves children helping each other to interpret meanings and to fix misconceptions.

With significant relevance to this study is the quality of the interaction leading to enhanced learning experience and effectiveness. This has implications for the type of interaction with ICT tools promoted/set up by the teacher. Scaffolding is a term coined by Wood *et al.* (1976) from the ideas of Vygotsky (1978; 1986) to account for how a more knowledgeable partner can assist the cognitive development of a less able one, and gradually foster the development of successful independent task performance. The work of Vygotsky places emphasis upon interaction between a learner and her environment. The development of the individual is the result of her internalisation of this interaction: the relationship between development and learning was the object of Vygotsky's attention when he proposed the Zone of Proximal Development (ZPD) as the essential 'ingredient' in effective instruction (Vygotsky 1986). A fundamentally important feature of the ZPD is the necessity for collaboration or assistance from another more able partner. The need for this more able learning partner arises from the belief that the activities that form a part of the child's education must be beyond the range of her independent ability. Teachers are able to fulfil the sort of collaborative partnership role envisaged within this theory (Plowman *et al.*, 1999).

Another interesting aspect of collaboration is the way in which it provides participants with more than one viewpoint on the nature of the creative process. In this context, collaboration provides opportunities for more ambitious creative projects (Edmonds and Candy 2002).

2.2.5. Theme 3 – Engendering Enthusiasm for Learning and Discovery

The foundation for the Irish Primary School curriculum is built on a number of learning principles, chief among them being the child's sense of wonder and natural curiosity at the complexity of the world (NCCA 2004). Properly cultivated and fostered, this natural curiosity is a powerful motivational force for the child's learning, engendering in him/her a lifelong love of learning.

An important factor in engendering enthusiasm for learning is the degree of active engagement a child exercises in his/her learning process. Seymour Papert, who was inspired by his earlier experiences as a researcher in Piaget's laboratory, argued that children should be viewed as active builders of their own intellectual structures with materials drawn from the surrounding culture and experience (Papert 1983). Echoing Papert's findings, Wheeler (2002) asserts that 'The skill of teaching to foster creativity has to be a combination of structured and unstructured activities to enable unconscious as well as conscious thought and where intuitive reasoning is as valued as rational calculation. There is a fine balance between freedom and control. In all of this, motivation is a key factor for stimulating creative performance and the notion of self-directed learning is crucial to the development of the independent thinker. Encouraging children to think about their own thinking (metacognition) can enhance the learning process and teaching children to foster creativity encourages a responsibility for learning''.

According to Plowman and Stephen (2003), 'new ways of conceptualising ICT ...can encompass participation by practitioners, parents and children in different learning spaces and promote discovery, delight, curiosity, creativity, self-expression and pleasure in learning'. When exploring new technology, children need to experience enjoyment from their computer interactions in order to continue investigating the possibilities of that technology (Inkpen 1997 cited in Scott 2003). Various ICT tools, such as camcorders, digital cameras and mobile technology which facilitate media production, build on the notion of learning through doing, and according to Sefton-Green (1999), this can be

said to account for much of the excitement and enthusiasm of participants in such work.

Through ICT, the balance of power in the classroom tilts in favour of the student. Nevertheless the role of the teacher is still an important one. Goodison (2002) acknowledges this: ‘With increased use of technology, we are already finding that teaching and learning becomes a far more collaborative process with adults and children being engaged in both. . . Schools will become much more of a whole learning community. Children will be able to lead and direct the learning with the support of their teachers and other children, they will feel much more in control of the learning and therefore more enthusiastic’. The success of this new order depends on the enthusiasm of the child. “It is essential for students to display curiosity and love of learning. When that curiosity and learning occur, teachers glow” (Cordes & Miller 2000).

2.3. Important Factors for Creativity

The degree of creativity is mediated by such factors as the child’s self-confidence, his/her motivation for learning, the source of his/her inspiration and whether he enjoys the experience. Conversely, this creativity can be stymied by premature judgemental feedback from teachers/parents, fear of failure and lack of self-confidence in expressing one’s thoughts.

2.3.1. Confidence in Learning

For the purposes of this research, confidence in learning is expressed as a child’s belief in their own abilities and their own identity as active, competent learners. It will prepare them to relate later to more advanced concepts with the same self-confidence and sense of personal competence that they developed using simpler tools (Cordes and Miller 2000).

If you’ve had the experience of binding a book, knitting a sock, playing a recorder, then you feel that you can build a rocket ship— or learn a software program you’ve never touched. It’s not bravado, just a quiet confidence. There is nothing you can’t do. Why couldn’t you? Why couldn’t anybody?

(Peter Nitze: Fool’s Gold)

Armed with this self-confidence, the child demonstrates ‘productive failure’ (Vygotsky 1962) to explore the various possibilities to participate and succeed in seeing a task through to completion. The theory of “Productive Failure”, espoused by Vygotsky, refers to the child’s ability to treat mistakes and misconceptions as learning experiences, fuelling his desire to persevere and to apply his new knowledge to the task.

2.3.2. Motivation in learning

Motivation is a key factor for stimulating creative performance (Wheeler 2002). Amabile et al (1998) refine this further, stating that “Intrinsic motivation, the motivation to engage in an activity for its own sake, is conducive to higher creativity”. Using a maze with several exits as an experiment, Amabile et al concluded that individuals, who are motivated by their feelings of interest, involvement, enjoyment, curiosity, satisfaction, or positive challenge in the problem, will actually explore the maze to find the less obvious exits. These individuals are not simply interested in exiting the maze, because the very exploration of the maze provides them with pleasure. Additional prospecting in the maze, or additional involvement in the task, is more likely to yield the payoff of higher creativity.

We saw earlier that the child’s natural sense of wonder at the complexity of the world is a powerful motivation for their learning (section 2.2.5). Motivation is crucial for productive learning activity to occur (Leontiev 1978 cited in Hall 2004). The empowering effect of motivation is considered by Hinostroza et al (2002) which notes that children became much more motivated learners through the innovative use of ICT in the classroom and the teachers themselves also became more motivated as a result. In this study, the teacher used ICT as a lever to change students’ perception of the subject in order to make it more ‘attractive’.

Learning without motivation is akin to running a race without a goal. It is only through achieving our goal/objective that we can savour the fruits of our efforts. This sense of achievement invigorates us, driving us to scale even greater heights in our next endeavour. Similarly with learning, the quest for

knowledge is translated into self-directed goals pertaining to new challenges. With the teacher's assistance, the child is challenged to experiment, to explore, to engage in a multi-sensorial way with the subject with the objective of revealing latent talent, interest or creativity.

2.3.3. Inspired learning

In the context of this research, inspiration or a love of learning refers to the inherent enthusiasm for learning that manifests itself as an insatiable quest for knowledge. The child asks questions, is curious, soaks up information. Using tools acquired in the classroom setting, he/she conducts further research to explore the topic that stimulates his/her interest and curiosity in greater depth. The child is inspired to learn by the enthusiasm of a teacher they respect - the teacher's enthusiasm, that is, for both the students themselves and the world the teacher is introducing to them (Cordes & Miller 2000). Such is the love for learning he/she engenders, the child sees it as a fun and enjoyable experience.

2.3.4. Enjoyment of learning

Enjoyment of learning is the common thread running through the three factors hitherto discussed. To foster a lifelong love of learning and higher creativity, the experience must be pleasurable for children, an experience that they would enjoy and remember; as Gardner notes, "creative solutions to problems occur more often when individuals engage in an activity for its sheer pleasure than when they do so for possible external rewards." (1993: 25).

2.4. Quality of learning

"Vygotsky defined the zone of proximal development as 'the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers' (Vygotsky, 1978; p. 86). According to this theory, a child performs at a higher developmental level of abstraction and performance with a knowledgeable and skilled partner than she would achieve independently." (Ryokai 196) This does not render peer interaction any less important than adult interaction. "Peers offer a unique learning opportunity for children that adults may not. While parents and teachers may not always be available to listen to children's

everyday stories, peers are available and also scaffold their equal-status partners” (Ryokai 197). In interacting with their peers, the child is given “a forum to explain and clarify *what they mean*”. According to Daiute *et al.* (1993), through these explanations, children linguistically externalise their thoughts and ideas for their peers, which is key to producing audience-based language. Thus, the social nature of the interaction around literacy learning is just as important as the absolute expertise of any partner.”

An important aspect gleaned from this study of relevance to this thesis is the evidence that ‘there seems to be an advantage in making technology play a more social role in supporting children’s learning. In literacy learning, such social interactions are important as they provide opportunities for children to gain knowledge about language and communication, and also to test their knowledge of language.’ (Ryokai:198) This is premised on the children’s performance in playing the dual role of tutor and learner.

Another useful perspective with which to explore the role of computers as “*participants* in collaborative learning” is discussed. “This work contributes to the field of computer-assisted learning as it illustrates how computers could play a more social role in supporting young children’s literacy learning by both scaffolding and reproducing social learning environments.”

The importance of building on the strengths of each individual also needs to be emphasised. This is essential if we are to cultivate a strong population of engineers and inventors to address the pressing issues of environment, climate change and energy efficiency. James Dyson criticises our education system in failing to attract sufficient numbers of graduates in engineering, maths and physical science. Instead they are picking arts, business and social sciences as career choices, the staples of a service economy (Weckler 2008).

2.5. Chapter summary

The review of literature helped to answer aspects of each of the research questions posed in this study.

Firstly it illustrated how ICT could be deployed effectively in the classroom to enhance children's creativity, interaction and learning.

Furthermore, it also helped to clarify contributing factors promoting greater creativity in our children.

Finally, the review identified important methodological requirements which would need to be addressed in any research approaches adopted. As the next chapter shows, these considerations were taken into account in developing the research methods for this study.

3. Research Methodology

3.1. Chapter Introduction

This chapter describes the research method chosen for this project. It describes the reasons for selecting the comparative study approach and discusses the benefits and limitations of this method with regard to the project. It also describes the data collection tools employed during the project.

3.2. Comparative Study Research Method

The comparative study approach was decided as a research method for this project because the intention of the project was to test the hypothesis of the research in contrasting settings. This method provides an opportunity to explore an idea or a theory in terms of real people in a real life setting where students will behave as they normally would in the given situation.

The comparative study approach has the drawback that it is not possible to establish generalisations with regard to the wider field. However, the researcher attempts to generalise findings back to theory, since the theories may, through further research, be generalised and expanded.

This small-scale study pitches a primary school equipped with the latest technology and its own computer lab (the **Experimental** school) against its counterpart at the other end of the ICT spectrum (the **Control** school). Both schools are governed by the Irish Department of Education and Science. Despite the existence of common ICT standards as set out by NCCA and NCTE (National Centre for Technology in Education), there are still significant differences in the way in which ICT is configured and used in both schools, differences which may have some far-reaching effects on teacher and pupil perceptions towards learning with ICT. The study uses multi-method triangulation (students, their teachers and parents) involving questionnaires, focus groups, interviews and class exercises to capture the multi-faceted aspect of this thesis.

3.2.1. Scope of Study

This study was conducted over a four month period during which the researcher performed a number of comparative exercises in the Experimental school and Control School. The children from 4th, 5th and 6th classes in both schools were involved in the various exercises. Ranging in age from 10 to 13 years, these children, according to Piaget (1973), typically display more abstract cogitative awareness and are thus ideally placed to make a meaningful contribution to this research.

The empirical evidence collected needs to be interpreted in the context of the 'point-in-time' nature of the various exercises conducted. In view of the limited timeframe for the research (most of which coincided with the school summer holidays), it was not possible to conduct a longitudinal study to counteract the effects of temporary factors which could possibly impinge on the outcomes of the exercises performed.

3.2.2. Profile of the 'Experimental' School

The 'Experimental' School is a large urban school with a complement of 25 classroom teachers, 12 support teachers and the Principal. The school caters for 600 children and is proud of its cultural diversity incorporating 40 nationalities. This school could be considered representative of high provision and usage of ICT by virtue of its dedicated computer room, equipped with 17 networked computers, all with broadband access to the Internet and of the high priority given to ICT. Furthermore, there are an additional 21 standalone computers located in the classrooms. With two permanent IT postholders on its staff charged with the school's IT strategy, this ensures that IT facilities are constantly upgraded and the latest technology is made available to enhance the learning environment. These include digital cameras, digital projector, scanners, printers and interactive whiteboards. All classes from first to sixth are timetabled for one hour per week in the computer room, with the standalone computers in the classroom available for use at the teacher's discretion.

3.2.3. Profile of ‘Control’ School

At the other end of the ICT spectrum is the ‘Control’ School. A small rural school, it has just 60 pupils under the instruction of 3 permanent teachers (including one acting principal) with the assistance of 3 support teachers. The school has just 4 standalone computers, one in each classroom and one in the office with no dedicated IT staff or computer room. Just two of these computers have broadband access – the computer in the senior room and the office computer. Children’s interaction with ICT is ad-hoc, at the teacher’s discretion. This school is representative of the low (very few computers and reported low priority given to ICT) provision of ICT.

3.3. Sampling

The size of the whole sample (in both schools) was 85 pupils – 22 from the Control School and 63 from the Experimental School. The Control School comprised 9 pupils from 4th Class (children aged 10), 10 from 5th Class (children aged 11) and 3 from 6th Class (children aged 12). In the case of the experimental school, 23 pupils were selected from 4th Class (children aged 10), 24 from 5th Class (children aged 11) and 16 from 6th Class (children aged 12).

It would have been preferable to involve 6th Class pupils (children aged 12) from the Experimental group in the Class Exercise but the date of the exercise coincided with their preparations for SATS (Standard Assessment Tests). Nevertheless, this should not significantly affect the validity of the Class exercise as the preparation for SATS meant that the pupils’ interaction with ICT facilities was severely curtailed during their final year in Primary school.

Teachers were asked to ensure that the sexes were equally represented and that the ethnic mix of the sample matched that of the class as a whole. While the gender mix was evenly balanced in the sample size, an interesting observation was the 8 different nationalities in the Experimental group, representing 20% of the school population. The Control group did not have any such influence.

Where a choice was possible, a child with good verbal communication skills was to be preferred, for obvious reasons, to one with less good communication skills.

It was also felt worthwhile to profile their parents to try and gauge their influences and to place the children's views in a broader perspective. Out of a sample size of 19 parents for the Control School, 18 provided feedback. For the Experimental Group, 29 feedback forms were received from a sample size of 62 parents.

To complete the triangulation process, the views of teachers on ICT and learning were also sought. The 4th, 5th and 6th classes in the Control Group have the same teacher but to provide more insightful information, a second teacher, the Learning Support assistant, volunteered to offer her perspective. Three feedback forms were received from the Experimental Group, one per class profiled.

3.4. Data Collection Tools

For this research both qualitative data and quantitative data was used.

Qualitative data was collected in a variety of ways:

- Participant observations and discussions recorded by the author during or after each exercise
- Output from each exercise – e.g. images, documents, music and drama clips created during the process

Quantitative data was collected in the following ways:

- Questionnaires from 3 sources: Students (see Appendix E), their parents (see Appendix C) and their teachers (see Appendix D)
- Analysis of the Creative writing exercise for evidence of the key themes

According to NACCCE (1999), creative abilities are developed through practical applications; by being engaged in the processes of creative thought production: by making music, creating and writing stories, conducting experiments etc. All of these activities can be classified as being within the Arts. For this reason, it was decided to focus on these activities as a way of analyzing creative activity.

3.4.1. Focus Groups

The purpose of the focus groups was to elicit the children's views about the role of ICT in their learning environment. They were not aware that the focus of the research was on perceptions of learning.

A group interview format was selected instead of a one-to-one interview. Each group comprised two children, selected for their ability to communicate and for their familiarity with the topic.

For the Control School, there were 2 focus groups:

- (a) The first group focused on a drama exercise, 'The Brown Bull of Cooley', a famous legend in Irish mythology, which was rehearsed and enacted by all the 4th, 5th and 6th class pupils. While ICT tools were not utilised in its production, the benefit of this group exercise to this research as a vehicle for self-expression and as a multi-sensorial activity rendered it a worthwhile analytical activity.
- (b) The second group were asked for their views on the 'Write A Book' project which involved each child in a creative writing exercise which he/she subsequently typed up on their home PCs (or school PC where appropriate) and embellished with relevant images. It provided a useful means of gauging creativity while simultaneously chronicling the influence of the ICT component of the exercise.

In both instances, the focus groups were asked to compare the drama exercise with the 'Write A Book' exercise.

The Experimental School was subjected to similarly themed exercises:

- (a) The first focus group discussed their experiences with two pieces of novel music technology – Wavepad and EJay – learned during their weekly ICT class. This exercise required the students to work in pairs and engaged the children’s creativity, and also their senses in composing their own piece of music and in experiencing different sound effects.
- (b) The second group focused on the ‘Write A Poem’ project where each child composed a poem individually which was subsequently typed up on the school PCs and embellished with relevant images. This exercise sought to examine creativity and the influence played by ICT.

As for the Control school, each group was asked to compare the ‘Write A Poem’ project with the music technology exercise.

Within the general discourse between interviewee and interviewer, there were 7 specific questions based on the themes of this research and the same ones were used for each focus group. Each interview lasted between 20 and 25 minutes.

	Question	Purpose
1	What did you learn from the experience?	An indicator of confidence in learning
2	Did you enjoy the experience?	Tests for enjoyment of learning
3	Is this something you would like to try out at home?	experience/opportunity to express oneself creatively Provides insights into degree of motivation/inspired learning
4	How would you compare each exercise?	An indicator of preferences and type of activity
5	Which one did you prefer and why?	Probes reflective and analytical ability
6	What tools did you use? Easy or hard to use?	Aims to identify positive/negative experiences
7	Did you get to express yourself?	Invites children to discuss their creativity

Table 3.1 Interview Questions

It was decided that the class teacher in each case would conduct the interviews rather than the researcher, who would act as ‘technician and observer’ instead (Goodison 2002). This was to take cognisance of the richly textured set of shared experiences that teachers and their students build up as they use ICT within the classroom, experiences, according to Goodison, that are needed to achieve any degree of understanding of the processes at work in ICT

integration. In order to capture the richness of this shared experience, it was decided to record conversations between teacher and pupils as they recalled and reflected on their work together. The teacher, in this approach, becomes the medium for eliciting and elucidating evidence of the children's experiences, by structuring the conversations appropriately, on the basis of the interview template provided by the researcher, and interpreting any utterances which could be obscure to an observer (Goodison 2002).

Goodison identifies two problems with this approach. Firstly, a teacher, anxious to present him/herself as a competent professional and user of ICT in the classroom, might be tempted to use the interviews to showcase his/her teaching skills. The format of the interview, however, provides few opportunities for this type of scenario. On the one hand, the focus is squarely on the children, not the teacher, and, on the other hand, the presence of the researcher would discourage any radical departure from the agreed format. In addition, neither the teacher nor the pupils were aware that the focus of the research was on perceptions of learning. As far as both parties were concerned, the goal of the exercise was simply to collect children's views about using ICT tools. The second problem was that, in this situation, one cannot be sure to what extent the children recognise their intended meaning in the teacher's construction of the topic. Fortunately, these methodological issues did not detract from the value that the teachers themselves placed on the data. They saw the exercise as valuable and revealing, providing useful pointers for the future direction of their teaching. So whilst there are, inevitably, issues surrounding the reliability of the testimony provided, the interviews had validity in the eyes of teaching staff.

3.4.2. Questionnaires

As with the focus groups, it was decided that the class teacher in each case would guide the children in completing the questionnaires rather than the researcher, who would be available in an 'observer' capacity, clarifying any issues. The detached and regimented nature of this research method was softened by the teacher's approach who facilitated the interpretation of the

various questions in the children's language. This quantitative technique sought to capture the children's use of ICT both at home and in the classroom setting and their perceptions of learning (APPENDIX E).

The researcher identifies two problems with this approach. Firstly, a child is restricted in his/her natural desire to express his feelings and thoughts on various topics. The format of the questionnaire provides little opportunity for this expression, consisting mainly of checkboxes and multiple-choice areas. Where free-form feedback was required, children were restricted to 2-3 lines. These open-ended questions invited children to give their personal views on a wide range of topics viz. future aspirations, hobbies, TV preferences, personal likes/dislikes and issues that concern them.

Nevertheless, this methodological method provided valuable insights into the children's exposure to ICT, providing a level playing field for comparison purposes across both schools.

As part of the triangulation process, the parents of the children concerned were also invited to complete a questionnaire probing their views on ICT in their child's classroom (APPENDIX C). This was balanced by similar input from the teachers concerned (APPENDIX D).

3.4.3. Class Exercise

Children were given a creative writing exercise 'How I envisage my life in 2020'. This was given in the researcher's absence and timetabled during normal classroom activity to eliminate the possibility of bias or skew of ideas. A standard approach was adapted to ensure consistency, and to facilitate comparison across schools. Pupils were given 30 minutes to write their thoughts on the topic with the option of drawing a picture to support their output. Furthermore, the teacher was guided not to provide any suggestions in completing the exercise.

The objective of this exercise was twofold: to assess the children's creative strengths and the influences shaping their concerns and hopes for the future.

The researcher identified 2 problems with this approach: as a vehicle for self-expression, it favoured those pupils comfortable with creative writing and having a fluent writing style. On the other hand, creativity is one of the central themes of this paper. That, in itself, provides a useful barometer for comparison purposes between schools. The other difficulty with this research method is that the children, anxious not to be 'shown up', will endeavour to express ideas that are 'cool' or aligned to those of their peers. Nevertheless, this exercise provided an invaluable insight into the children's concerns, their hopes and their dreams.

3.5. Chapter Summary

This section discussed the comparative study based approach as the research method for this project. It sought to investigate children's experience of learning and using ICT in the classroom. The analysis of observations and feedback of children's interactions centres on examining the key themes identified in the literature review, namely their creativity; engagement; motivation and confidence and in identifying whether new ways of conceptualising ICT spark creativity and love of learning among our children.

In developing the research methods, the researcher took cognisance of the theories in the literature review and sought to use tools/methods that would enable children to freely express their creativity, confidence and love of learning. These methods of data collection were described, the conditions under which they took place outlined and their advantages and disadvantages in the context of this research discussed.

4. Findings

4.1. Chapter Introduction

This chapter evaluates the data collected for the purpose of confirming the hypothesis that children engaged in using technology in innovative ways demonstrate greater creativity, collaboration and enthusiasm for learning. Using the control group as a baseline, several analytical methods were engaged to compare the experimental group under these headings. The chapter concludes with a summary of the key findings of the evaluation.

4.2. Research Objectives

A large body of data was collected. In the following sections, the thesis will discuss the issues that emerged in the analysis of this data that impact positively on creativity and love of learning.

The objective of this research was to investigate evidence of ‘higher’ creativity and enthusiasm for learning sparked by innovative use of ICT in the classroom.

In evaluating the outcome of the analysis with regard to this objective, the following question was investigated:

- Did the experimental group demonstrate greater creativity than the control group throughout the various exercises?

4.3. Key Findings

The Literature Review section identified the following ways in which innovative use of ICT in the classroom can spark creativity and love of learning:

- Enriching the learning experience
- Fostering collaboration
- Engendering enthusiasm for learning and discovery

Evaluating the research data with respect to these themes yielded the following findings:

Creativity

- While both groups demonstrated considerable creativity throughout the various analytical exercises, what emerged from this experiment was the importance of allowing children to express their creativity in different ways. In the class exercise, the Control Group outscored the Experimental Group in the creativity stakes. A deeper analysis, however, revealed that the Experimental group enjoyed expressing their creativity in more challenging ways (through ICT) and were more confident in doing so.
- The Experimental Group availed of the multi-sensorial opportunities offered by various ICT tools to enrich their learning experience.
- The Experimental group demonstrated great ability in analysing the relative merits of various ICT tools
- The Experimental group enjoyed expressing their creativity through more complex ICT tools.
- ICT has played a significant role in fostering greater self-confidence in both groups. The Experimental group, with its greater ICT proficiency, shows a desire to achieve greater control over their learning thus fostering independence in learning

Collaboration

- In the class exercise, the experimental group demonstrated the effects of collaboration through ICT activities. This suggests that the experimental group have developed closer working relationships in the classroom facilitated by ICT. The Control environment does not afford this collaboration where class exercises, in general, are undertaken as an individual exercise.
- Both groups highlight the importance of having fun with their friends during the learning experience. This had important bearing on learning effectiveness and enthusiasm.
- The Experimental group engaged in more productive collaborative engagement throughout the various ICT exercises

- The teacher has an important role to play in structuring ICT activities to ensure effective learning and greater independence in learning

Enthusiasm for learning

- There was a good deal of evidence from both groups to demonstrate enthusiasm for learning. Various motivating factors were given by the children in their reflections on a given experiment.
- Active engagement by the child in his/her learning experience is an essential ingredient of enthusiasm for learning.
- It is also clear from the observations that fun and enjoyment in the learning process are highly valued by the children and have a positive role in learning outcomes.

5. Discussion

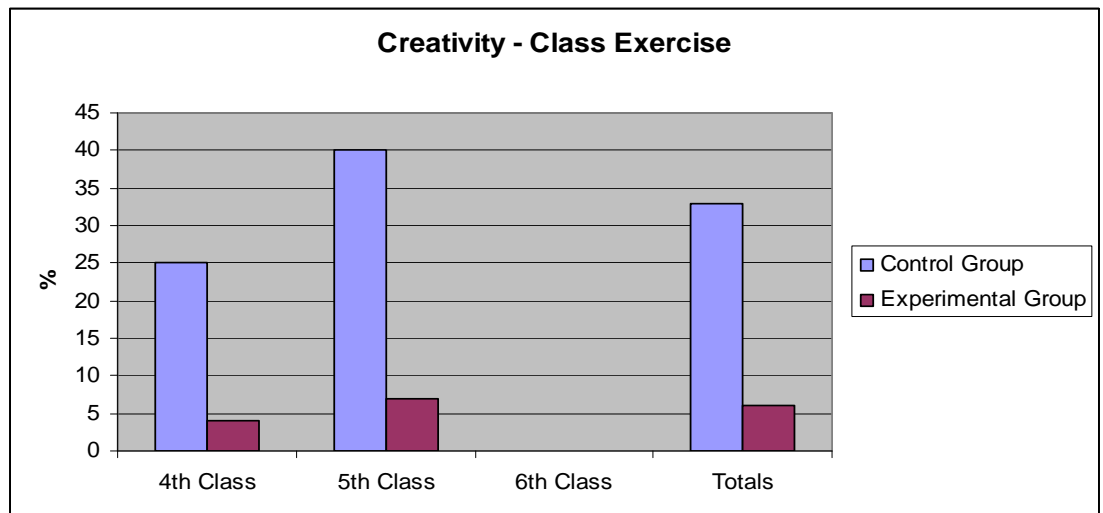
5.1. Enriching the learning experience:

From the literature review, ICT can play a significant role in fostering higher creativity in the following ways:

- It offers a multi-sensorial experience (Fusai, 2003; Decortis and Rizzo, 2002)
- It facilitates intersubjectivity (Fusai, 2003)
- Provides a vehicle for expressing emotional experience (Fusai 2003; Vass 2002)
- It promotes independence in learning (Hinostroza et al 2002)
- It puts the student centre-stage with the teacher as a facilitator (Hinostroza et al 2002)

Starting with the creative writing exercise, a number of interesting findings were revealed:

- The Class Exercise provided a useful indicator of the preferred mode of creative expression. It was the favoured vehicle of the Control Group which demonstrated greater confidence in expressing themselves creatively and imaginatively.



Graph 5.1 Creativity

This can be gauged from the average length of the output at 1 page for the Control group whereas the Experimental group struggled to provide half a page. The Control Group performs weekly creative writing exercises which

probably explains this edge over the Experimental Group. Evidence of this skill in the Control Group is further demonstrated in the writing style of the pupils. The example below is a case in point where one student ditches the common 'fact' version of her life in 2020 in favour of a more story-orientated approach:

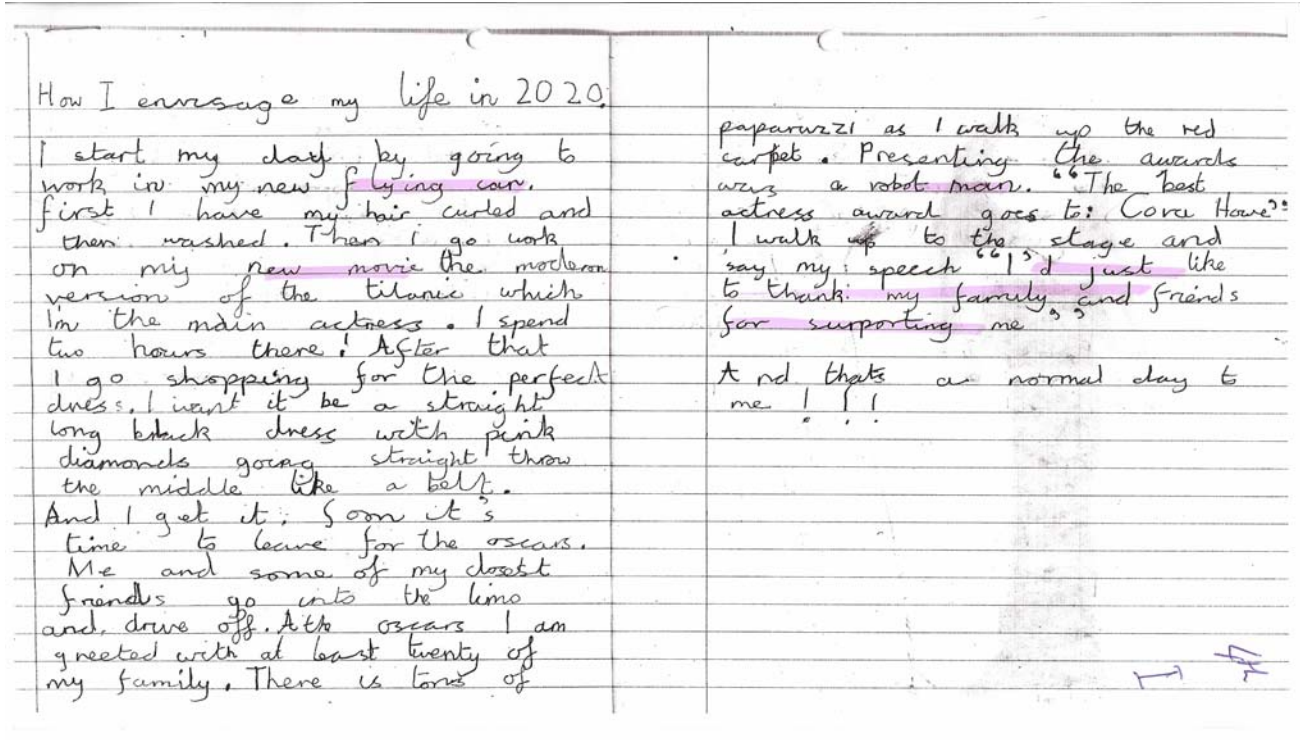
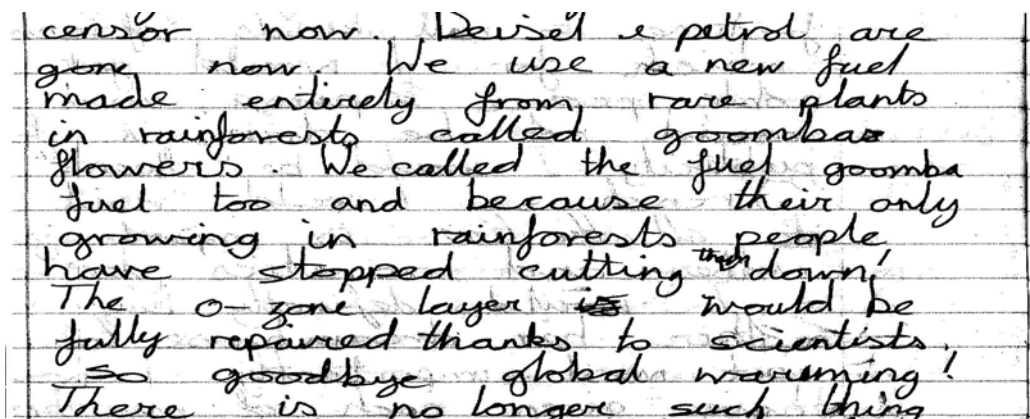


Figure 5.1 Creative Writing 4th Class student, Control Group

- Another interesting insight was provided by both groups in their ability to engage in 'Possibility thinking' (Riley et al 2004) to identify and recognise problems facing the world around them. They showed a keen interest in tackling the problems themselves by devising unique solutions and in analysing its impact as the example below shows:



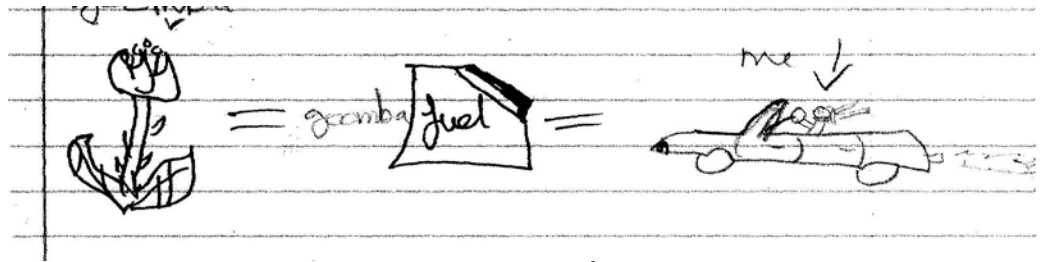


Figure 5.2 Creative Writing 5th Class student, Control Group

Evidence of higher creativity is clearly demonstrated in this extract:

One pupil in the experimental group came up with this original idea in his class exercise – the Thoughtometer:

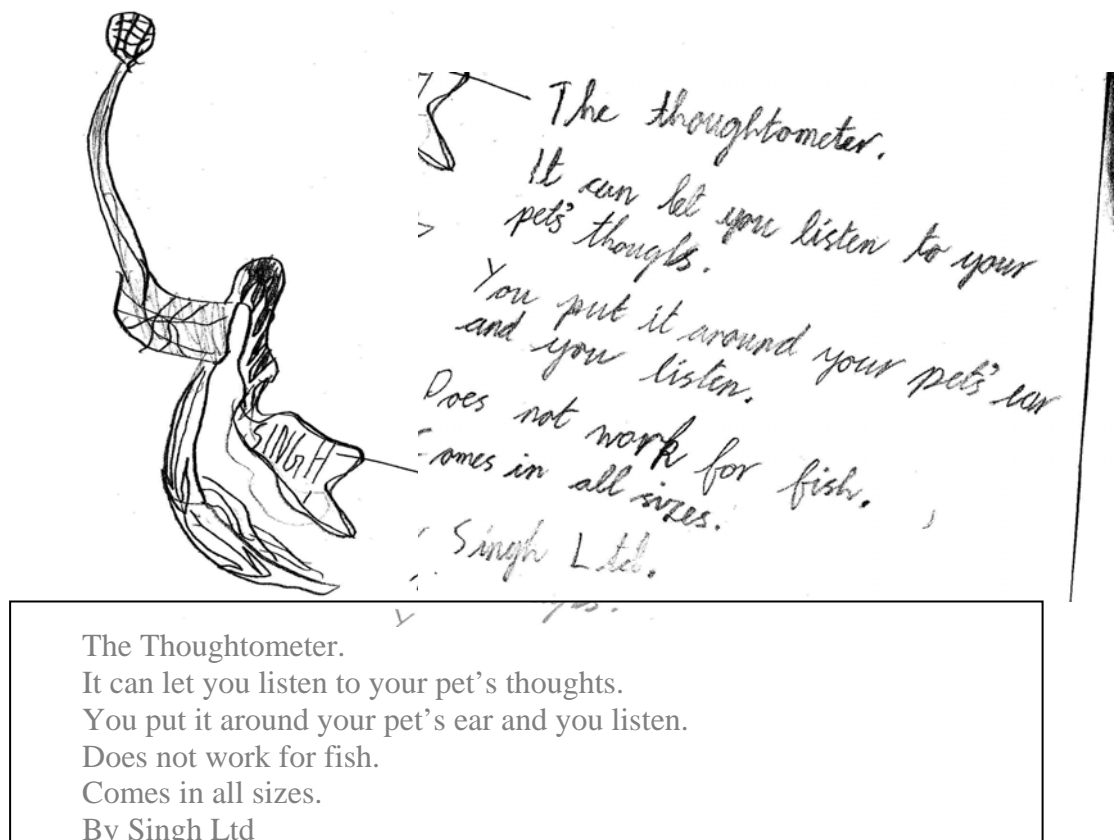


Figure 5.3 Creative Writing 4th Class Student, Experimental Group)

He demonstrated all attributes of creativity in devising a unique solution to a problem (to decipher his pet's thoughts) and showed great confidence in expressing himself creatively both graphically and in writing. He demonstrated intersubjectivity through his ability to discuss the workings, merits and limitations of his invention and put his own individual stamp on his idea ('Singh Ltd').

- Another aspect of collaboration, the willingness to help others, comes to the fore during the class exercise. This student shows a high degree of consideration for her family members, even at her own expense!:

clothes and cosmetics' for me. I would definitely buy my mother her dreamhouse too, but most importantly I would have given each of my brothers and sisters a small fortune to help their dreams come true too! Which by then I'll probably be broke so I'll have to just live off the dole!!

Figure 5.4 Creative Writing 5th Class Student, Control Group

These sentiments are also shared by the Experimental Group as in the following example:

My life in 2020
Yipee its 2020 ill be twenty three I will hopefully be in College in Dublin Because I want to be teacher I will probably be living in dublin I'd say more people would care more for the environment And all my friends will be 23 and they may be in college or have jobs I would like to have a nice car and house I hope my friends are doing well And I can't wait until 2020.

Figure 5.5 Creative Writing 5th Class Student, Experimental Group

- One of the interesting features to emerge from the analysis of the class exercise scripts was that children possess a high degree of moral awareness. They expressed an understanding of one's obligations towards each other and the world around them. In the following extract, a child from the Experimental group spells out his hopes for the future:

people sometimes, No rules for
Gaelic Football, School to be better,
children to be nicer to other
people, No bullus, manchest. in,
everyone to be friends no fights
or rows and for the world to
be a better place.

Figure 5.6 Creative Writing 4th Class Student, Experimental Group

There were also similar comments from a student in the Control Group which showed that he was strongly motivated in playing a proactive role in solving world issues:

Helping to stop world pollution
and helping charities, and
stopping animal slaughter
The first person to find
a cure for every known
disease, to man.

Figure 5.7 Creative Writing 4th Class Student, Control Group

While the Creative writing exercise provides a useful indicator of the inherent creativity in each child (Craft 2000), it has its limitations as an indicator of 'higher' creativity. A deeper analysis of the outcomes from the other exercises reveals evidence of these 'higher order' attributes:

- **Multisensorial experience**

In the music composition exercise, the experimental group were asked to discuss the benefit of using additional tools, in this instance the microphone:

T: Did you get a chance to record your own voice?

S1: Yes with the microphone you gave us.

T: What kind of stuff did you do to your voice?

S1: I reversed the sound, I made it fast and I made it slow, I put in the echo, I did a load of stuff with it.

Table 5.1 Transcript of dialogue re multi-sensorial experience

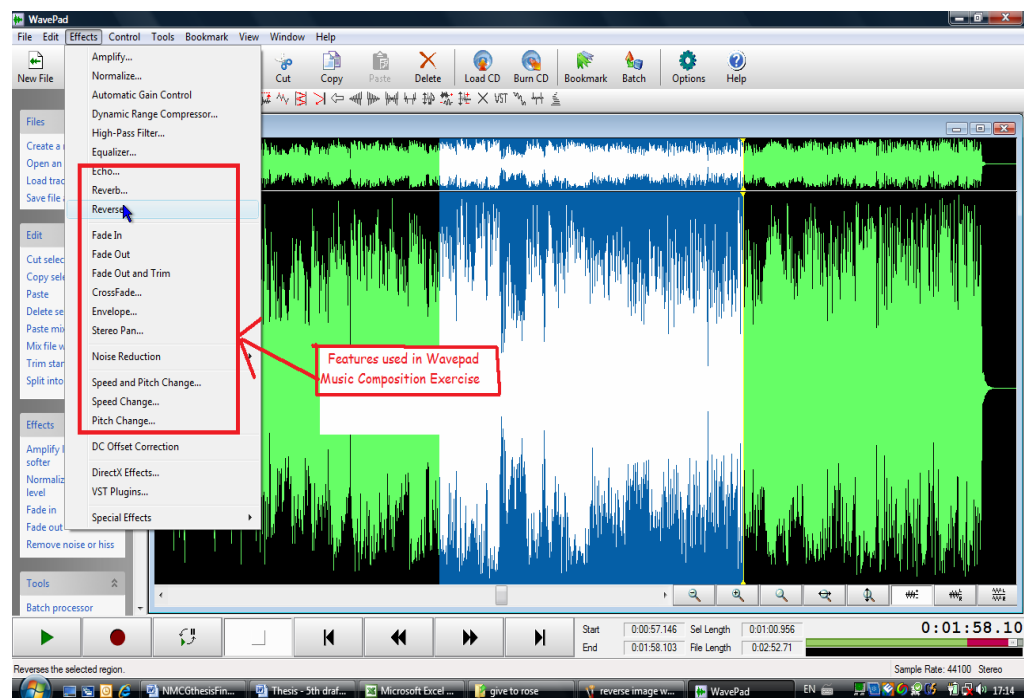


Figure 5.8 Screenshot of Wavepad and associated features

This child enjoyed the opportunity to enrich his musical composition experience by adding his own voice. Drawing on his creative abilities, he manipulated his voice in various ways. In the words of Fusai (2003), this facilitated a rich sensorial interaction where the physical and affective elements of children’s realities were explored, analysed, decomposed and recombined in new and exciting ways. In the words of Decortis and Rizzo (2002), this had the effect of transforming the activity into a creative, productive and stimulating experience.

- **Intersubjectivity**

The ability to enter into another state and to understand other perspectives (Fusai 2003) was a key trait that surfaced during this research. The control group enjoyed the multi-faceted aspect of the drama experience in assisting them to understand its cultural significance:

S1: I also learned a lot about their clothes and the way that they used to be, their weapons and things.
T: How and why did you learn about their clothes?
S1: Because we had to get dressed up as them and we had to know what they wore at that time

Table 5.2 Transcript of dialogue showing Intersubjectivity



Figure 5.9 Screenshot of Drama Exercise showing children wearing traditional costumes & weaponry

Staying with the drama exercise, possibility thinking was employed to solve the problem of communications in an innovative manner. The children came up with the idea of using the mobile phone to show Queen Maeve contacting the Kings of Leinster and Munster requesting their help to capture the Brown Bull of Cooley.



Figure 5.10 Screenshot of Drama Exercise – Innovative use of Mobile Phone

Similarly, the experimental group demonstrated a great ability in evaluating the relative merits of each music composition package:

<p>T: How would you say EJay was different to Wavepad?</p> <p>S1: Well, with EJay you'd get the sound off a box of sounds and drag it up onto the timeline but with Wavepad you had more power over the sound and you could do a lot of stuff in Wavepad with changing your voice.</p> <p>T: Which package did you prefer working with- Wavepad or EJay?</p> <p>S1: Probably EJay because you could compose your own tune whereas in Wavepad you were just changing a sound that was there already.</p>

Table 5.3 Transcript of dialogue comparing Wavepad and EJay

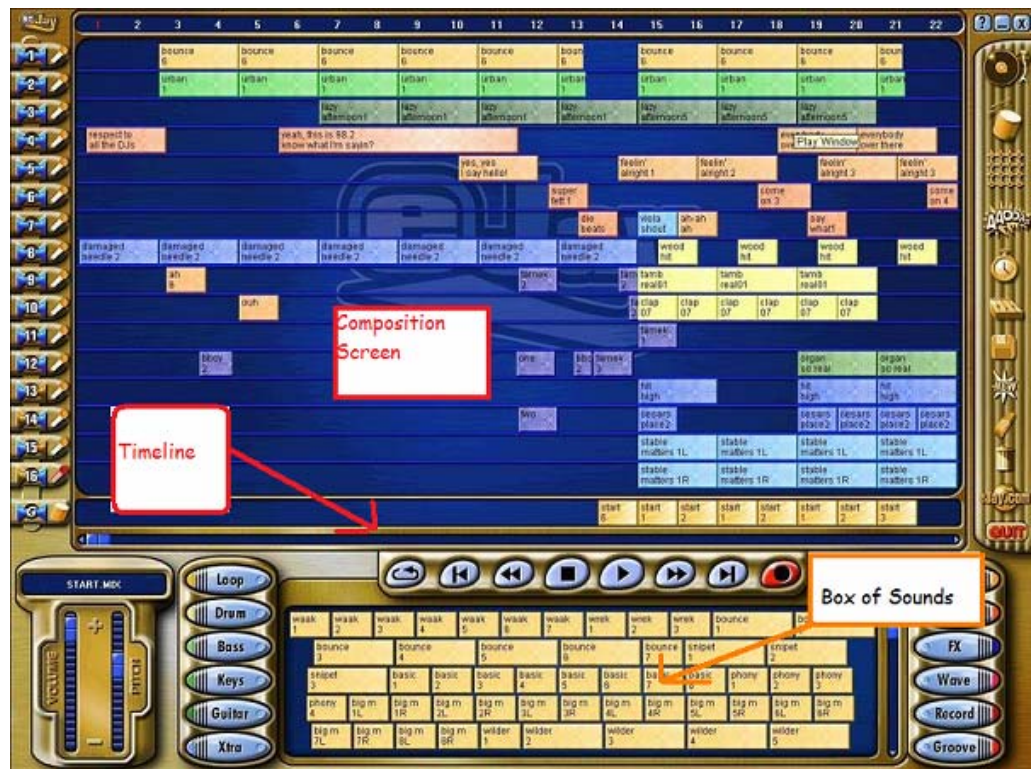


Figure 5.11 Screenshot showing features of EJay

- **Self-expression**

Both groups underlined the importance of having a medium through which to express themselves as a means of increasing self-confidence. In comparing the Write A Book exercise with the Drama exercise, the Control group had this to say:

T: Which do you think was the most rewarding?
S1 and S2:Drama
T: In what way did the exercises differ?
S1: In the drama you were with loads of people at the same time but with the Write a Book, it's just yourself and you can't talk.
T: So did you get to express yourself in your character?
S2: Yes, we got to express our emotions
S1:and personality. I grew confident in myself
T: What do you think you learned most from the drama experience?
S1: More confidence
S2: Yeah, a lot more confidence and I get to express my whole emotions.

Table 5.4 Transcript of dialogue comparing Write A Book with Drama

The Experimental Group also enjoyed expressing their creativity, using the focus group to discuss it. They also underlined the importance of self-

expression using various ways i.e. mentally and physically in demonstrating their creativity:

T: What did ye enjoy about EJay?
S1: Just to make your own tune and then you could put your own voice in...it was cool.
S2: Yeah, because you could make your own unique piece of music That nobody had ever made before.

Table 5.5 Transcript of Dialogue re EJay

SEE LINK TO EJAY TUNES

In comparing the Write A Poem project to the music technology exercise, the Experimental group enjoyed expressing their creativity in more challenging ways:

T: And which was more interesting for you to do?
S1: Hip Hop EJay
T: And why would you say that Microsoft Word is not as interesting?
S1: It's not as creative.
S2: I liked making a song and messing about with it.

Table 5.6 Transcript of Dialogue comparing EJay and MS Word

- **Independent learning**

With its greater proficiency in ICT, the Experimental group expresses a desire for more control over learning. Hinostrroza et al (2002) highlight independent learning as one of the innovative characteristics of their study exploring the impact of ICT on music composition.

T: How was it different to any other piece of software you've used?
S1: You had a lot of control over stuff.
T: Were you happy with what you composed...what features of the package did you use?
S2: Yeah, it had a lot of drums and guitar and it had good voices in it
T: What about you?
S1: I used the drumbeat a lot and the base guitar for at the end of it

Table 5.7 Transcript of Dialogue analyzing Music Composition exercise

The value of ICT as a learning tool is addressed by the Experimental group discussing the music composition exercise. From the extract below it is clear

that ICT has played a significant role in enhancing the learning experience for this group:

T: What have you learnt about composing tunes and about music from having done E-Jay?
S1: About keeping a drum beat and about keeping the music together
T: What did you learn/what did you find unusual/did you have any ideas about how music was composed beforehand/was it all new to you?
S1: It was mostly new to me.
T: What did you think of that layout?
S1: I think it makes it easier.

Table 5.8 Transcript of Dialogue discussing value of ICT to Music Composition Exercise

The beneficial nature of ICT is echoed by the second experimental group in their analysis of Wavepad and EJay:

T: What did you learn about composing music?
S3: I didn't know that that is how a lot of music is made, using computers.
S4: It was new to me the way you could make tunes using EJay
T: Any hard bits?
S4: I didn't know stuff like that it was important to put different sounds on different timelines.

Table 5.9 Transcript of Dialogue comparing Wavepad and EJay

The Experimental group displayed greater confidence in using 'higher order' ICT skills of the type proposed by Tondeur (2007). In analysing the Write A Book exercise, the Control group looked at ICT from the 'basic computer skills perspective':

T: What did you learn from it?
C: I learned about typing and paragraphs.
J: I learned about punctuation and paragraphs.

Table 5.10 Transcript of Dialogue analyzing value of ICT to Write A Book exercise

Nevertheless, further analysis of this discussion reveals an interesting insight into the role played by ICT, even at this basic level, in increasing confidence and in encouraging independence in learning:

T: The first of many books for you both, I think! Were you comfortable doing it yourself or did you need some adult help?
S1: No, I was comfortable doing it myself
S2: Yeah
T: So you both had computers at home and you were able to set it up yourself, edit it with any changes you had to make?
S1 & S2: Yeah
T: Did you have sufficient skills to do this on your own?
S1: Yeah, I know how to start and go about it.
S2: I started writing a story a long time ago but I never got it finished.
T: So it was good to have a finished product?
S2: Yeah!
T: So what are your emotions about the finished product?
S1: Good
S2: I'd love to read it in a couple of years to come when it's all finished and typed up.

Table 5.11 Transcript of Dialogue re impact of ICT on confidence

This Experimental group analyse the contribution made by MS Word and MS Paint to the Write A Poem project. These students are looking beyond the 'basic computer skills' perspective and reflecting upon the contribution ICT makes to the overall effectiveness of their work. While acting as a motivational agent, the students acknowledge the limitations of ICT as a 'learning tool':

T: How would you compare doing something by hand or typing it up and doing a picture in Paint?
S1: It's better fun doing it on the computer but it does take longer because you're having to look for all the keys.
S2: I like the typing the way you can change the colour of the writing and so on but the picture is harder to do on the computer.

Table 5.12 Transcript of Dialogue analyzing value of ICT as a learning tool



Figure 5.12 Sample of work from Write A Poem Exercise 4th Class Student, Experimental Group

Delving further into their analysis, it is clear that the students are still coming to grips with technology, albeit of a more complex nature, and this has impacted on the degree of satisfaction generated from the project:

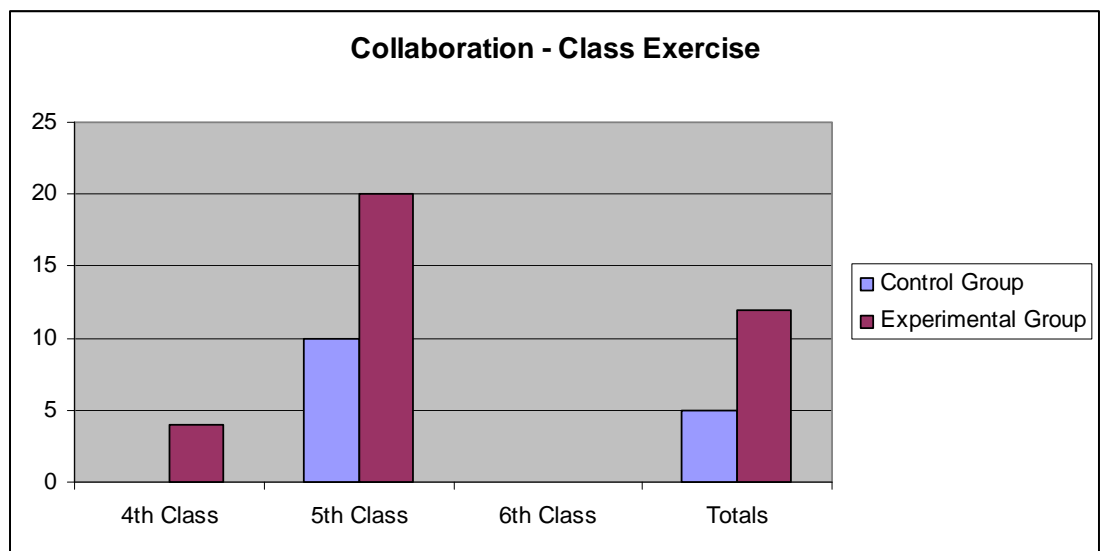
T: How do you cope with saving work, finding stuff, saving on a memory stick etc with M Word docs?
S1: I get a bit mixed up when I'm saving stuff to my memory stick
T: So you're still getting used to it and what about you?
S2: I know how to save work to the computer but yeah I still am having trouble saving stuff to the memory stick.
T: Were ye proud of the work that you did with the poem and picture
S1: I was happy enough with it but I was a bit annoyed that I couldn't get the picture right in Paint
T: If you took a digital photo would you be able to put it into a Word doc
S2: I don't know how I did it yesterday but I put a picture into my film review

Figure 5.13 Transcript of Dialogue analyzing perceptions of ICT as a learning tool

5.2. Fostering Collaboration

The preference for collaboration and working with others emerged as a very strong theme during the various exercises.

In the class exercise, at 24% the experimental group outscored the control group by a margin of 2.4 to 1. The significance of this margin suggests that the experimental group have developed closer working relationships in the classroom facilitated by ICT. The Control environment does not afford this collaboration where class exercises, in general, are undertaken as an individual exercise.



Graph 5.2 Collaboration

In performing the drama exercise, the Control Group highlighted the importance of having fun with their friends during the learning experience:

T: Did you enjoy taking part?
S1: Yeah, it was very good. You're having fun with your friends
S2: Everyone is taking part
S1: I don't think anybody didn't like it because it was really fun and you're with your friends all the time.
T: So you think it was good to be working in a team as part of the drama?
S1 and S2: Yeah!

Figure 5.14 Transcript of Dialogue re collaboration in Drama Exercise



Figure 5.15 High Drama involving all the children!

In the drama exercise, the students are engaging in ‘face-to-face collaboration’ with each other and in physical engagement with the activity. Scott et al (2003) reinforces the importance of this type of collaboration as a motivating agent and in increased effectiveness of learning.

This point is reinforced when the teacher probed further, asking them to compare the Write A Book project (which each child undertook on their own) with the drama, a group exercise:

T: You also did the Write-a- Book project, which was a different type of exercise. They both had an end product – your book or your performance tomorrow. One you have in your hand, one you have in your memory. Which experience did you prefer?
S1: The drama
S2: Same
T: Why?
S1: It was fun and everybody was doing it
S2: Everybody got enjoyment out of it

Figure 5.16 Transcript of Dialogue comparing Write A Book project to drama exercise

The degree of collaboration was more evident in the replies from the Experimental group analysing the EJay music technology exercise:

T: How did you know that the music you were composing was correct?
S1: Well, we kept listening to it until both of us were happy that it was right and not just one of us.
T: How did ye find working together-were there ever problems?
S2: Well, we would work it out- if he liked a sound and I didn't like it sometimes we'd put it in and I could put in a sound he didn't like.

Figure 5.17 Transcript of Dialogue demonstrating Collaboration in Music Composition Exercise



Figure 5.18 Students working in pairs under watchful eye of teacher

Using the terminology described by Wegerif & Scrimshaw (1997), these students engage in “educationally important” talk, involving co-construction of ideas, acknowledgment of each other’s contribution and the need of compromise in arriving at a mutually acceptable final product. It is also evident that “collaborative patterns of behaviour such as symmetry of ideas, equity of control and action, parallel or co-operative work, as well as reciprocity and elaboration of ideas” (Stanton et al 2003) were involved in the process of creating the final product. The quality of this interaction has positive implications, leading to enhanced learning experience and effectiveness (Vygotsky 1962),

The nature of the interaction between a child and his/her teacher has significant implications for the child's cognitive development and can gradually foster the development of successful independent task performance. Vygotsky's theory of the Zone of Proximal Development (ZPD) underlines the necessity for collaboration or assistance from another more able partner in assisting the child to reach his/her learning potential. This experimental group, in the following discussion on EJay, are well on the road to independent learning, and acknowledges the role of the teacher in facilitating this experience:

T: And have you saved it to your memory sticks?
S1: yes
S2: Yes.
S1: That was kind of easy.
T: And would you think of putting it on your MP3 players or anything like that?
S1: My MP3 player is broken.
S2: I didn't even think of that yet!!

Figure 5.19 Transcript of Dialogue demonstrating Independent learning

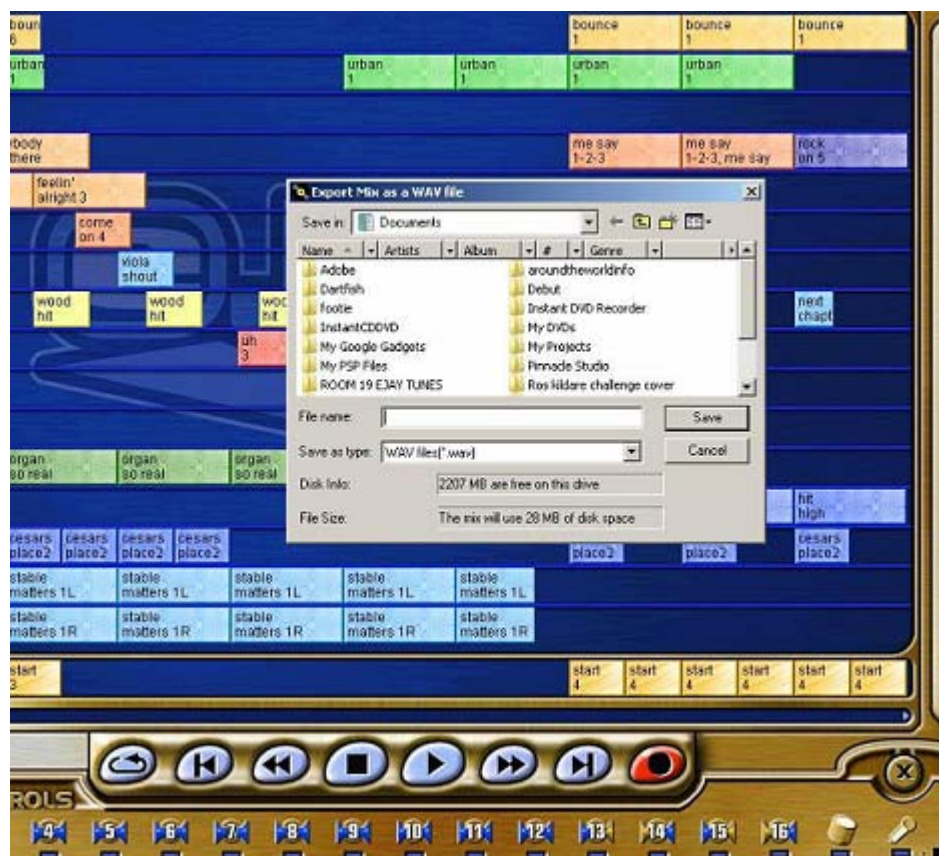


Figure 5.20 Exporting the finished track ready to put on a CD/Memory stick

The teacher of this experimental group fulfils the role advocated by Druin et al (2003) and Plowman et al (1993), as outlined in the Literature Review, in structuring the learning experience to achieve specific outcomes. In completing the teachers' questionnaire, this teacher acknowledged that children 'love ICT and are very receptive to learning which is conducted through this medium'. Through his innovative use of ICT in conducting the EJay exercise, the teacher achieved a number of learning objectives: fostering music appreciation, increasing ICT proficiency (using memory sticks and MP3 players), independent task performance and greater co-operation among students. The outcomes, as we see, are greater creativity, greater task independence and real enthusiasm for learning.

The example below is another good case in point of this teacher promoting different learning objectives through innovative use of ICT:

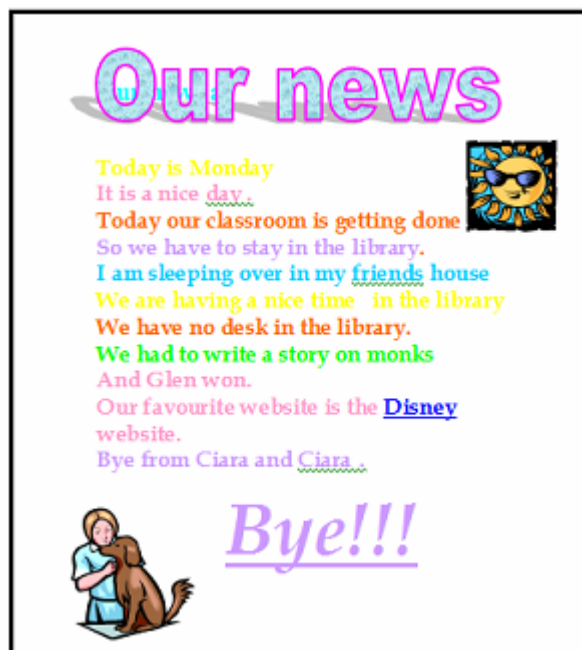


Figure 5.21 Sample of work on MS Word, 4th Class Experimental Group

The evidence from this study indicates that the degree of interaction with ICT is largely influenced by the teacher's perception of ICT, which in turn, is mediated to a large degree by the ethos of the school. In the Control school, with the lower priority afforded to ICT, the teacher states: "while I am aware

that there are many positive aspect to the use of ICT in the classroom, I don't consider that my students are at a big disadvantage from not having it as a formal part of their education". This could explain the "basic IT skills" or "Learning about ICT" approach adopted by the teacher and students alike.

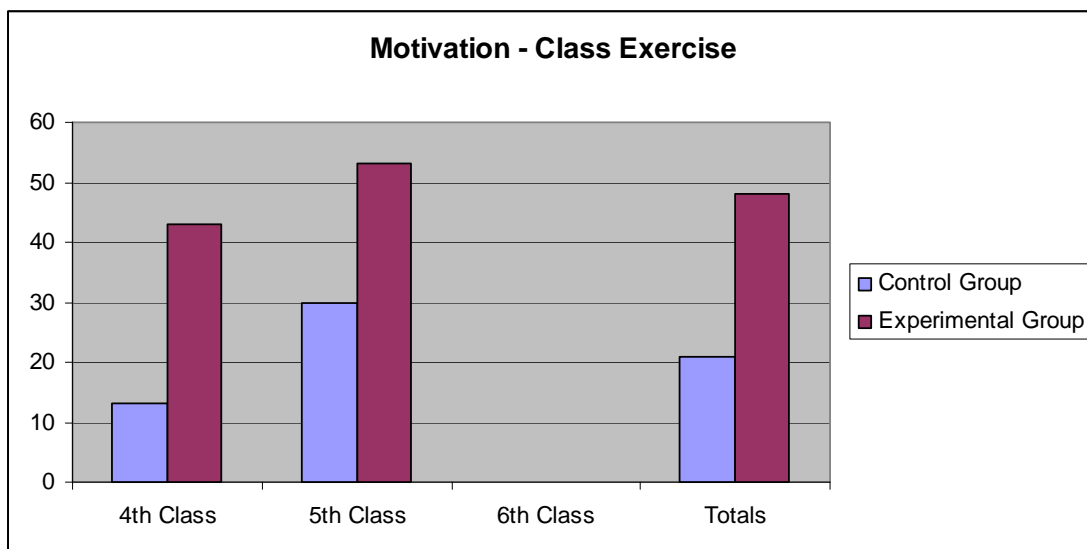
Furthermore, this evidence is supported by the students' desire to see more frequent use of ICT in the classroom. An analysis of the replies to the students' questionnaires reveals that 100% of the Control School would like 'more frequent use' of ICT in the classroom. This contrasts sharply with the Experimental School where preferences for 'More time in Class', 'Everyday use' and 'Less Guidance from the Teacher' are cited in 95% of the cases.

This dissatisfaction is mirrored by the parents. A large proportion of parents (80%) of the Control School pupils are not satisfied with the level of technology interaction in their child's school. The parents' questionnaire invited them to contribute their views/inputs regarding ICT in schools. Many availed of the opportunity to request "more time" and "more computers". One parent, however, exonerated the teacher: "Teachers can't be expected to do everything and know all about them". This parent also questioned the value of ICT in the classroom: "Considering how long computers have been in existence, they have not made much impact on the educational system where personal use is concerned". Perhaps these findings call for a greater reinforcement of ICT values in schools. Similarly, the "voice of the parent" may need to be considered in addressing future ICT needs in the classroom.

The parents of the Experimental School pupils have a much more positive approach to ICT with 98% expressing satisfaction with the level of ICT interaction in their child's school. This satisfaction is tinged with trepidation, however, with some parents acknowledging the negative aspects of ICT requesting awareness sessions on cyber-bullying for their children. This highlights the importance of 'netiquette' – encouraging students to have a responsible approach towards online communications and use of technology - and the role schools need to play in instilling moral awareness in our children.

5.3. Enthusiasm for Learning:

From a general educational perspective, it is highly desirable for children to be motivated to learn. There was a good deal of evidence from both groups to demonstrate enthusiasm for learning.



Graph 5.3 Motivation

It is interesting to note that the experimental group is again to the fore, this time in the motivation stakes. A deeper analysis of the results reveals various motivating factors given by the children in their reflections on a given experiment.

In the discussion on the drama exercise, these students from the Control group enjoyed the experience, not simply for the sake of novelty, but rather because of the additional possibilities that it offered them:

T: What do you think you learned most from the drama experience?
S1: More confidence
S2: Yeah, a lot more confidence and I get to express my whole emotions.
S1: I can't wait til tomorrow to show everybody that we've been really working hard on it.

Figure 5.22 Transcript of Dialogue highlighting Enthusiasm in Drama Exercise

An exchange on very much the same lines occurs with regard to the discussion in the Control Group on Write A Book exercise:

T: Did you enjoy doing the Write a Book?
S1: Yeah **S2:** Yeah, definitely
T: Was it the first time you had ever written your own book?
S1 & S2: Yeah
T: Why did you enjoy it?
S1: It was fun and we learned lots about writing on the computer, how to do new paragraphs and everything. I got practice because I did a computer course using the correct fingers and everything when I was only in 3rd class and I used that.
S2: It was challenging but once I had the plot I was able to do it. The sense of achievement when I had it done, it was really good.

Figure 5.23 Transcript of Dialogue discussing impact of Write A Book exercise

This is also apparent in the experimental group, with its higher degree of ICT proficiency, where both students demonstrate a willingness to experiment and to utilise their newly acquired skill (EJay) beyond the confines of the classroom environment:

T: Is EJay the kind of package that you could figure out for yourself or would you need someone else to show you?
S1: Well, it was kind of easy because the line was there and all you had to do was drag up the sounds onto the timelines. It sounds a bit hard but once you do it, its actually really easy
T: Could both of you go on yourselves and compose your own tune, open up the package, work on it, save and render it....would you be happy that you could do all that?
S1: Yes. **S2:** Yes.
T: Would it be something you would do yourself at home/would it be something that would interest you?
S1: Yeah, it would be kind of like a hobby-you could do it if you were bored

Figure 5.24 Transcript of Dialogue showing Enthusiasm in Music Composition Exercise
It is clear from the observations that fun and enjoyment in the learning process are highly valued as this excerpt from the interview with the Control Group regarding the drama exercise shows:

T: Did you enjoy taking part?
S1: Yeah, it was very good
T: What was different about it from your regular school work?
S2: You get more confident in yourself
S3: Yeah, confidence in your voice and with schoolwork, you're just doing it by yourself but there you're having fun with your friends

Figure 5.25 Transcript of Dialogue discussing Enjoyment in learning experience

The Write A Book exercise generated a similar response from the Control Group:

T: Did you enjoy doing the Write a Book?
S1: Yeah
S2: Yeah, definitely
T: Why did you enjoy it?
S1: It was fun and we learned lots about writing, how to do new paragraphs and everything.

Figure 5.26 Transcript of Dialogue discussing Enjoyment in Write A Book Exercise

The importance of fun and enjoyment in the learning process is also emphasised by the Experimental group in their discussion on the E-Jay project:

T: How would you describe working with EJay?
S1: Fun.
S2: Great fun.
T: Did you enjoy the EJay experience? What was different about it?
S1: It was fun because all the other stuff can be boring.
S2: Yes, you could make your own song instead of remixing others.

Figure 5.27 Transcript of Dialogue discussing Enjoyment in EJay Exercise

The above excerpt also highlights the importance of active engagement (Papert 1983) by the child in the experience in order to engender enthusiasm for learning. The child is not happy merely remixing music already available but prefers the challenge of composing his own music. Creativity is fostered in this semi-structured environment where the teacher acts as a facilitator, giving advice only where necessary (Wheeler 2002). With the child directing his learning with the support of his teacher, he feels much more in control of learning and therefore more enthusiastic (Goodison 2002).

5.4. Summary of Findings

The evaluation of the research data shows that, as a whole, the children engaged in using technology in innovative ways demonstrate greater creativity, collaboration and enthusiasm for learning. Whilst some of the quantitative data suggests otherwise, an in-depth analysis indicated that 'higher' creativity was evident among the experimental group. Thus it can be said that this study provides evidence to support the introduction of new and innovative use of ICT into educational practice.

6. Conclusions and Further Research

6.1. Summary

There is wide-spread acceptance of the importance of creativity to learning. It is essential for the holistic development of the learner, fostering an individual who espouses confidence in learning, who values close collaboration with peers and significant others and who is inspired to engage in life-long learning. Such an individual is well-equipped for the challenges of the 21st century.

This research explored the potential of ICT in sparking this creativity and love of learning in Irish Primary School Pupils. Despite the existence of common ICT standards (as defined by NCCA and NCTE), there is no consistency in the way ICT is configured in schools and integrated into the Irish primary school curriculum. Numerous studies as outlined in the Literature Review investigated the creative impact of ICT in the classroom and its potential to promote “discovery, delight, curiosity, creativity, self-expression and pleasure in learning” (Plowman and Stephen, 2003). Furthermore, the Literature Review indicated that ICT can consolidate this enriching experience, leading to more effective learning, by facilitating active engagement and fostering greater collaboration among peers and teachers alike.

This comparative study, involving two schools at opposite ends of the ICT spectrum, investigated the propagation of creative thinking in the arts through the use of ICT. The evaluation of the data from this research provides evidence of the potential of ICT to spark creativity and love of learning in Irish primary school children. However, it illuminated several issues and raised a number of pertinent questions related to teaching and learning:

6.2. Conclusions

6.2.1. Enriching the learning experience

(a) ICT needs to support somatic learning

Within the confines of this comparative study, there is evidence to indicate the potential of ICT to support the social nature of learning and, in the words of Decortis and Rizzo (2002) to transform an activity into a creative, productive and stimulating experience. The multi-sensorial engagement involving sound, vision and touch enriched the child's interactive experience enhancing the learning outcomes. For this 'Nintendo generation' (Solloway 1991) which has grown up with technology and has a wealth of ICT tools at its disposal, both at home and at school, there is vast potential for children's narrative experience to be transformed in a creative way, beyond the confines of the desktop computer. Given that 90% of students sampled have their own mobile phones, many of which are equipped with multimedia features, and the prevalence of Wii, digital cameras, camcorders, the potential to enhance the multi-sensorial experience is enormous. To capitalise on their expertise and enthusiasm for this technology, teachers and educationalists would be well advised to consider their creative input into the curriculum/classroom environment.

(b) ICT needs to support different learning outcomes

The ability of students to analyse the relative merits of various ICT tools was observed throughout this study. The experimental school has moved beyond the basic IT skills stage and appreciates the challenges afforded by more complex technologies. Teachers need to tailor the tools to achieve different learning outcomes – both on an individual and group basis and to take accounts of differing levels of proficiency in the classroom. The tools need to be challenging to maximize the learning experience, to increase confidence in learning, to promote enthusiasm and enjoyment levels while simultaneously minimising frustration.

6.2.2. Fostering collaboration

(a) ICT tools need to facilitate collaborative activity:

Evidence from this research indicates a strong preference by the children for collaborative activity of any type. It has been shown that engagement in this kind of activity can have positive implications for the degree of enjoyment, motivation and effective learning which ensue. These outcomes were in evidence not just as an end product but during the process itself. There is an argument, therefore, for selecting ICT tools for the classroom which support this kind of activity. The Literature Review cites multi-modal interaction which supports different kinds of collaborative experience both with the activity and with each other. The author believes that the use of tools such as the “Smartboard” have the potential to harness the power of collaborative co-operation to enrich the child’s learning experience, fostering greater creativity and enthusiasm for learning. As one teacher noted when asked to contribute her views on the use of ICT in education: “interactive whiteboards are the way forward to help integrate ICT into the classroom”.

(b) The Teacher needs to act as a collaborative partner

The teacher needs to strike a proper balance between freedom and control both in structuring the learning activities and in the degree of freedom afforded to the students in their interaction with the technology. While some of the Literature Review cites the children as leading and directing the learning in the new learning environment with the support of their teachers (Goodison 2002), the author believes the new environment would be better served by a more “collaborative partnership” one. Evidence from the Experimental school would indicate the role of teacher in “scaffolding” – setting challenging assignments to achieve desired learning outcomes, promoting awareness of possibilities and the creative potential of ICT tools, intervening where necessary to address difficulties and to offer support while simultaneously permitting sufficient freedom to allow the children flexibility in forming their own groupings, in experimenting with the technology and in determining their outputs.

6.2.3. Engendering enthusiasm for learning and discovery

(a) Children need active engagement and participation with ICT tools:

A recurring observation throughout this research is the importance of “learning through doing” and, according to Sefton-Green (1999), this can be said to account for much of the excitement and enthusiasm of participants in such work. With a wide variety of ICT tools at their disposal, children have the potential to enhance their learning experience beyond the confines of the classroom to explore new avenues of interest and curiosity. This has implications for the role of the teacher. The “collaborative partnership”, discussed earlier, facilitates this greater engagement, fostering a win-win situation for everyone concerned. “When that curiosity and learning occur, teachers glow” (Cordes & Miller 2000). This situation, however, would appear to be contingent on the teacher’s proficiency and confidence with ICT. It is often the case that children are more ICT literate than the teachers themselves and they are aware of this. Many studies have shown that children learn more ICT skills from their peers than from their teacher. Goodison 2002 is a case in point who concludes that this loss of confidence can manifest itself as a distortion in the dynamics of the learning situation which can hinder ICT integration into the curriculum. This strengthens the argument for:

- activities that foster collaboration or co-operative work
- regular sessions with an ‘ICT expert’ who inspires the children with his skills and who is available to support the teacher
- further resources to be channeled to staff development where necessary

6.3. Recommendations for Future Research

The following recommendations are made for future research:

(a) From this study, the author believes that the teacher plays a pivotal role in determining the potential for ICT to spark creativity and love of learning in the Irish education system. As Wheeler (2002) states “encouraging creativity in the classroom is primarily the task of the teacher”. The results of this study can inspire teachers to examine computer use in their educational context by

developing tools, practices and environments that make the most of creative potential. This review would need to consider the following objectives:

- encourage greater integration of ICT in classroom activities
- tailor ICT tools to suit different learning outcomes
- avail of expertise at their disposal to assist them in selecting/using ICT tools through which creative and effective practices that have educative value can be developed
- incorporate creative input from children and parents in facilitating more creative use of ICT in the classroom

(b) Amabile et al (1998) refer to higher creativity as being motivated by the sum of “feelings of interest, involvement, enjoyment, curiosity, satisfaction, or positive challenge in the problem”. It would be interesting to explore the characteristics of this higher creativity and how it can be impacted by ICT. Can it influence ‘higher order thinking skills’ advocated by Benjamin Bloom? In this context, in order to determine if their creativity is further enhanced by the experience, a useful experiment would be to repeat the drama exercise with the same students, allowing them free rein to exploit both school and personal ICT tools at their disposal,

(c) This study focussed on integrating ICT with the Arts as a way of gauging children’s creativity. It would be interesting to look at integrating ICT with other subject areas, particularly in the realm of Science and Mathematics. Despite significant investment in ICT in our schools since the 1990s, the continued fall-off in interest in these subjects at secondary-level and beyond is a cause for concern especially among advocates of our knowledge economy. Perhaps it is the case that cultivation of higher creativity, through integration of ICT, has benefits for particular aspects of cognitive development e.g. socialisation rather than the anticipated propagation of interest in Science and Mathematics-related fields?

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8. APPENDICES

APPENDIX A – PARENTAL CONSENT LETTER

'Rosville',
Lanesboro Road,
Roscommon

10 June, 2008

Dear Parent/Guardian,

For the purpose of completing my postgraduate thesis leading to an M.Sc in Technology Management from the National University of Galway, I am conducting research into the use of technology in primary schools. The school principal has kindly given me permission to conduct research in the school, on an afternoon in the coming weeks, with children in **4th, 5th and 6th** classes, subject to permission from parents/guardians and the child's consent.

I am writing to you to seek your consent for your child to take part in this research.

Children will be divided into focus groups consisting of three or four children. The purpose of these focus groups will be to discuss and explore children's use of technology in the classroom and at home, their views on technology, learning and their general interests. This will be conducted with myself/class teacher and children will return to class immediately afterwards (roughly 20 minutes in length).

Important Information:

- As this study involves children under the age of 18 years, it is required that each participating child must return the attached consent form signed by a parent or guardian.
- This form should be returned to the class teacher by **Wednesday, June 18th**. Children who have not returned the consent form will not be allowed to participate in the research.
- Participation in this research is entirely voluntary. Any parent has the right to exclude their child from the focus groups.
- Any parent who wishes to use this opportunity to contribute their views may do so by completing the questionnaire attached specifically for this purpose.
- Research findings will be used for the purpose of my thesis and related academic publications. They will also be communicated to the participating schools.
- No child's identity will be mentioned in any of the research.
- Should you have any questions or concerns relating to the focus groups, please feel free to contact the school principal.

Thanking you in advance for your kind cooperation.

Yours sincerely,

Rosaleen Greene

APPENDIX B - RESEARCH PARTICIPATION CONSENT FORM

I _____ (Parent/Guardian's full name)

Give permission Do Not Give Permission (please tick
box) Appropriate

For my child _____ (Child's Name)
to participate in Ms. Greene's research.

Signed: _____ (Parent's/Guardian's
Signature)

APPENDIX D – QUESTIONNAIRE FOR TEACHERS

General Questions:

- Name: _____ Class: _____
- Educational qualifications:
Primary Teaching Degree Masters Degree
- General interests:
Arts Sport Reading ICT Drama/music

Specific Questions relating to your views on ICT and learning:

- What degree of autonomy do your students exercise in selecting non-ICT areas of interest/learning?

- What degree of autonomy do your students exercise in selecting ICT areas of interest/learning?

- Do you see ICT as an essential tool/aid to learning? Yes No
- Do you expect your students to have prior knowledge/experience of using a computer? Yes No
- Do you encourage your students to have a responsible approach towards online communications and use of technology (e.g. responsible use of the Internet, password security, respect for others' identity/privacy etc)?
Yes No
- What ICT tools, if any, do you employ in the classroom?
Computer Camcorder Smartboard
Digital toys Digital Camera
Other: _____
- In using ICT tools, do you find less scope to use creative techniques in class? Yes No
- List the subjects, if any, in which you employ ICT tools

- Type of activity you feel lends itself to effective use of ICT tools?
Creative Exploratory Group Project work
If other, please specify: _____
- Proportion of classroom time, if any, spent weekly on technology?
- Please feel free to contribute your own views on the use of ICT in education:

Thank You for your Co-operation!

APPENDIX E – QUESTIONNAIRE FOR STUDENTS

Focus Group Theme Sheet

General Questions:

- Name: _____
- Age: _____ Nationality: _____ Class: _____
- How many (if any) brothers and sisters do you have? _____
- Where do you come in the family?
 Oldest Middle Youngest
- Which of the following does your family own?
 - TV MP3 Player
 - DVD Player IPOD
 - Camrecorder Digital Camera
 - Games Console (e.g. playstation)
 - Desktop computer/laptop
 - Internet connection
- What type of internet connection? Dial-up Broadband
- Do you own your own mobile phone? Yes No

Exploring your use of ICT (Information and Communications)

Technology at home:

- What do you use the computer for at home? Personal Use School work
- If for own personal use, describe what you use it for:
 Research on Internet Games
 Chatpage (Bebo/Facebook) Entertainment (playing DVDs, music, photos)
- If for schoolwork, describe what you use it for:
 Research on Internet
 Project work Circle packages used - MS Word, MS Paint
 Describe any other use:

- Do you use the Internet at home? Yes No
- How often would you use the internet at home?
 Monthly Weekly 3+ times a week

- What do you do online at home?
 Chat page Which one: Facebook Bebo Club Penguin
 Research for school work

Exploring your use of ICT in school:

- Do you enjoy working on computers?
 Yes No Not really interested
- What computer activity in the classroom do you enjoy best?
 Creating projects Research on Internet
 Describe any other

activity: _____

- What computer activity in the classroom do **not** enjoy/find boring/frustrating?

- Do you prefer to work on the classroom computer:
 On your own With friends
- What other ICT tools do you use in school?
 Camcorder Scanner
 Digital Camera Interactive toys

Describe any other tools used:

- Have you used the following :
 USB port Mouse
 Memory Stick Mouse pad
- Would you like to use ICT in classroom:
 Less often More often If so, everyday More time in class
 Less guidance from Teacher More guidance from teacher
 Any other ideas: _____

Exploring your enjoyment of learning:

- Favourite school subjects:
 Irish PE Geography Computers
 English Religion Drama SESE
 Maths History SPHE Music

- What activity you enjoy doing best in school?
Interactive Creative Musical Exploration
- Why do you enjoy this?
Challenging Learning Sense of achievement Sharing

Exploring your Personal Views:

- What are your hopes and dreams for your future:

 - What are your interests?

 - What are your favourite TV programmes? Why?

 - What TV programmes do you not like? Why?

 - What do you like to buy? Why do you buy it?

 - If you could change something in the world, what would you change?

 - Do you like reading? Yes No
 - Are you a member of your local library? Yes No
- How often do you read books?
Never Occasionally Regularly

Thank You for your Co-operation!