Trinity College, The University of Dublin

A case study of 21st century learning in an Irish context:

An exploration of the utilisation of mobile devices and how they contribute to the realisation of the aims of the new Junior Cycle framework

A thesis written in fulfilment of the requirements for the degree of Doctor in Philosophy (Ph.D)

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Summary

The 20th century has provided a number of significant technologies that have transformed education, with the introduction of the overhead projector, Schools TV, the whiteboard, personal computers, video projectors and access to the World Wide Web. The latter part of the century has furthermore provided us with mobile technology, virtual learning environments, learning platforms and augmented reality/virtual reality.

The Irish governments' first national education policy to address the increased emphasis on Information Communication Technology (ICT) within Irish schools, *Schools IT2000 initiative* was first launched in 1997. This £40 million investment had aimed to ensure the distribution of 60,000 multimedia computers to Irish schools by the end of 2001, with each school assisted in acquiring at least one multimedia-ready computer system with Internet access, before the end of 1999. A further subsequent provision of teacher development in relation to ICT for at least 20,000 teachers nationally was also deployed within a schools support initiative (SSI), providing information and support via an online website available at www.Scoilnet.ie

Previous literature has shown us that the embedding of new technology in many schools in Ireland has previously been typically provisioned without any formal government support or initiatives (Lee, 2010). For a number of years, both primary and post-primary schools have embedded new technologies via school investment and donations from parents. The reform of the Junior Cycle key skills framework in 2011 was primarily developed for post-primary schools to develop students' knowledge, and attain the necessary skills and attributes for future learning and to face the myriad of challenges presented in today's world (NCCA, 2011). Following on**,** the recently published Digital Learning Framework (DES, 2017b), aligned with the earlier Digital Strategy for Schools initiative in 2015, holds particular promise, in supporting the embedding digital technologies into teaching and learning practice based upon adopting constructivist principles that foster a learner-centred approach to teaching, learning and assessment (Education & Skills, 2015). As a reflection of earlier comments, once again society has led the way with education playing catchup in relation to the demand for students to attain the necessary skills required in the context of 21st century workplace.

The developing discourse related to technology and its potential role in 21st century learning, depicts the proliferation and ubiquitous nature of today's mobile devices and subsequently provides education with a unique opportunity to harness the potential of their unique affordances within an educational context**.** The overall aim of this study was to explore how digital devices such as a tablet pc (iPad) can contribute to the realisation of the aims from within the Junior Cycle Framework (NCCA, 2011) through an intervention, based on the Bridge 21 learning model, developed across three case studies in three unique post-primary schools within Ireland. This study reports on the findings of a survey and case study approach on the pedagogical impact of adopting tablet devices affording students the ability to create and collaborate in developing content in line with required Junior Cycle key-skill competences.

The key finding from the evidence suggests a significant increase in confidence levels in relation to 'Motivation' across all three case studies, with further increases in '*Engagement*', '*Collaboration*' and '*Communication*' across a number of the studies. The convincing evidence further suggests a change in pedagogical practice that has subsequently provided students an opportunity to take ownership and responsibility for their own learning as they create and collaborate with their peers. Evidence from the intervention clearly articulates a link between the affordances of mobile devices and the new Junior Cycle key skill competences, whilst furthermore assessing the impact of changing dynamics within each classroom. In contrast, the lack of adequate resources/experience, challenging ICT issues and time management have played a dominant impact on the overall findings. In relation to government policies and initiatives, this study has used empirical findings to show that national policy initiatives such as Schools IT2000 have unfortunately not made the anticipated impact in Irish schools. This research supports the need for schools to adopt a social constructivist, technology assisted project-based approach to their teaching, learning and assessment that facilitates engaging students as life-long learners while meeting the needs of a 21st century society.

Acknowledgement

Firstly, I would like to thank my supervisors Dr. Melanie Ni Dhuinn and Dr. Keith Johnston for the guidance, expertise, advice and support throughout the course of this study. Thank you for your insightful comments and patience at all times.

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To my Mum and Dad, thank you for your thoughts and prayers.

Finally, to Louise, for your love, patience, generosity and kindness. I am eternally grateful.

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Glossary of Terms

21st Century skills – Abbott (2014, p. 1) stated 'The term 21st century skills refers to a broad set of knowledge, skills, work habits, and character traits that are believed—by educators, school reformers, college professors, employers, and others—to be critically important to success in today's world, particularly in collegiate programs and contemporary careers and workplaces. Generally speaking, 21st century skills can be applied in all academic subject areas, and in all educational, career, and civic settings throughout a student's life.

App – a self-contained program or piece of software designed to fulfil a particular purpose; an application, especially as downloaded by a user to a mobile device.

BYOD – (Bring your own device) the practice of allowing the employees/students of an organization to use their own computers, smartphones, or other devices for work purposes.

iPad - A typical 9.7 inch tablet device for browsing the web, reading and sending email, accessing photos, videos, music, games and e-books. High-resolution Multi-TouchTM display allows users to physically interact with applications and content.

m-learning – Mobile learning

Mobile device - A mobile device is a handheld tablet or other device that is made for portability, and is therefore both compact and lightweight. New data storage, processing and display technologies have allowed these small devices to do nearly anything that had previously been traditionally done with larger personal computers.

Tablet pc - a small portable computer that accepts input directly on to its screen rather than via a keyboard or mouse.

Chapter 1. Introduction to the research

This subsequent research describes an intervention conducted to identify how mobile digital devices (such as tablet pcs) can contribute to the realisation of the aims of the Junior Cycle educational framework. As part of this intervention teachers have been tasked with identifying teaching and learning activities that students need to participate in whilst developing 21st century skills. This introductory chapter will provide background and context to the research, describing the main aim of this research and rationale and motivation for the intervention. The significance of the research and research questions will be outlined and followed by an overview of the research methods employed. This chapter will conclude with an overview of the thesis that provides a roadmap and brief synopsis of each of the chapters therein.

The researchers initial background was not positioned within the sphere of education when first employed at Trinity College Dublin in 2005 as an IT programmer. In a subsequent appointment as an IT trainer and Trinity Access Program IT Tutor (TAP), the researcher began to take a keen interest within the area of Technology & Learning within education. Following the attainment of an M.Sc, Technology and Learning at TCD, the researcher investigated the potential of further studies within this domain. With the introduction of the iPad in 2010, the researcher was provided a unique opportunity to research the potential pedagogical affordances of mobile tablet devices within an educational setting. During this period the researcher was also keenly aware of the introduction of the Junior Cycle Framework at Post-Primary schools across Ireland. It was at this point with the initial interest in tablet devices coupled with the introduction of the Junior Cycle key-skill Framework and subsequent access to early iPad adopters across the country, that the researcher approached the School of Education at TCD to develop and submit a PhD research proposal. In this climate of change the researchers early inspiration draws upon the thoughts of educationalist Prof Diana Laurillard,

> '…Teaching is changing. It is no longer simply about passing on knowledge to the next generation. Teachers in the twenty-first century, in all educational sectors, have to cope with an ever-changing cultural and technological environment. Teaching is now a design science' (Laurillard, 2013).

1.1. Background and Context

Over the past decade research within the area of mobile technologies has generated much discussion around their potential to support teaching and learning. The preponderance of literature available to date reflects an emerging area on adoption and integration of the devices, with an international flavour from Australia, Japan, Europe and the USA. However, caution needs to be exercised with the acceptance of new technology such as mobile tablet-pcs. Already it has its vocal opponents, who emphasise the hype-factor, the financial burden incurred and the obvious questionable degree when debating how tablet pcs actually motivate and support learning (Courtois et al., 2013). However, many researchers still regard this topic to be in its infancy and under-examined. This lack of attention is somewhat significant, as a deeper understanding of the pedagogy employed and the additional alignment of 21st century skills in using the devices, can potentially provide extensive benefits in supporting teaching and learning.

To highlight the importance and relevance within this field of research, Male and Burden (2014a) contend that with 21st century technological adoptions in schools becoming more prevalent, 'the implications for education are enormous and the anticipated change probably ranks alongside the introduction of the printing press in terms of historical importance' (Male & Burden, 2014b, p. 423). Similarly, recent projects such as 'Assessment 2020' developed by the Learnovate centre at Trinity College Dublin, attempt to 'create a common framework to interpret, visualise and assess evidence of learning, which comes from multiple sources of implicit and continuous assessment'. This endeavour, similar in nature to Australian counterparts (University of Technology, Sydney), highlights the focus for many students to acquire the necessary 21st century learning skills, thus leading to a significant impact for many schools to meet this need, on their classroom pedagogy, curriculum design and delivery.

1.2. Rationale for the study

In order to address this issue, this work inquires, within an Irish context, how mobile devices (such as tablet pcs) can contribute to the achievement of the aims from within the Junior Cycle framework (years one to three at post-primary (lower-secondary) school). These aims include the promotion and fostering of motivation, engagement, communication, collaboration, reflection and assistive learning. This study however did not provide a significant focus on the potential linkage between tablet pc's and the key aim of assistive learning. Published in the Spring of 2013, the Junior Cycle educational framework is heralded as a learner-centred approach to teaching and learning within

post-primary education in Ireland. Furthermore the framework includes 24 statements of learning, with 6 key skills and literacy and numeracy.

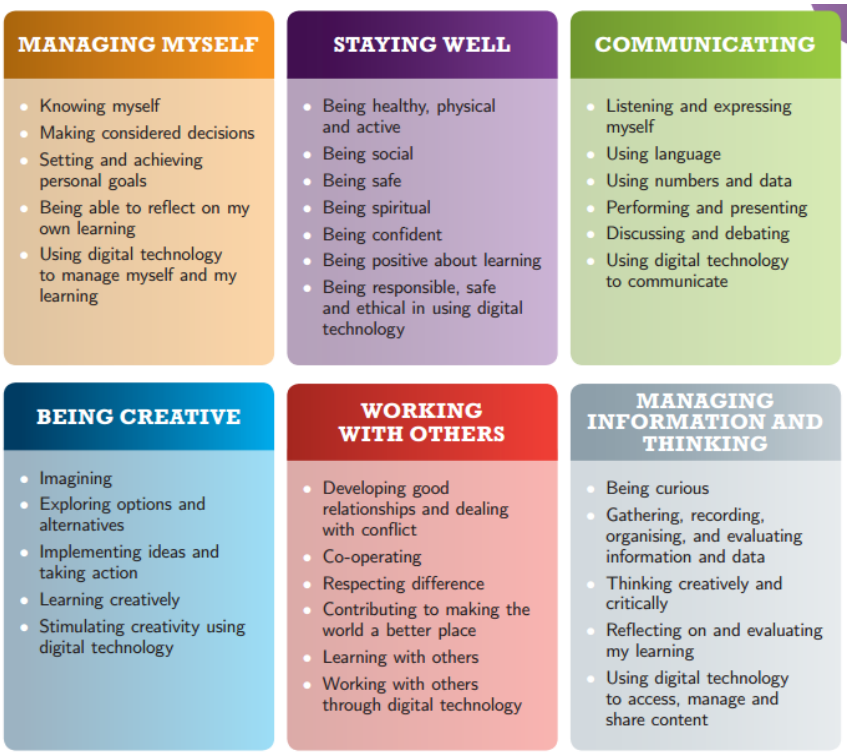


Figure 1-1: Junior Cycle Key Skills Framework

This study is underpinned by a social constructivist approach to teaching and learning, focusing on students-generated content while constructing interactive iBooks (using iBooks Author) as part of learning activities developed by participating teachers within the intervention. Thus, this study investigates the affordances of mobile digital devices (such as a tablet pc) and addresses linkages between these affordances and the required key-skills of the new Junior Cycle Framework.

1.3. Significance of the research

The overarching aim of this work is to determine how mobile digital devices can contribute to teaching and learning in the context of the new Junior Cycle educational framework in Ireland. The current trend toward mobile computing demonstrates a major shift in educational policy for many schools in Ireland, for many different reasons. In providing a better understanding of the contribution of digital devices in 21st century

classrooms the research will provide a distinctive insight into such technological adoptions and perceived affordances to teaching and learning.

1.4. Research Questions

- How can teachers take advantage of the affordances of mobile devices and in particular the iBook Author application in their instructional activities, so as to address the aims of the new Junior Cycle (*motivation, engagement, communication, collaboration, reflection and assistive learning*)?
- What pedagogies fully leverage using iBooks Author content on mobile devices for teaching & learning in the context of the new Junior Cycle framework?
- As a consequence of using iBooks Author with tablet PCs, in what ways have the dynamics changed between the teacher and student?

1.5. Overview of the Methodology

As such, the research will outline a theoretical framework developed by Crotty (1998) which will provide a structure for the theoretical and philosophical perspectives that influence both a qualitative and quantitative inquiry. Furthermore, the research will test this theory in an Irish setting and will discuss the extent to which this applies. To complete this inquiry, a survey and multiple site case study approach was adopted. This type of empirical enquiry affords the researcher an opportunity to collect multiple sources of data/evidence for the purpose of ensuring construct validity, as argued by both Yin (2013) and Stake (1978). Moreover as Creswell (2012, p. 97) suggests, a case study is a qualitative approach '…in which the investigator explores a real-life, contemporary bounded system (a *case*) or multiple bounded systems (cases) over time, through detailed, in depth data collection involving multiple sources of information'. Within the study, each of the sub-questions formulated lends itself to a specific chosen method to address the over-arching research inquiry. Following on from this, the thesis will describe each of the subsequent chosen methods adopted. It is anticipated that through the combined survey, focus group and semi-structured interviews within this research study, knowledge will be generated to provide an insight into the impact of mobile digital devices in pedagogical practices and student learning, in the context of the Junior Cycle educational framework. Firstly, data was initially collected from 'Early technology adopters' of digital tablet pc devices. A total of (n=160) schools within Stage 1 of the intervention were identified and surveyed as an entry mechanism to establish base line

data regarding tablet adoption and initial perspectives across post-primary schools in Ireland. Secondly, three post-primary schools were identified within the survey to take part in a more in-depth intervention. Thirdly, within Stage 2 of the multiple case study approach and post intervention, data was collated, collected and analysed from a number of surveys and interviews as detailed below.

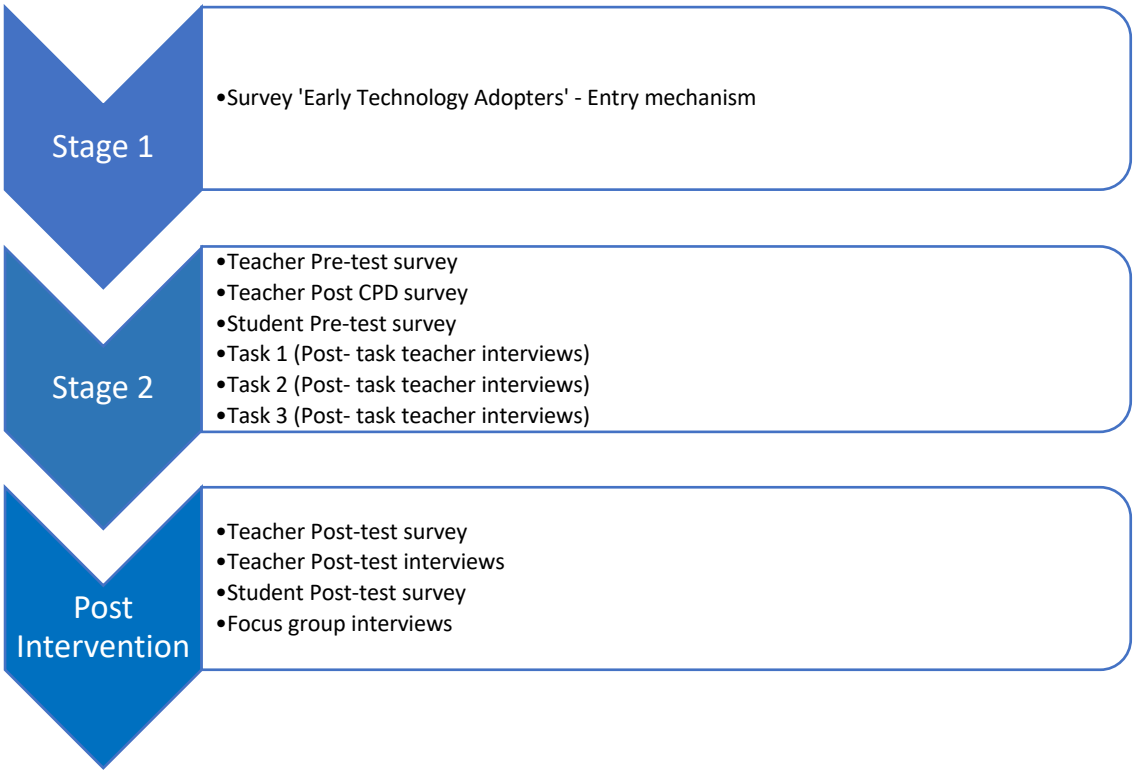


Figure 1-2: Data Collection Overview

1.6. Overview of the Dissertation

Chapter 1. Introduction to the research

The introduction chapter presents the background to the research study whilst discussing the key factors and issues related to the evolving landscape of mobile learning and adoption of digital devices within education. Following on, the researcher highlights the rationale, significance and importance of the inquiry. Moreover, this chapter will also present the research questions guiding the study and offer an overview of the adopted methodology employed within the research.

Chapter 2. Literature review

This chapter contains a review of the relevant literature in relation to a history of technology in education and adopted approaches to the embedding of ICT. Moreover, this chapter discusses the educational drive for change, mobile device features and highlights the potential affordances of mobile learning, particularly in relation to adoption digital tablet devices. The pedagogical approaches to m-learning are discussed and examined in consideration of the technical characteristics of mobile devices. This chapter also deliberates upon the core educational frameworks including Junior Cycle and Digital learning frameworks and relevant national policy initiatives such as Schools IT 2000 and Digital Strategy for Schools 2015-2020.

Chapter 3. Methodology

The following chapter firstly discusses the theoretical underpinnings to the methodology and methods employed within the inquiry. Furthermore, this chapter will deliberate upon the chosen research paradigm, providing a schema outlining the theoretical framework of the researcher's inquiry. The data collection methods employed within the inquiry are discussed, justified and evaluated for both their reliability and validity. Details related to ethical approval and considerations within the study, alongside any methodological limitations are also presented and addressed. A discussion on the research phases within the inquiry to evaluate the effectiveness of an intervention is presented, detailing each of the three phases within the adopted intervention.

Chapter 4. Findings

This chapter presents the findings of the data collected from the initial Survey study with 'early technology adopters' of tablet pcs and the findings generated by the multiple Case study instruments within each of the intervention schools, including pre and post-test questionnaires, teacher and focus group interviews. Both qualitative and quantitative data analysis and findings from each of the three studies are discussed and evaluated in detail, with a follow up cross case analysis to identify and review the commonalities and characteristics of each of the case reports within the intervention. A thematic analytical approach is adopted across the inquiry to identify key themes and relevant subthemes to present a synthesis of the adopted intervention.

Chapter 5. Discussion

This chapter comprises a summary and discussion of the main findings within each case, with a further outline and synthesise of the empirical findings to address the three core research questions. This chapter will further address potential pedagogical strategies that can leverage technology adoption and a pedagogical approach similar to the researchers inquiry.

Chapter 6: Conclusions

This chapter will focus on the inquiries contribution to knowledge, the research limitations and empirical findings from the study. Moreover, this chapter will describe the theoretical and policy implications and provide recommendations for further research. This chapter will conclude with a summary of the key findings from the research study.

Chapter 2. Literature Review

'Smartphones and tablets have redefined what we mean by mobile computing, and in the past four to five years, apps have become a hotbed of development, resulting in a plethora of learning and productivity apps. These tools, ranging from annotation and mind-mapping apps to apps that allow users to explore outer space or get an in-depth look at complex chemicals, enable users to learn and experience new concepts wherever they are, often across multiple devices.' Johnson et al. (2013, p. 7)

2.1. Introduction

The following chapter provides a review of literature relating to both past and current research which provides the theoretical foundations for the existing study. The chapter will be presented in two sections. Section One acts as a contextualisation section and will review the history of technology in education, address the long-standing educational drive for change and focus on Educational Frameworks (Junior Cycle) in the context of 21st century learning ideas. The section will also explore teacher education approaches to the embedding of ICT in teacher preparation courses and will use a sociological lens to describe cultural capital and agency relative to the progression of technology in schools. Section Two will focus on the contemporary aspects of the relevant literature and will highlight specific features of mobile devices whilst providing an in-depth linkage between the perceived affordances of mobile learning in relation to the six key skills within the Junior Cycle educational framework adopted in Ireland. The Junior Cycle framework consists of 24 statements of learning. These statements include six overarching key skills (Managing myself, Staying well, Communicating, Being creative, Working with others, Managing information and thinking). Throughout the Junior Cycle process students are expected to firstly acquire and subsequently enhance their proficiency in the aforementioned skills. This section will also discuss mobile learning from a pedagogical perspective and classroom dynamics within a pedagogical context. Finally the chapter will describe the potential impacts on the curriculum from using mobile technology.

2.2. Background

To date, major technology companies, including Google, Apple and Microsoft have made significant investments worldwide, into technology and learning using tablet pcs. While charting these emerging mobile technologies for teaching and learning, research by Johnson et al. (2013, pp. 16-17) suggests that '…tablets, smartphones, and mobile

apps have become too capable, too ubiquitous, and too useful to ignore'. Thus, as the literature suggests, given the potentially pivotal role of mobile technology within schools it is therefore important to establish if the devices can facilitate the enhancement of students' learning and the pedagogical practices of their teachers.

As this developing area in mobile technology evolves, the implementation of a new educational framework in Ireland promotes '…a shared understanding of how teaching, learning and assessment practices should evolve to support the delivery of a quality, inclusive and relevant education that will meet the needs of junior cycle students, both now and in the future' (NCCA, 2015, p. 6) . Whilst moving away from providing centralised examinations, the framework also re-positions assessment. Furthermore, it facilitates schools to ensure that literacy and numeracy are key skills embedded in the learning within classrooms.

Continuing within an Irish context, earlier research by Butler and Kelly (2007) fostered the debate into digital literacy in 21st century classrooms as part of an integrated technology project (using robots, presentation and programming software across fifty schools in Ireland), highlighted the high level of digital fluency that had markedly developed as a result of engagement with their study. The research also underscored the display of confidence from both teachers and students alike and the subsequent independent decisions taken by both parties. However, one might argue that the study by Butler and Kelly (2007) fails to highlight the non-confident users who remain silent resulting in unnecessarily narrow, incomplete and possibly biased conclusions.

By 2009, the discussion in Ireland had moved on to the requirement to meet the challenges derived from the need for students to acquire 21st century learning skills, in particular the need to transform the current education system at that time. Highlighting these previous discussions, a report by Ryan (2009, p. 25) focused on the following key aspirational action points, including '…a national strategy, a transformed education system, a new government department, a converged Irish Creative Media Board, and a new role for Radio Teilifís Éireann (RTÉ) (National Television Network)'. The focus of the national strategy was to maximise Ireland's competitive advantage in the digital era. Two Irish Government policy documents that followed reflected this desire for aspirational change, 'Investing Effectively in Information and Communications

Technology in Schools, 2008-2013' (DES, 2008), and 'SMART SCHOOLS = SMART ECONOMY' (DES, 2009).

Similarly, in the latter part of 2013, a consultative paper by Butler, Leahy, Shiel, and Cosgrove (2015), reflected earlier findings by Hallissy et al., 2013 on the need to meet the challenges of a rapidly evolving digital society. For students to experience success in the 21st century, these challenges include their commitment to gaining the relevant knowledge, skills, abilities and competencies. As Butler et al., 2015 suggest, with students living, learning and working in the 21st century, the development of a National Digital Strategy for schools is therefore of critical importance. The available evidence identified by Osmon (2011) suggests educational benefits arising from the interactivity of tablet apps, along with communication opportunities and the technologies' ability to record a learner's progress, as just some of the areas of interest to educators.

The affordances reflect similarities to the popularity of e-learning (and gaming) including; the opportunity to standardise assessments, cost effectiveness, instant feedback, actively engaging learners, easily transfer learning/skills to the real-world and lastly a learning pace tailored specifically to the student. Consequently, a formidable collection of research has focused primarily on the tablet device's attributes. In part, this review will investigate and evaluate related research from educators embracing mobile digital devices in classrooms (Wellings & Levine, 2009), to those notable researchers who in the past have questioned such technologies' validity as a learning tool (Bowers, 2011; Cuban, 2009; Oppenheimer, 2007).

2.2.1. Teacher education

A 2015 Department of Education and Skills report, (Striking the Balance, 2015) highlighted the imbalance of supply and demand for teachers in Ireland, particularly in post-primary schools. The report also focused on issues regarding substitution and short-term postings and capping of applications by the Department of Education and Skills. Prior to this, the "Learning to Teach and its implications for the Continuum of Teacher Education: A Nine Country Cross-National Study (Conway, Murphy, Rath, & Hall, 2009) report focused on the development of a more seamless Teacher Education continuum progressing from initial teacher education, to newly qualified status to continuing professional development for practising teachers. This report served to carve

out a new shape for Teacher Education in Ireland and took on board the impact of globalisation and the knowledge society of a contemporary society. Increased timeframes for programmes of Initial Teacher Education followed with increased emphasis on preparing teachers with 21st Century skillsets to teach future generations of pupils. The extended programmes of Initial Teacher Education included new modules focusing on embedding pedagogies to teach digital literacy and utilising ICT within pedagogies on School Placement and as discrete modules within the programmes. In 2012, an international review panel reviewed Irish primary and post-primary teacher education programmes provided by higher education institutions in Ireland, (International Review Panel on the Structure of Initial Teacher Education Provision in, Sahlberg, Ireland, Department of, & Skills, 2012). The report accepted the recommendations of the then Minister of Education and Skills (Ruairí Quinn, T.D.) to reduce the number of providers in teacher education with a view to establishing six centres of excellence of Teacher Education. Whilst noting the high calibre of entrants, the review reiterated the key characteristics of internationally recognised teacher education systems include high quality instruction in pedagogy and pedagogical content knowledge, with a strong emphasis on research as a basis of teaching and learning underpinned by a recognition of the use of ICT and digital tools within cross-curricular approaches. The report furthermore highlighted the required provisioning of continuing teacher education. Previous research had shown that continuing professional development for many teachers in Ireland, was very informal, leaving individual teachers responsible for their own professional development (Dolan, 2012). The importance of the use of ICT, the development of digital literacy of teachers and the embedding of 21st Century skills in ITE programmes represents a recognition of the role of ITE in preparing teachers to deliver a contemporary curriculum in schools and to optimise potential for pupils to achieve a range of learning outcomes.

By May of 2019, a review of progress by Professor Pasi Sahlberg, implementing the reforms suggested earlier in 2012 to consolidate 19 teacher education providers into six centres of excellence, whist initially critical of higher fees within initial teacher education programmes, welcomed and affirmed the continued consolidation progress under challenging economic conditions. The original intent to form six centres of excellence was revised to seven centres of excellence and furthermore highlighted the need to enable the sharing and dissemination of good teaching practice between each of the institutions.

A continuing professional development (CPD) programme for practising teachers (Cosán) is currently in the initial roll-out phase and offers practising teachers the opportunity for CPD as throughout their teaching career. Teachers may avail of different types of CPD including programmes enhancing ICT and digital competences. Within Ireland, the induction and probation of newly qualified teachers (NQTs) is provided through the 'Droichead' programme. The Droichead pilot programme began in 2013 with a subsequent review by Smyth et al. (2016) which concluded that a set of factors, rather than one specific component, is critical in the effective induction of newly qualified teachers. In promoting the professional development of teachers and to regulate standards within the profession, the Teaching Council of Ireland has recently contracted a number of researchers within both Marino Institute of Education and Trinity College Dublin, to formally conduct research of teachers' experiences with the 'Droichead' programme. The research commenced in 2018 and will continue until 2021.

The Teaching Council is currently preparing a new set of guidelines and standards for ITE in Ireland (Céim, 2018) which set out new requirements within the specific elements required within ITE programmes focusing on literacy and numeracy to include Digital Literacy and Numeracy and ICT in Teaching and Learning. The Teacher Education continuum therefore is a critical piece of the architecture that supports the education of teachers at all stages of their careers and the skillsets which are required to enhance digital literacy, numeracy and ICT in teaching, learning and assessment in schools at all levels.

2.2.2. 21st Century skills

The term 21st Century Skills refers to a wide-ranging body of knowledge and skills deemed critically important in today's employment sector, by educators, researchers and employers alike. In 2003, the Learning Point Associates (USA) released the 'enGuage 21st Century Skills: Literacy in the Digital Age' publication, in what it believed was an important step towards Digital Age readiness. At this time, with the rapid expanses in technology in people's everyday life, the publication highlighted the critical need for cognitive skills, whilst coining the term 'life skills'. Interestingly the publication focused on the influences of technology in learning (Burkhardt et al., 2003, p. 10), as a;

1. driver for change
2. bridge to academic excellence

3. platform for informed decision making and accountability.

According to Carr, it is of the utmost urgency for education to prepare students for ‘the diversity of the 21st century wilderness that they will encounter’ (Carr, 2008, p. 26). As further suggested by Dede (2010), people require different skills, for work, citizenship and self-actualisation. The current trends in Information Communication and Technology (ICT) are transforming the world of work, requiring advanced levels of cognitive skills and learning capacities (Magner, Soulé, & Wesolowski, 2011). In describing the pace of change with technology as '…breathtaking, relentless and potentially liberating for all humanity', Hallissy, Butler, Hurley, and Marshall (2013, p. 4) further advocate that even though the stakes may be high, there is ultimately a need to embrace the challenges and redesign of existing education systems in Ireland and in doing so, foster innovation and support entrepreneurial culture.

Hallissy, Butler, et al. (2013) describe in detail the technological changes in the workplace and society in general, believing these to have serious implications for schools in general. The research further elaborated on existing changes to education systems made in Australia, Finland and South Korea, to meet 21st century skill-sets required by students. These countries it suggests are moving away from summative assessments, to an educational model focused on '…cultivating engaged connected global citizens' who are life-long learners (Hallissy, Butler, et al., 2013, p. 6).

2.3. Section One: Culture, History and the Drive for change

2.3.1. Cultural capital

The concepts of culture and capital are both complex and contested. The Bourdieuian perspective of cultural capital offers a useful theoretical viewpoint and distinct terminology with which to differentiate and understand various forms of cultural capital which may include; social capital, academic capital, educational capital and economic capital and how they may manifest as institutionalised capital, embodied capital and objectified capital. Economic capital and Cultural capital may operate on an exchange basis however as economic capital confers possibilities that allow people to purchase additional educational services and resources that in turn confer greater cultural capital (Ní Dhuinn, 2018) which in turn may confer advantage or enhanced outcomes on individuals.

In adopting the concept of cultural capital and applying this to education, social theorist Pierre Bourdieu suggests the accumulation of knowledge, skills and behaviours that we have acquired and can tap into, are intrinsically linked to our particular social class. Bourdieu coined the specific term in 1973 while co-authoring a paper entitled 'Cultural Reproduction and Social Reproduction', with French sociologist Jean-Claude Passeron, (Bourdieu, 1973). Bourdieu describes this set of ideas and values that we acquire as *the habitus (cultural capital)*. This habitus contains a set of assumptions which Bourdieu argues is a major source of social inequality. A key aspect of cultural capital includes 'Educational capital', whereby middle-class parents are more likely to have attained university degrees and are subsequently in a better situation to help and guide their own children with their homework and educational aspirations. Bourdieu further proposes that the educational system in general, presupposes that students possess cultural capital. While it may be the case that students possess cultural capital originating from their family background, how that capital will manifest differs from family to family and how they utilise their capital will also differ. A selection will possess high levels of objectified capital which manifests in the form of cultural goods and objects or access to services including technology and internet connection which may enhance their levels of engagement in the education system. Their values, orientation, habitus and general disposition to engagement in education is therefore influenced by their levels of cultural capital in what Bourdieu describes as an inculcation effect exerted directly by families and schools.

Early research by Nakhaie and Pike (1998), drawing upon Bourdieu's concept of cultural capital, portrayed education as the key factor in relation to access to and use of home computing. Moreover, the study further concluded that education also played a key part in transitioning from lower to higher socioeconomic class. Furthermore, recent studies have highlighted the concerting lack of penetration in relation to Internet access for a number of ethnic social groups, due to their disregard of the advantageous nature of ICT to their own lives (Jansen, 2010; Jones & Fox, 2009). As such, Bourdieu's concepts of *habitus* and capital in relation to digital inclusion as depicted by Rojas, Straubhaar, and Spence (2012) clearly demonstrate the influence of class, ethnicity and gender. More recently, the focus on the digital divide related to internet access by Calderón Gómez (2020, p. 1) clearly defines that digital capital, "can be retransformed into each of the three main forms of capital: to economic capital by means of professional networking and access to goods; to cultural capital through access to knowledge; and into social capital by the differential management of social ties".

2.3.2. History of Technology in Education

Throughout the 20th century, technology has been the catalyst for revolutionary educational possibilities. As proposed by philospher Dwayne Huebner, whilst reflecting that technology is a tool, Huebner suggests we cannot think of anytime in educational history where educational hopes were not directly linked to an emerging technology at that time. Since the 1900s, the classroom has seen the significant introduction of the pencil (1900), overhead projector (1930) and ballpoint pen (1940), to the introduction of educational television in the 1960s. In 1971, Dr. Samuel Hurst of the University of Kentucky invented the first 'touch sensor' called the 'Elograph', which was to become a significant milestone in touch screen technology. However, it was two decades later before these 'convertible computers' gained popularity among computer manufacturers like IBM and Palm Inc. Following on from this the 1970s saw the development of the hand-held calculator and, in 1985, the CD drive, that worked in combination with the first personal computers on the market.

In San Francisco, the first computer introduced into a classroom back in 1976 by educational philosopher Lisa Loop, after a chance meeting with Apple co-founder Steve Wozniak, was certainly not a success. Wozniak explained that he had built the computer specifically for teaching and learning within a classroom but, unfortunately, after loading the operating system for 25 minutes the computer eventually crashed. As Loop explained, '…I took it back to Woz, and said, you know I really think this is a great idea. I'm all for it and I really want to use it. But I can't use this machine in a classroom. You're going to have to do something else.' For many educationalists the integration of technology into education continued its history of hype and disappointment as was evident in this early example (Bowers, 2011; Cuban, 2009; Oppenheimer, 2007; Stoll, 1996)

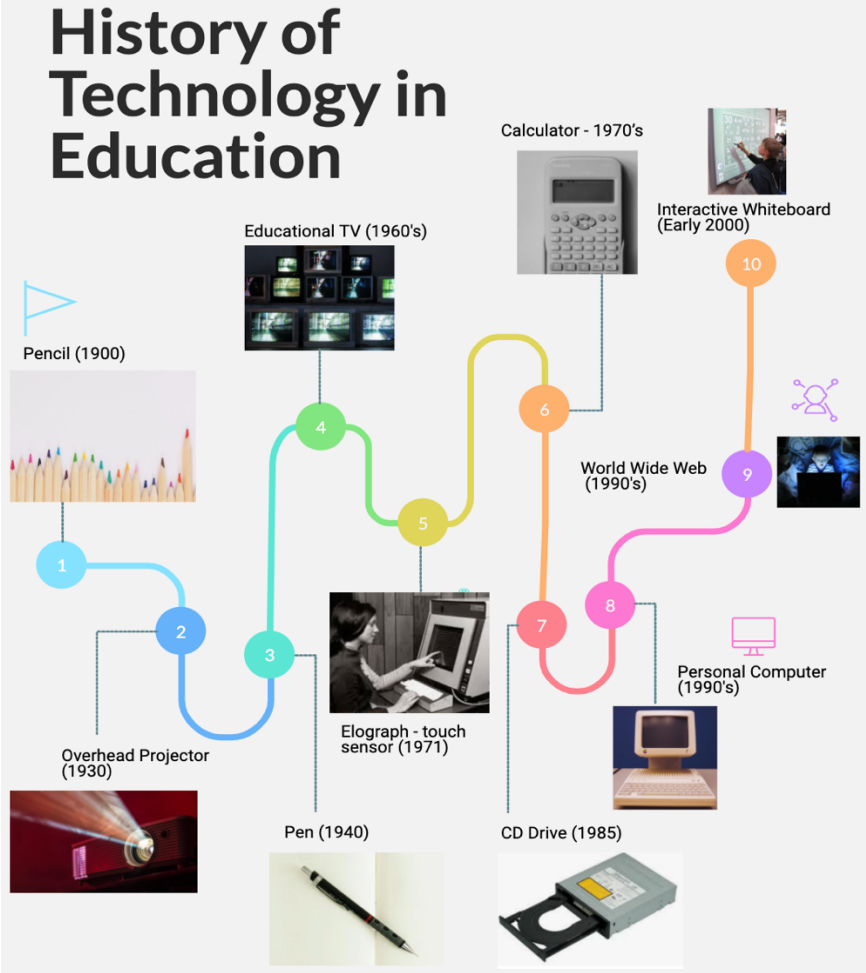


Figure 2-1: History of Technology in Education

The mid-1970s also saw the development of one of the most important applications of the Internet (ARPANET), email. Prior to its release for commercial use, individual researchers and Universities accessed email via the DARPA network. Access to the internet and the email until the 1990s, was in a limited format to the general public via their Internet Service Providers. In 1973 Dr Martin Cooper debuted the Motorola Dyna-Tac in New York and was credited as being the first person to make a call on a portable mobile phone. However, it was not until 1996 before the first mobile phone developed in Finland by Nokia enabled internet connectivity. The late 1990s heralded the introduction of interactive whiteboards (smart boards) into many classrooms in some countries including the UK and the USA. These devices afforded the use of different learning styles, including visual, auditory and kinesthetic. The adoption of interactive whiteboards (IWB) was rapid as their popularity grew among schools in Ireland in the late 2000s, interestingly this growth took place without any formal government support or initiatives. It is claimed that up to 90% of funding came from schools and school fundraising

activities by parents, (Lee, 2010). In just a few short years, adoption of whiteboards rose from 30% to 45% across both primary and post-primary schools in Ireland.

As suggested by the report authored by Lee (2010), schools in Ireland, with support from parents, have led the way in interactive technology adoption within classrooms across the country, with little to no help from government funding or initiatives. This was very much in contrast with other countries, subsidised by their governments into IWB adoption. It was estimated that by 2010, 50-75% of classrooms in Ireland had an IWB at their disposal, unfortunately with the market flooded by distributors and manufacturers, many schools struggled with a lack of consistency or compatible software when using the devices (Lee, 2010).

By early 2000, integrated technology developed further with the introduction of an interactive classroom response system (iClicker). This intuitive system allowed teachers to pose questions, record and process results from students and display the resulting feedback instantly onscreen within classrooms. Following on in 2006, a Miami-based non-profit organisation developed a mission statement to build a durable, affordable educational device for developing countries and called it the One Laptop Per Child (OLPC) program. Notable companies involved in funding of the project included AMD, Google, News Corporation, Nortel and Red Hat. By 2011 the program had delivered over 2.4 million devices in the developing world.

In 2010, another significant milestone within the area of technology in education saw the release of an interactive touch screen tablet from Apple, called the iPad. Whilst not ideally appropriate to exclusively meeting all the needs of students, research suggests that tablet pcs like the iPad comparatively '…serve as an additional device to augment and expand the connectivity and lifestyle computing choices of students who desire increased connectivity and social interaction, with improved applications and interface choices not currently offered by smartphones or laptops' (Fischer, Smolnik, & Galletta, 2013, p. 19).

As an inquiry by Leblois (2013) further advocates, '…mobile phones and tablets are poised to be omnipresent in most education settings—in developing nations in particular, which can leapfrog personal computer technology and adopt cheaper, more versatile

mobile devices' (Leblois, 2013, p. 11). However, in contrasting terms a compelling alternate narrative by Stoll (1996), expresses how consumers simply swallow conventional wisdom regarding the benefits of the introduction to technology, far too easily. His concerns on the myths of technology still hold significance today in respect of research into technology and learning. Similarly, Toyama (2011) whilst defending an earlier study by Behar (2010), claims there are no technology shortcuts to good education. As detailed previously, notable researchers have consistently argued that technology in education suffers from a poor historical record (Bowers, 2011; Cuban, 2009; Oppenheimer, 2007).

Regardless of some of these concerns, since 2010, the introduction of lightweight and portable pc devices has produced an increased growth in tablet adoption within classrooms across Asia Pacific, Europe and North America. In 2011, South Korea renowned for its advancements in technology announced the transfer from traditional curriculum paper textbooks to a digital format accessible via mobile devices including '…smart pads, smart TVs, and a variety of digital devices' by the year 2015. In 2013, Apple's Vice-President Jeff Williams met with the Turkish government to co-ordinate a joint iPad initiative, putting approximately 12 million tablet pcs into the hands of Turkish students at an estimated cost of $5 billion dollars, as part of the Fatih Project (www.FatihProject.com).

Later that same year, Microsoft announced special discounted pricing on their Microsoft Surface RT tablet device directly to schools and universities in Australia, Austria, Belgium, Canada, China, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Korea, Mexico, Luxembourg, the Netherlands, Norway, Portugal, Russia, Singapore, Spain, Sweden, Switzerland, the United Kingdom, and the United States (including Puerto Rico). Google meanwhile rapidly expanded its educational offering via its Nexus tablet and delivery of Android apps via Google Play for Education (http://www.google.co.uk/edu/android/). To date, the current market leaders in tablets include Google with the Nexus, Samsung's Galaxy Note, Asus and Dell with Windows 8, Apple's iPad, Microsoft Surface RT and Blackberry with the Playbook. These are followed by a multitude of imported Japanese and Chinese Android devices alongside an endless array of e-readers from Amazon, Barnes and Noble, Kobo and Sony, to name but a few.

Prior to the rapid increased adoption of ICT in education, research by Anderson (2009) made five prevalent predictions regarding developments on the educational horizon. They included the digitising of human knowledge and the introduction of cloud computing and social networking. Interestingly the most relevant predictions to this study included the introduction of touch-screen technology and the convergence of both mobile and computer technologies.

In summary, as the literature suggests, historically the previous inclusion of technology within education has developed a poor track record and ultimately for many, delivered false hope. Research into the adoption of technology within the sphere of education has also come under particular scrutiny, as described by Zhao, Pugh, Sheldon, and Byers (2002, p. 483),

'…traditionally, studies on educational technology have been largely interested in finding out, in horserace fashion, the relative success of particular technological innovations as it affects student learning….Because many of these technology-specific studies did not explore more fundamental issues in technology and education…the research community is having a difficult time offering desperately needed suggestions to policy makers and practitioners'.

However, educators continue to investigate various educational technologies to address teaching and learning. Therefore, due to the significant investments into mobile devices, it is important to establish if any one of these tablet pc's mentioned previously, hold the possibility to leverage today's mobile technologies, to help students enhance their learning (Martin & Ertzberger, 2013).

2.3.3. Teacher agency

The adoption of digital devices potentially provides opportunities for more diversified approaches to teaching and learning, leading to a more interactive student-centered learning experience. As a consequence and in the wake of any potential change in curriculum policy, teachers are mandated to act as agents of change whilst provisioning student agency and empowerment (Priestley, Edwards, Priestley, & Miller, 2012). In defining the term 'teacher agency', Biesta, Priestley, and Robinson (2015, p. 1) offer the opinion that this describes a teacher's '…active contribution to shaping their work and its conditions – for the overall quality of education'. Drawing from a 2-year study against the backdrop of implementing Scotland's *Curriculum for Excellence*, their research

describes how teachers in general '…struggle to locate their work within deep consideration of the purposes of education. Teachers are driven by goals in their work, but such goals often seem to be short-term in nature, focusing on process rather than longer-term significance and impact', (Biesta et al., 2015, p. 636). This awareness of a teacher's role within schools highlights their unique and significant portrayal '…as change agents in professional development, school reform and school improvement', (Imants & Van der Wal, 2019, p. 1). However, as previous literature suggests, in many instances the levels of agency vary within various contexts, conditions and constraints (Priestley et al., 2012). With teachers perceived as resistant to change and reluctant to engage in reform, recent research highlights their '…willingness to engage with changes was also related to their sense of subject identity', (Harris & Graham, 2019, p. 1).

Within an Irish context, teachers in Ireland have enjoyed high cultural and social status within their communities, with teacher unions previously observed as employing an effective veto over curriculum decision-making. The initial proposed curriculum reform at junior post-primary level in Ireland led to a very long and protracted dispute from 2011 onwards, leading to strike action by teachers' unions in 2015. In this instance a compromise was found in a programme provisioning gradual internal and external evaluated assessment from September 2015 (NCCA, 2015). Whilst Ketelaar, Koopman, Den Brok, Beijaard, and Boshuizen (2014, p. 317) believe that 'teachers with a strong sense of agency tend to attribute their successes and failures with an innovation to themselves, while teachers with a lack of agency tend to attribute it to external factors', Biesta et al. (2015, p. 636) continue to observe 'some uncomfortable issues about the ways in which teachers engage with new curricular policy, and about their agency'.

2.3.4. Student agency

In describing the future of education and skills for 2030, the OECD characterises student agency as pupils having the ability and will to positively influence their own lives and the world around them (TAGUMA, Senior Analyst, FERON, & Meow Hwee, 2018). However, the OECD further suggests that students firstly require the necessary foundation skills. As agents in their own learning they subsequently play an active role deciding how and what they will learn. Thus, as they become more responsible for their own learning, they are ultimately much more motivated and participatory. Fostering student agency in parallel with the growing and potentially productive use of mobile technology, is a key enabler to students '…capacity to act as learners and future practitioners', (Trede et al.,

2016, p. 1). The previous focus on student agency within education research literature firmly positions teachers as facilitators, students as authentic participants, with adaptive schools providing opportunities for the 'student voice' to be heard (Robertson, 2017).

2.3.5. The Educational Drive for change

'I hold out four criteria for integrating technology and pedagogy to produce exciting, innovative learning experiences for all students – something desperately needed to bring education into the 21st century. These new developments must be i) irresistibly engaging (for students and for teachers); ii) elegantly efficient and easy to use; iii) technologically ubiquitous 24/7; and iv) steeped in real-life problem solving' (Fullan, 2013, p. 4)

Whilst debating the topic of technology enhanced learning, Goodman (2001) highlighted what he described as the opportunities for change. Goodman was to describe the technological revolution at this time, as having not only '…profound impacts on the educational process' but an underlying theme as to how to '…react to or adapt to technology to fit the missions and goal of our institution', (Goodman, 2001, p. Xvi).

Highlighting the changing economics of education and the drive for lifelong learning on the back of 'Internet2' - the new super highway, Goodman acknowledged that institutions at that time required new strategies 'to survive and enhance their positions' (Goodman, 2001, p. Xvi). In a similar vein, research by Natriello argued that '…sociologists of education can play a significant role in designing the educational institutions of the digital age. Failure to engage at this defining juncture may appropriately lead to forfeiture of the right to criticise in the future', (Natriello, 2001, pp. 263-264). Describing the nature and accomplishment of curriculum-based integration of educational technologies, Kovalchick and Dawson (2004, p. 194) suggest, '…the role of the teacher must change to become that of a facilitator. The teacher's role changes from being the "sage on the stage" to being the "guide on the side."' As teachers plan authentic learning experiences that incorporate a variety of tools and technologies, they need to be prepared to guide students through the learning experience. This requires a good foundation in computer literacy, information literacy, and integration literacy. Initially, teachers may be uncomfortable with the role of facilitator; however, as students adjust and learn to be more responsible for their learning, they will be more motivated and become better problem-solvers'. With a similar focus on the need for change, Fullan (2006) described

the dilemmas facing organisational leaders when radical change effects their environment, proposing that a failure to act ultimately leads to extinction.

Later in the autumn of 2008, whilst predicting the rise and fall of tablet computers, research by Atkinson (2008) suggested that from a social constructionist viewpoint, the success or failure of technological devices lies in a 'complex range of social factors'. Atkinson argued that different groups of people have varied views on the extent to 'which a particular technology works for them' (Atkinson, 2008, p. 21). The acid test for technology, he concludes, relies heavily upon human acceptance. Several researchers including Vollmer (2010) and Wembler (2010) note that with the introduction of the tablet, there is for the first time a functional device in which a '…readable touch screen frees a learner from the constraints of a keyboard' (Wembler, 2010, p. 6). As Marmarelli and Ringle (2011) predicts, the adoption of tablet pcs with a seemingly endless array of educational apps will continue to grow rapidly. The pedagogical advantages of handheld wireless devices have been previously well documented by Chan and Robbins (2006), including portability and customisation of individual learning paths to social interactivity and the building of relationships as demonstrated by Rowan and Bigum (2004). In Taiwan, a similar enquiry into the adoption of digital products including tablet pcs, netbooks and smart phones, proposes the 'age' factor of the recipient as being the '…most powerful demographic variable for technology adoption, indicating that the respondents who were younger were more likely to adopt the three technologies', (Li, 2014, p. 250).

With young people being actively engaged in their learning, Hallissy, Butler, et al. (2013), highlights the need to help students become critical thinkers and ultimately take responsibility for their learning. As the research by Hallissy, Butler, et al. (2013) was to confirm, digital technologies have the potential to transform how our teachers teach and students learn. Within this Irish context, initiatives such as 'Project Maths' and plans to transform the Junior Cert programme have been widely contested by educators (Shiel & Kelleher, 2017). Similar moves away from teacher-led pedagogies and the over-reliance on summative high-stakes examinations are described as fitting with best international practice, as the evidence from international assessments demonstrates a significant increase in performance for those choosing a more student centered model Hallissy, Butler, et al. (2013). As such, with more and more countries moving away from the reliance on teachers preparing their students for summative assessment, the focus for

many has developed into the cultivation of student centered learning to engage and connect students as life-long learners (Hallissy, Butler, et al., 2013). Furthermore, within the Irish context, Hallissy, Butler, et al. (2013, p. 7), believe this approach heralds an opportunity to create a vision for 'a smarter education system that better meets the needs of a modern 21st century society', echoing earlier arguments in reports published by both Ryan (2009) and Ireland (2008).

Whilst reflecting on previously mentioned research, a number of overarching themes have developed when debating the introduction of technology within classrooms in Ireland. These include the lack of an underpinning theoretical and philosophical framework, as explored by Conway (2000), with the potential for external influence of corporate interests and the significance of various agencies' inter-relationships in successive policy decisions (Galvin, 2009). With the absence of a theoretical framework, it is argued that the Irish government policy Schools IT2000 simply took a technological approach, as they believed by simply creating an infrastructure, provisioning technology coupled with limited IT training for teachers, would lead to both encouraging and successful outcomes. However, as Dede (2000, p. 282) argues, ultimately '…technology is not a 'vitamin' whose mere presence in schools catalyses better educational outcomes.'

Within Ireland, as a result of the research evidence, public and political consensus and growing professional private sector concerns, a reform of the Junior Cycle was initiated in 2011 (NCCA, 2011). The reform of the Junior Cycle proposes a greater emphasis on key skills to deepen students' learning and equip them '…to take up the challenges of further study in senior cycle and beyond' (NCCA, 2011). Even though technology is just one element within this framework, once again society has led the way, with education playing catch up to the demand for a new diversity of skills required in the 21st century.

2.3.6. Educational Frameworks

'We are currently preparing students for jobs that don't yet exist . . . using technologies that haven't been invented . . . in order to solve problems we don't even know are problems yet' (NCCA, 2011, p. 19)

As a feature of 21st century learning, the development of key skills or competencies alongside a myriad of frameworks has been created to '…delineate content and

processes that teachers should convey as part of students' schooling' (Dede, 2010, p. 51). There are a numerous technology-based frameworks for teaching and learning; the three most popular models to illustrate the concept and applications of 21st century skills in education include the following:

2.3.6.1. International Society for Technology in Education (ISTE)

Notable frameworks specifically related to 21st century competences include the International Society for Technology in Education (ISTE®), a non-profit organisation, creator and steward of definitive education technology standards. The ISTE standards framework successfully implement digital strategies to enable a positive impact on both teaching and learning (Handler & Strudler, 1997), setting both teacher and student goals in relation to technology integration in education (Education, 2007). With society moving to an information/knowledge culture this set of standards focuses on the use of technology to actively support student learning (Voogt, 2008). With the recent advances in digital mobile device technology, a revision of the ISTE framework has incorporated the original standards with an additional enhanced focus on '…collaboration, advocacy, digital literacy, media literacy, computational thinking, privacy and student data, student empowerment, data-based decision making, feedback, and teaching colleagues', (Trust, 2018, p. 1). With the inclusion of seven key themes; Learner, Leader, Citizen, Collaborator, Designer, Facilitator, and Analyst, the ISTE framework today promotes a unified educational technology experience to empower teachers with the ability to enhance teaching and learning (Borthwick & Hansen, 2017).

2nd edition (1997)	3rd edition (2004)	4th edition (2008)	5h edition (2017)
3 domains, 18 indicators	6 domains, 23 indicators	5 domains, 20 indicators	7 roles, 24 indicator
1. Basic Computer/Technology Operations and Concepts 2. Personal and Professional Use of Technology 3. Application of Technology in Instruction	1. Technology Operations and Concepts 2. Planning and Designing Learning Environments and Experiences 3. Teaching, Learning, and Curriculum 4. Assessment and Evaluation 5. Productivity and Professional Practice 6. Social, Ethical, Legal, and Human Issues	1. Facilitate and Inspire Student Learning and Creativity 2. Design and Develop Digital Age Learning Experiences and Assessments 3. Model Digital Age Work and Learning 4. Promote and Model Digital Citizenship and Responsibility 5. Engage in Professional Growth and Leadership	Empowered Professional 1. Learner 2. Leader 3. Citizen Learning Catalyst 4. Collaborator 5. Designer 6. Facilitator 7. Analyst

Figure 2-2: Iterations of the ISTE framework

2.3.6.2. *The Partnership for 21st Century Learning (P21)*

By 2002, the Partnership for 21st Century Learning (P21) also came into existence. In contrast to ISTE, the P21 framework was founded by a coalition of policy makers, business community and educational leaders. The US Department of Education was instrumental in the founding of P21, alongside AOL, Apple, Microsoft, and Dell, to name a few. With a focus on integrating skills into cross-curricular teaching within a framework for 21st century learning, key aspects to the framework highlight students acquiring the necessary essential skills in relation to critical thinking, communication, problem solving, creativity, innovation and collaboration (Skills, 2009). Since its conception in 2002 a series of iterations of the framework have evolved into *The partnership for 21st Century Skills*, presenting an holistic view of 21st century teaching and learning. The theoretical basis of the framework as defined by the coalition was to highlight the necessary skills it believed students must acquire for success in today's workplace.

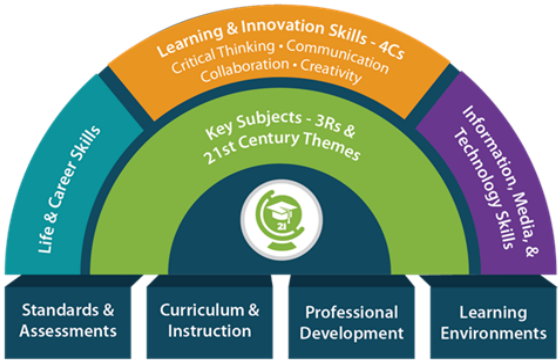


Figure 2-3: The partnership for 21st Century Skills framework

2.3.6.3. *Junior Cycle Framework*

Against this backdrop of reform and within an Irish context, the Junior Cycle educational framework was first published in October 2012. It was formally based on the National Council for Curriculum and Assessment (NCCA) advice to the Department of Education in Ireland as set out in 'Towards a Framework for Junior Cycle' (Nov 2011) and on research into education for young people aged 12-15/16 years. Early reform reflected educational aspirations in relation to the development of key skills that complimented a format of traditional content based learning. The core emphasis on Key Skills was derived as a result of the proliferation of digital technologies and its potential impact on education. Within a global context Key Skills competencies are firmly aligned with curriculum reforms. Since the early 2000s a significant body of literature has influenced the reform, providing frameworks and strategies. In presenting Key Sills as '21st Century'

competencies, reflects both digital technology development but also in relation to the 'world of work', influenced by globalisation and international comparative assessments (PISA). The origins of 21st Century competencies can be traced back to the work of DeSeCo (2005) and Rychen and Salganik (2003) to the eight key skills and related elements set out in NCCA (2015), that reflect skills originally identified globally in the work of Voogt and Roblin (2012).

The framework was created to enable teachers to develop their students' skills and abilities in ways that reflect the interests and needs of students. Prior to the framework several concerns had been raised regarding literacy and numeracy standards achieved by Irish students. By the end of year one a significant number of students did not progress in English and Mathematics. Furthermore research by Halbert (2005) for the Economic and Social Research Institute (ERSI) highlighted the issue of second year students becoming completely disillusioned with the learning process. Moreover, the assessment practice at the end of the Junior Cycle in Ireland was described as being out of line with the best practice of high-performing educational systems in many other countries. International testimony has shown a narrowing of the learning experience when the assessment system is restricted to assessing students via external examinations and testing. As the evidence suggests in this example, both the teachers' and students' focus is primarily on learning what is necessary to do well in the final examinations, rather than the pursuit of an educational program designed to meet the interests and needs of students. Finally, whilst empowering schools with flexibility, the framework intended to provide teachers with an opportunity to take more control over and involvement in assessment, thus encouraging schools to engage in a process of self-evaluation and reflection. As part of the framework students acquire a range of key skills and competencies, including the following as depicted in Fig 2-1:

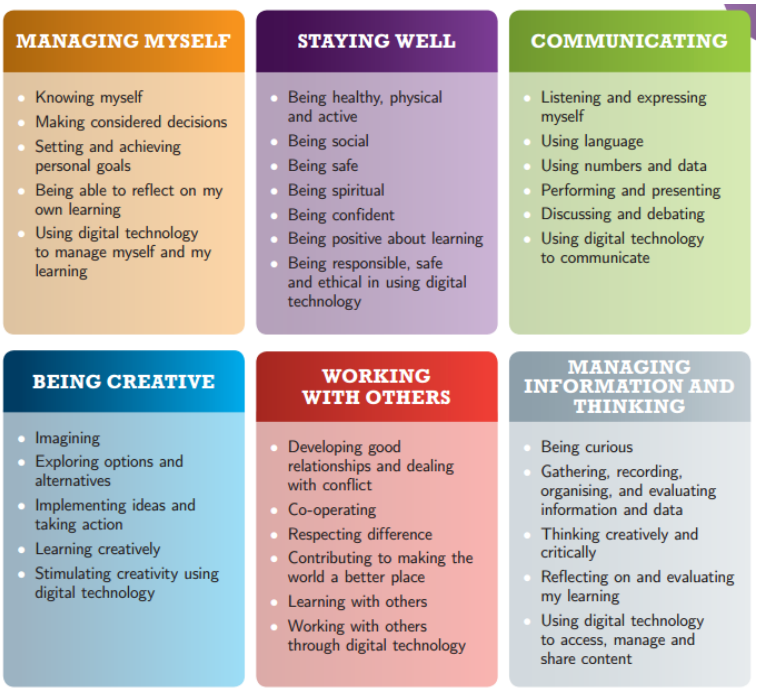


Figure 2-4: Junior Cycle Key Skills Framework

Recent evidence of technology-mediated learning related to the achievement of key skills is provided by Johnston, Conneely, Murchan, and Tangney (2015) while adopting the project-based Bridge 21 model (Lawlor, Conneely, & Tangney, 2010). The positive results provided statistically significant gains, with the role of technology reflecting as both enabling and enhancing the project approach. However, classrooms lack an emphasis on 21st Century skills, as high stake summative assessments do not assess these particular outcomes (Dede, 2010; Dempsey, 2016). As such, the challenges for teaching and learning in a digitalised world, are to acquire new assessment frameworks and pedagogical practice to successfully assess 21st Century competencies (Voogt, Erstad, Dede, & Mishra, 2013). The challenge is the alignment of curriculum, pedagogy and assessment as reflected in key skill-based approaches. This has already begun with the recent changes in respect of greater emphasis on individual and group classroom-based assessments. As reflected by Fullan and Donnelly (2013, p. 10) '…pedagogy and change knowledge will have to dramatically step up their game in order to contribute their essential strengths to the new learning revolution'.

2.4. Section Two: Learning technology

Within an Irish context, the following section primarily focuses on mobile technology, the potential linkages between the perceived affordances of digital mobile learning and the Junior Cycle Key Skills. The key areas of specific focus within this section include pedagogy, classroom dynamics and curriculum development.

Within a rapidly evolving digital landscape in Ireland a National Digital Strategy for Schools became a critical component in preparing students to live, learn and work within a 21st century society (Butler, Leahy, Shiel, & Cosgrove, 2013). However, with the initial focus on ICT infrastructure and technical support, the report highlighted that '…teachers' pedagogical orientations are pivotal in how the digital technologies are used, (Butler et al., 2013, p. 11)'.

By 2015, the Digital Strategy for Schools (2015-2020) based on levels of ICT usage by teachers and schools across Ireland. Initial perceptions highlighted the views of many viewing ICT as peripheral in contrast to the strategy promoted by the government, integrating ICT as central within its Digital strategy for schools, (Education & Skills, 2015). Whilst acknowledging the importance of aquiring the necessary 21st learning skills to develop higher order thinking, creativity and collaboration, the strategy's vision was to '…enhance teaching, learning and assessment so that Ireland's young people become engaged thinkers, active learners, knowledge constructors and global citizens to participate fully in society and the economy', (Education & Skills, 2015, p. 5).

By 2018/19, a new Digital Learning Framework for primary and post primary schools was developed in relation to embedding digital technologies in teaching and learning and assessment. Incorporating Digital Learning Planning Guidelines alongside continuous development resources, the framework supports the Digital Strategy for Schools, (DES, 2015) and other previously published Irish government policy documents, while providing agency in curriculum reform, implementation, skills development, teacher education and learning outcomes. With the key focus of improving students' learning whilst underpinning constructivist principles within teaching and learning practices, the framework supports a 'higher level' of teacher education mediated by digital technology while promoting active learner participation and engagement within developed learning activities. In essence, the framework primarily advocates a student-centered approach whereby students are self-directed and ultimately motivated in their overall approach to their own learning. A key outcome is the adoption of a 'whole school' commitment and accession to effective use of digital technologies. As a consequence

the framework will generate discussion, reflection and planning of digital integration.

The Framework seeks to actively engage students as critical thinkers, active learners and knowledge constructors. For teachers, the Framework is recognised as a useful tool in identifying their Continuing Professional Development needs within a holistic school-wide commitment to embedding digital technologies within their teaching practice whilst meeting the needs of all learners. This pro-active approach to engaging with the framework within a local context further provides teaching staff ownership of this challenge as they identify the key aspects of ICT integration within their own schools. Underpinned by five key principles the framework, in adopting a constructivist pedagogical orientation, embeds ICT to both support the inclusion and diversity for all leaners by enhancing a range of learning opportunities. The framework further provides a proactive role by the Department of Education (with additional agencies) in implementing the strategy. Both schools and the Depratment of Education will enable users to adopt ICT in both an ethical and safe manner. Lastly, all key levels of the education system will be actively engaged in inclusive planning for effective ICT integration across all schools. This strategy underpinned by the five key principles will ensure all key stakeholders a proactive role in enhancing ICT integration within the education system. The following figures respectively depict the Post-Primary Teaching and Learning and Leadership and Management domains within the Digital Learning Framework (DES, 2017b).

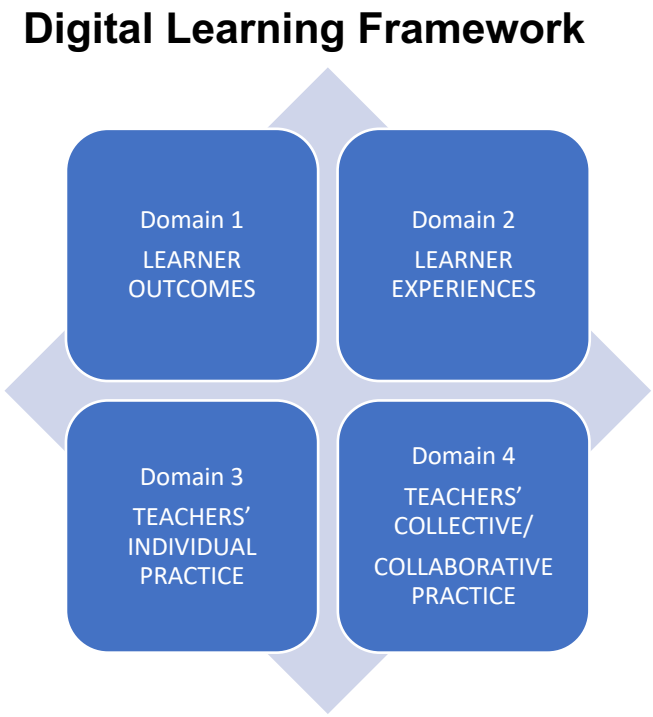


Figure 2-5: Post-Primary - Teaching and Learning domains (DES, 2017b)

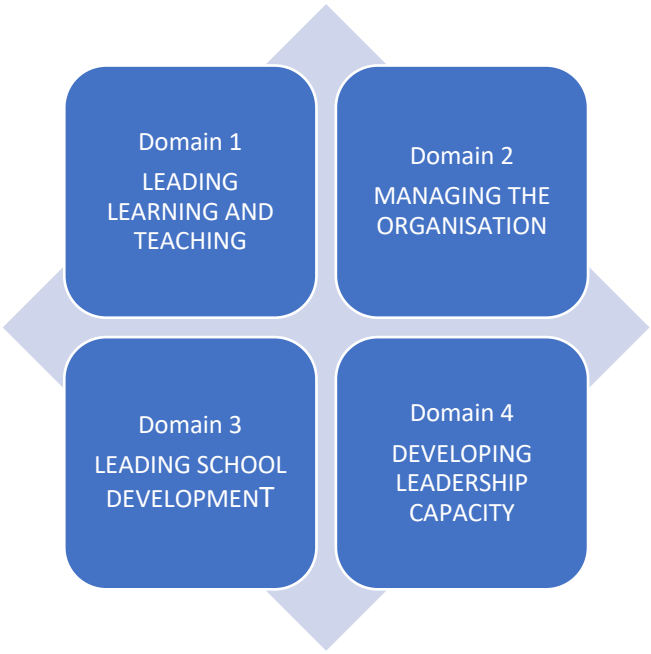


Figure 2-6: Post-Primary - Leadership and Management domains (DES, 2017b)

2.4.1. Mobile device features

In relation to mobile tablets and since the introduction of the iPad, similar numerous devices have been released to the market, each with its own app store that leverage the device's built-in features. For many such mobile devices these features include a high definition photo and film camera, Wi-Fi, audio recording, Bluetooth, tethering, apps and touchscreen. By 2012, Google (Google Apps for Education) claimed to have over 10 million users, Microsoft (Office 365 for Education) with 15 million users while Apple in 2015 claimed to have a total of 75,000 educational Apps available to download via its iTunes store.

The capability of 'apps' has rapidly emerged as a focal point in the affordances of mobile device technology. Highlighting these affordances, the Australian Learning Exchange focused specifically on the ways a tablet might be used to interact with student learning in the classroom. A number of key factors were discovered including the device's portability and 'fit-for-task' suitability to support learning. The inquiry further discussed the affordance to learners of quick access to a multitude of apps for particular learning tasks, the ease of use which appealed to a wide variety of users and the features therein which would cater for different learning styles; visual, tactile and auditory. The report findings noted that learners of all levels could use the apps especially for '…reinforcement and rote learning of basic concepts' (Education, 2011, p. 2). Despite some methodological caveats, it concluded that the device and apps showed extensive

affordances as a learning tool especially in the areas of critical thinking, problem solving, decision-making and research and information fluency.

Similarly, earlier research describes how the devices cannot only be useful in providing instruction but also '…model technology integration in multiple formats' Steinweg, Williams, and Stapleton (2010, p. 59). This, the authors believe, affords the likelihood of student learning to take place by addressing student's specific learning preferences or styles, due to the versatility of tablet pcs with their multiple input options. The next section will describe the affordances that lend themselves to the educational setting.

2.4.2. Affordances of mobile learning

The following section details the key characteristic affordances of mobile learning. These include motivation, engagement, communication, collaboration, reflection and assistive learning. These characteristics are of importance, as the researcher will address a linkage between each of these affordances of mobile devices, and the required key skills of the Junior Cycle framework.

2.4.2.1. Motivation

Early studies by Guthrie and Richardson (1995) and Talley, Lancy, and Lee (1997) discovered that students were essentially more motivated to use computers due to the duration of time spent using the devices and involvement in focused sessions, compared with other non-related computer-related activities. The effects of technology integration within classrooms are as the literature suggests, primarily positive, wide-ranging and well documented. For example, whilst exploring motivation in using mobile devices Jones and Issroff (2007) claim five key factors dominate this area: informal learning, a sense of ownership, communication (supporting collaboration), entertainment value, accessibility to resources and lastly portability (providing continuity between settings). Similarly, an inquiry by Couse and Chen (2010) analysed students becoming accustomed to tablet technology and its effectiveness in relation to engagement. Findings from the study demonstrated high levels of interest and persistence without frustration when adapting to any technical issues that occurred. The main criticism of this inquiry is primarily due to the restrictive data collection, limiting the empirical validation of the benefits of this technology in learning. However, there is ample growing

support for the claim that there is an impact on motivation once students begin to use mobile devices (Valstad, 2011).

As earlier research by Twining et al. (2005, p. 8) advocates, '…if they are motivated and enjoying learning then there is a higher chance that it will affect attainment and progress'. In one of the first comprehensive reports into tablet adoption, the Open University provided extensive analysis of twelve case studies from various schools in the UK. Both slate/style and convertible tablet PCs were used across all the schools. Interestingly, the report highlighted the motivational impact not only on students but on teachers too. As one researcher from the report commented, using the devices had appeared to revitalise the teachers, increasing their motivation and their enthusiasm for integrating ICT into the curriculum. However, the documented research took place at a period of transition for many schools investigating the potential of tablet pcs. Each reported case study enjoyed its own considerable variance of resourcing levels, highlighting for many the need for careful planning and extra on-site support. Later research by Sachs and Bull (2012) proposes that there is a motivational factor in learning, once tablets become introduced into the classroom, confirming the earlier findings by Twining et al. (2005). From a learning perspective, using unique apps in conjunction with the versatile tablet photo and video camera can allow students to become spurred on by their unique creativity in storytelling and video production, making class projects almost 'come alive' (Twining et al., 2005, p. 8). In this particular pilot study by Sachs and Bull (2012), over 88% of the 884 students surveyed firmly believed that the tablet device enhanced their learning experience, while at the same time 90% believed the device had a positive effect on their motivation to learn. Similarly Goodwin (2012, p. 18) observed that '…when students discovered a new function on the iPad, there was a domino effect, where new information was discovered by a student and then 'ripples' followed around the room'. The literature has demonstrated the ability of digital mobile devices, such as a tablet pcs, to motivate and ultimately engage students in teaching and learning (Clarke, Svanaes, & Zimmermann, 2013).

In the context of Junior Cycle there is a distinct link between the perceived motivational factor in learning with mobile devices and the 'Managing Myself' key skill. In particular, linking motivation for learning with the key elements of 'Setting and achieving personal goals' and 'Using digital technology to manage myself and my learning'.

2.4.2.2. Engagement

In discussions around the topic of engagement, findings by Attewell and Webster (2005) and Oblinger (2010) lend support to the claim that mobile devices can facilitate engagement with students. Furthermore, arguments by Oblinger (2010) find support in recent research by Brown, Thomas, and Thomas (2014), declaring that '…students have a desire to use technology in the classroom'. Whilst researching engagement and support of mobile learners, Attewell and Webster (2005) contend that mobile devices increase confidence, focus and furthermore improve retention. The 3-year pan-European collaborative research and development (R&D) programme supported by the European Union (EU) involved over 300 reluctant young learners (in three separate European countries) using Smartphones and PDA/phone hybrids to gain access to both learning materials and systems developed within the project. The study's hypothesis suggested that hand-held mobile devices could be used for learning and could furthermore attract students who otherwise did not enjoy traditional education.

As one of the mentors from within the study states, '…the devices are good tools to engage non-traditional learners, they remove the formality, which is the most frightening aspect for those who have not engaged with learning' (Attewell & Webster, 2005, p. 18). However, the main weakness of the study is the failure to address how some of the positive outcomes highlighted, are possibly due to the novelty of using mobile devices. This study would have been more relevant if the researchers had asked students about previous experience in using similar devices. In the absence of adequate detail, it is difficult to access the validity and reliability of the findings.

According to later research by McCaffrey (2011, p. 2), '…mobile devices applied in the context of education will engage students, foster deep and meaningful learning, and result in today's kids reaching frontiers that generations before them could never hope to glimpse'. This study described the change of pedagogical approach using the device, making the learning experience '…simpler, yet deeper' (p. 62). Furthermore, the results showed that students learn best when such technologies are '…seamlessly integrated into the curriculum to enhance their learning experience' (p. 62).

The traditional format for the delivery of teaching sometimes involves the use of projected static slides. This type of delivery can allow students to switch-off, so in order

to engage the students the number of explanations and digressions from slides to the whiteboard can be increased using the tablet. This in turn allows students to witness how everything can be built from the ground up. Slides can be annotated in real time, with every note, graph and formulae written during the class captured in a video recording. The analysis noted the increased interest and participation of students to this approach, where the students felt safer and more confident that they could access the material at a later date to review (McCaffrey, 2011). In the same way, distance learners can benefit from this approach to delivery, as it can make them feel that they were in the classroom. In relation to particular Key Skills educational framework, students gain encouragement to use different technologies to plan, manage and engage in their learning. Research by the ERSI (Halbert, 2005), had previously highlighted that many second-year students simply became disengaged from the learning process. The Junior Cycle Framework in 2013 however aims to proactively overcome such disengagement in learning whilst facilitating a positive and captivating environment for students. On the basis of the evidence currently available, it seems fair to advocate that the use of technology fosters engagement of students. Moreover, current research appears to validate the view that mobile technology '…allows the novice and expert a reference at their fingertips' (Boyce, Mishra, Halverson, & Thomas, 2014, p. 817). As Boyce et al. (2014, p. 817) further propose, '…learning in informal settings allows students to engage in learning in ways that are not possible in a traditional classroom environment'.

2.4.2.3. Communication

Early research by Sneller (2007) explores the area of student-to-student communication using tablet pcs, whilst adopting a cloud-based classroom management application called Dyknow. Furthermore, Sneller also claims that use of the application in conjunction with WebCT (Virtual Learning Environment), afforded feedback on participant status, polling (real-time feedback) and student submissions. The student submission feature enhanced communication and feedback whilst students shared notebook panels with their instructor or the whole class, '…the feedback mechanism in particular seems to have been beneficial, resulting in fewer students than expected performing poorly' (Sneller, 2007, p. 8).

As suggested by McNaughton and Light (2013), for those students with disabilities, a device such as a tablet pc can afford the users new tools in which to potentially enhance communication with their peers. Within this theme, a systematic review of mobile devices, iPods and iPads by Kagohara et al. (2013), revealed eight studies targeting the

improvement of communication, with a relatively positive response. The studies concluded that mobile devices, such as the iPad, are viable technological options for those with ASD or an intellectual disability. In both instances, Kagohara et al. (2013) and McNaughton and Light (2013), agree that further research into the area of improving communication using mobile devices, particularly for those individuals with complex communication needs, is imperative. Mobile devices such as the tablet pc continue today to afford both educators and students alike, the ability to use digital technology to communicate 1-2-1 or collaboratively as a group. Furthermore, the apps within mobile devices afford educators and students the opportunity to extend their relationship outside of the four walls of the classroom (Falloon, 2015). In the context of Junior Cycle framework there is a distinct link between the varied communication apps within mobile devices (eg: Skype, Facetime, Instant Messenger) and the 'Communicating' key skill. In particular, linking the affordance of communication using a mobile digital device to the key skill element of 'Using digital technology to communicate'.

2.4.2.4. Collaboration

An inquiry by Falloon (2015) examined the ability of students to work collaboratively whilst using an iPad. Based in New Zealand, the study was prompted by initial observations revealing consistent use of the device and app use that appeared to support many students' collaborative efforts. Fallon's research had followed in the footsteps of an earlier study focusing on '…how students interact with one another while using technological devices (iPads) in traditional, face-to-face learning environments' (Fisher, Lucas, & Galstyan, 2013, p. 167). While the earlier inquiry by Fisher et al. (2013) signalled the design features of the iPad in supporting learner collaboration; it is nevertheless apparent that this is questionable data as the sample for the study included a limited trial within a single subject discipline. In contrast, Fallon's research study involved almost a hundred primary schools over a three-year period. As part of this follow-up investigation to earlier observations, students were tasked with several collaborative learning scenarios. Data collection from the study took the form of observations, recordings of exchanges with students and video capture of apps used. Analysis from the research displayed favourable patterns as to how the students used the iPads collaboratively and how different attributes and features within the device and apps, in particular Google Docs, appeared to support the students' endeavours. One particular criticism of the literature's analysis focuses upon the third and fourth year (aged 7-10) students who completed a 20-item Likert scale-based survey, which was employed as part of a classroom-based task. Unfortunately due to the age factor and in

some cases limited reading capabilities of some students, the survey ultimately necessitated a classroom-based location for its completion. In contrast, the fifth and sixth year students completed their surveys independently. Following on, the survey responses were linked to technical/design and app related classifications as part of focus group based discussions, with each group comprising of 7-10 random students. However, the data yielded by this study provides strong convincing evidence of the iPad's affordances in meeting the students' requirements in creativity, collaboration, consumption, communication, connections and curiosity. Fallon drew attention to the efforts needed to sustain such collaboration, '…first, having access to iPads such as described here will not guarantee collaboration. iPad use in these classes was embedded in curricula purposely designed to foster learner collaboration and higher order and critical thinking skills' (Falloon, 2015, p. 10).

The literature to date advocates general agreement that mobile devices such as the tablet pc can facilitate collaboration among students (Mang & Wardley, 2012; Rossing, Miller, Cecil, & Stamper, 2012; Smith & Caruso, 2010). In particular research by Fisher et al. (2013) specifically highlights the accessibility of the device (size, portability, versatility and tactile nature) as one of the main factors to enable such collaboration. In contrast Fallon's work has some limitations; its main value however lies in proposing the need for an educational curriculum designed specifically to foster collaboration in the context of mobile device utilisation. As clearly shown in the research, the affordance of collaboration within mobile devices can be linked with the Junior Cycle Key Skill '*Working with others through digital technology'*. Using apps like Google Docs and Dropbox within an accessible device can encourage and facilitate collaboration amongst Junior Cycle students.

2.4.2.5. Reflection

When discussing the topic of reflection, research by Dewey (1933, p. 35) claims that '…while we cannot learn or be taught to think, we do have to learn to think well, especially acquire the general habit of reflection'. Furthermore, Dewey believes this rational and purposeful act becomes an '…active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and further conclusions to which it leads… it includes a conscious and voluntary effort to establish belief upon a firm basis of evidence and rationality' (Dewey, 1933, p. 9).

In contrast, innovative thinking around 'reflection-in-action' by Schön (1983) depicts reflection as a key element in professional growth. Schön (1983) further suggests that

the capacity to reflect on action so as to engage in the process of continuous learning is in fact one of the defining characteristics of professional practice. Alternatively whilst developing his own experimental learning theory, Kolb (1984, p. 38) highlights the focus on the learner's internal cognitive processes, '…learning is the process whereby knowledge is created through the transformation of experience'. This four-stage learning cycle developed by Kolb includes:

- Concrete Experience - (a new experience of situation is encountered, or a reinterpretation of existing experience).
- Reflective Observation (of the new experience. Of particular importance are any inconsistencies between experience and understanding).
- Abstract Conceptualization (Reflection gives rise to a new idea, or a modification of an existing abstract concept).
- Active Experimentation (the learner applies them to the world around them to see what results).

However, as Kolb (1984) advocates, effective learning only occurs when the learner has completed all four stages of his model. In essence, no one stage of the cycle is on its own an effective learning procedure. Along similar lines, Boud, Keogh, and Walker (2013, p. 19) were to later propose that the purpose of reflection is to allow a person to '…recapture their experience, think about it, mull it over and evaluate it'.

As a characteristic feature of good teaching practice, critical reflection as described by Brookfield (1998, p. 197), is a process of inquiry where teachers try to discover and research '…the assumptions that frame how they work'. Following on, Brookfield (2002) further suggests that critically reflective teachers will continuously critique these assumptions through four complementary lenses.

- Lens 1: Our autobiography as a Learner of Practice – '…much of how teachers teach is in direct response to how they learned', Brookfield (2002, p. 32).
- Lens 2: Our Learners' eyes – '…having a sense of what is happening to students as they grapple with the difficult, threatening, and exhilarating process of learning constitutes instructors' primary pedagogic information', Brookfield (2002, p. 34).
- Lens 3: Our Colleagues' Experiences – '…although critical reflection often begins alone, it is most fruitfully conducted as a collective endeavor', Brookfield (2002, p. 34).

- Lens 4: Theoretical Literature – '…studying theory can help teachers combat the sense of impostorship that frequently troubles their existence', Brookfield (2002, p. 35).

In viewing classroom practice, Brookfield (2002) describes how each lens affords teachers an opportunity to make a more informed judgement on their practice and take the required necessary actions as a result. As Brookfield was to further assert, if teachers become more reflective in their practice, ultimately they would be better placed to make the necessary good judgements related to the appropriate instructional approaches, '…accurate evaluative criteria, helpful curricular sequencing, and useful responses to group problems and other matters', (Brookfield, 2002, p. 31).

Whilst focusing specifically on pre-service teachers' adoption of tablet pcs to facilitate learning, Pegrum, Howitt, and Striepe (2013) discovered the devices supported learning in four specific ways. These included; developing understanding of content, pedagogy, staying connected and staying organised. Despite some limitations to the version of the device within the study, teachers found the iPad supporting their learning in multiple ways, including the opportunity to develop reflective skills. Furthermore, in the context of using mobile apps for reflection in learning, a study by Leinonen, Keune, Veermans, and Toikkanen (2014) explored the outcome of using two particular apps in the classroom, ReFlex and TeamUp. Both apps were designed specifically for student-centred and collaborative-school learning in which reflective learning was an integral part of a students' learning process. This qualitative design-based research study was conducted with 165 teachers in 13 European countries. Both apps became practical results of the qualitative research in order to best understand the design challenges and also opportunities in schools in renewing their pedagogical practices. Furthermore the inquiry analysed the apps in the light of earlier studies into the use of digital devices for reflection by Kori, Pedaste, Leijen, and Mäeots (2014).

However, the emphasis for these earlier cited studies was particularly around pcs facilitating the writing of text for later reflective purposes. Moreover as implied by Leinonen et al. (2014) there are few studies with analysis aimed to describe or categorise different tools and their level of impact within the context of school learning. The ReFlex app was chosen for individual reflections while TeamUp for group work reflection. As claimed by Leinonen et al. (2014, p. 4),

'…digital tools can be used to record dialogue, to categorise contributions through meta-data and to step back in time: reconfigure the dialogue, evaluate it and

compare contributions. Furthermore, different representational means other than written text can be drawn on for reflective practices: for example, visualisations, audio and video or interactive simulations and software'.

This reflects claims by earlier studies in the use of digital devices to facilitate reflection (Fleck & Fitzpatrick, 2010; Hallnäs & Redström, 2001; Kori et al., 2014).

The study by Leinonen et al. (2014) essentially confirmed earlier findings of higher levels of reflection achieved when ultimately combined with human interaction. The study did however initially discover that a number of students felt discouraged from using video for reflections. Additional evidence gleaned from the server logs nonetheless indicated wide use of the apps outside of school hours, with devices such as the tablet decreasing boundaries between students due to their portability and accessibility. However, the main weakness within this research is by nature its limited duration. This study would have been more interesting and relevant if a longer time frame (school term) had been explored. A more comprehensive study would also include qualitative data gained from student interviews and/or questionnaires, particularly from those students who were discouraged from using video reflection. As depicted earlier, research has shown how mobile devices can facilitate the support of reflection in learning by using free in-built tools for audio-visual recording (Facetime, GarageBand, iMovie). Furthermore as reinforced by Leinonen et al. (2014) and confirmed by Jahnke and Kumar (2014), apps are available for digital devices, designed specifically to foster collaborative reflection by students.

As part of the Key Skills educational framework in Ireland, within the key skill 'Managing Information & Thinking', students are required to gather, record, organise and evaluate information and data. Subsequently as part of this process students are requested to reflect on and evaluate their learning. As a key element, students are tasked with reflection on reviewing their progress. Within this reflection process, students may identify blocks or barriers to their learning and suggest how to overcome these, using a range of tools to help manage their learning.

2.4.2.6. Assistive learning

In an effort to perform functions that might otherwise be extremely difficult or impossible, assistive technology assists those people with disabilities to perform such tasks. Tablet pcs as such, remove that layer of abstraction normally presented to users via a keyboard

and mouse, replacing these with accessible interactive touch screens. The subject of literacy learning has been explored with the emphasis on making text accessible in a variety of forms to students suffering from a disability (Baird & Henninger, 2011). The research discovered that students with a disability may still be somewhat unable to develop their literacy skills, proposing that app developers must adopt heuristic principles when designing digital technology, so that the playing field is level to all.

Tablet pcs, they believe, must follow the recognised standards for universal accessibility, as this consistency, they believe, would foster development in this area whilst enhancing the development of able-bodied users. It can be debated that mobile devices, such as the tablet pc, can be used and linked to each of the six key skills within the Junior Cycle Framework. As such a device facilitates someone with disabilities to complete scholarly tasks when using an interactive touch screen. The use of 'VoiceOver' on a tablet provides an opportunity for the student to navigate their device by listening with additional built-in app support. The various display accommodations provide a range of colour filters for those students with vision challenges, with the further addition of a magnifier to activate larger type fonts onscreen. The addition of 'Live listen' provides learners the ability to amplify conversations whilst further providing the ability to capture gestures, expressions and signs with access to 'Facetime'. With additional features such as captioning, voice recording, mobility, Switch control (linking adaptive devices), gesturing and accessible keyboards, devices such as an iPad can play a significant role in assistive learning for those learners with specific special needs. Therefore the current study by the researcher, proposes to clearly establish a linkage between each of these previously discussed characteristic affordances of mobile learning, to specific key skills in the context of the new Junior Cycle educational framework in Ireland.

Affordance	Key Skill
Motivation	**Managing Myself** *Knowing myself* *Making considered decisions* *Setting and achieving personal goals* *Being able to reflect on my own learning* *Using digital technology to manage myself and my learning*
Engagement	**Being Creative** *Imagining* *Exploring options and alternatives* *Implementing ideas and taking action* *Learning creatively* *Stimulating creativity using digital technology*
Communication	**Communicating** *Listening and expressing myself* *Performing and presenting* *Discussing and debating* *Using language* *Using number* *Using technology to communicate*
Collaboration	**Working with Others** *Developing good relationships and resolving conflict* *Co-operating*

	Respecting difference *Contributing to making the world a better place* *Learning with others* *Working with others through digital technology*
Reflection 	**Managing Information and Thinking** *Being curious* *Gathering, recording, organising and evaluating information* *Thinking creatively and critically* *Reflecting on and evaluating my learning* *Using digital technology to access, manage and share knowledge*
Assistive Learning 	**Managing Myself** **Being Creative** **Staying Well** **Communications** **Working with Others** **Managing Information and Thinking**

Table 2-1: Linking the affordances of tablet pcs to the key skill elements

2.4.3. Tablet Pedagogy

'At the heart of good teaching with technology are three core components: content, pedagogy, and technology, plus the relationships among and between them'

(Koehler & Mishra, 2008)

Pedagogy is the theory and practice of education; tablet pedagogy takes a step further by using a ubiquitous digital device to enhance learning. Early findings by Twining et al. (2005) lend support to the claim that for most teachers, using mobile devices such as tablets, inherently enables a transformation in practice. Whilst examining the instructional value of using tablets, an inquiry by Vrtis and Hansen (2010) perceived the device as having an impact on student learning and participation. However, taking a middle-ground position the authors further claim that teachers within their study, '…experienced changes in how they prepared materials but not necessarily how material was presented' (Vrtis & Hansen, 2010, p. 14).

Earlier research by Cochrane (2010) clearly identified the following gaps in the literature on mobile learning;

- no clear pedagogical theory for designing effective mobile learning
- limited evaluation for mobile learning activities
- a lack of longitudinal studies on mobile learning to determine the impact on learning
- how best to provide support for students in mobile learning
- how best to provide support for teachers in mobile learning

Melhuish and Falloon (2010) raise the need for a significant and innovative pedagogical approach whilst maximizing the potential of mobile devices to support learning. Whilst highlighting the significance of previous research in this area studies show '…that the device may offer an exciting platform for consuming and creating content in a collaborative, interactive way. However, of greater importance is that effective, evidence-driven, innovative practices, combined with a clear-sighted assessment of the advantages and limitations of any product, should take priority over the device itself' (Melhuish & Falloon, 2010, p. 1). This argument by Melhuish and Falloon (2010), Vrtis and Hansen (2010) and Cochrane (2010) is further supported by Lim (2011) whilst also highlighting the time constraints in developing digital material and the required familiarisation with the technology. The early findings lend credence to the claim that

whatever the conditions are, '…the diffusion of technology requires an accompanying guidance for effective use' (Lim, 2011, p. 332). This technological potential was further highlighted by Lim (2011), due to the ubiquity of mobile devices and the palpable appetite of users towards mobile learning. In addition, research by Dykes and Knight (2012) into the discussion of digital natives as learners advises that although technology has a major influence on student lives, it is only one of many, which affords teachers the opportunity to play a critical role in helping students '…navigate successfully through the promises and pitfalls of learning in the digital world' (Thompson, 2013a, p. 23). As Thompson (2013a, p. 23) advocates, new media, such as a tablet device, can enrich lessons because of their '…interactivity, visual aids and flexibility'. Moreover, as Huber was to clarify, with teachers having Continuing Professional Development (CPD) that involves effective use of tablet pcs within a classroom, the '…advantages and possibilities outweigh the disadvantages because most of them can be counteracted' (Huber, 2012, p. 80). In essence, the available research evidence suggests teachers require the adoption of a comprehensive pedagogy guiding their effective use of mobile devices within the classroom.

As Dalby and Swan (2019, p. 833) indicate '…the greatest challenge for teachers in using technology in the classroom is not the technology but an understanding of the process by which it can enhance student learning'. Tolisano (2009) created Bloom's Taxonomy for iPads, which maps applications for the iPad to Bloom's Taxonomy. Each of the apps mentioned are listed in parallel to the levels determined in Bloom's Taxonomy originally created in 1956 and revised in 2001. This classification of learning objectives is considered to be the foundational and essential element within education.

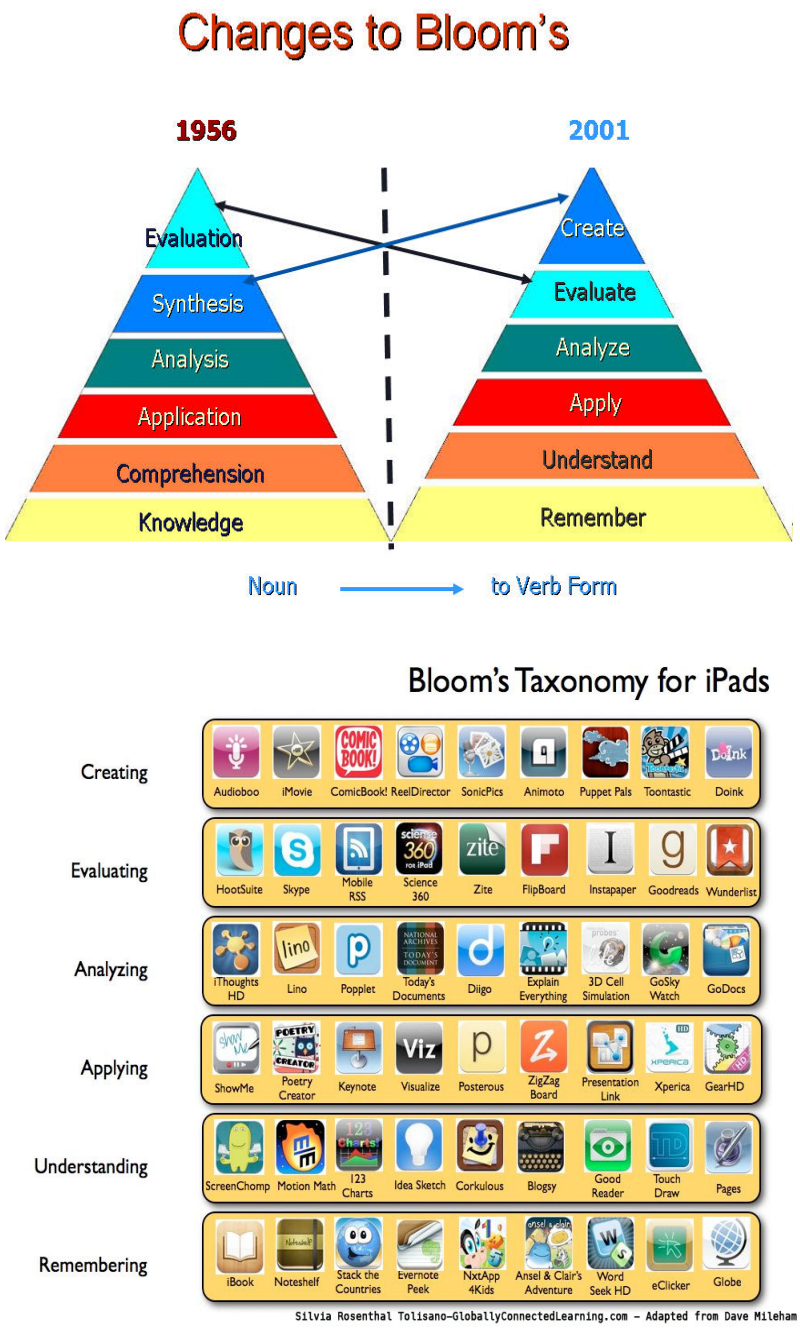


Figure 2-7: Blooms Taxonomy for iPads

2.4.4. Pedagogical Frameworks

Early educational research has previously sought a framework or pedagogical approach to underpin technological adoption and its complexities within the classroom. One such inquiry by Huber (2012) reviewed adoption using a theoretical framework entitled 'Technological Pedagogical Content Knowledge' (TPCK). TPCK extends the idea of

Pedagogical Content Knowledge as illustrated by Hofer and Swan (2008) and Koehler and Mishra (2008) while attempting to identify the nature of knowledge by teachers to successfully integrate technology within their teaching. This complex interplay of three primary forms of knowledge including content, pedagogy and technology, emphasises the knowledge that lies at the intersections between each of these primary forms.

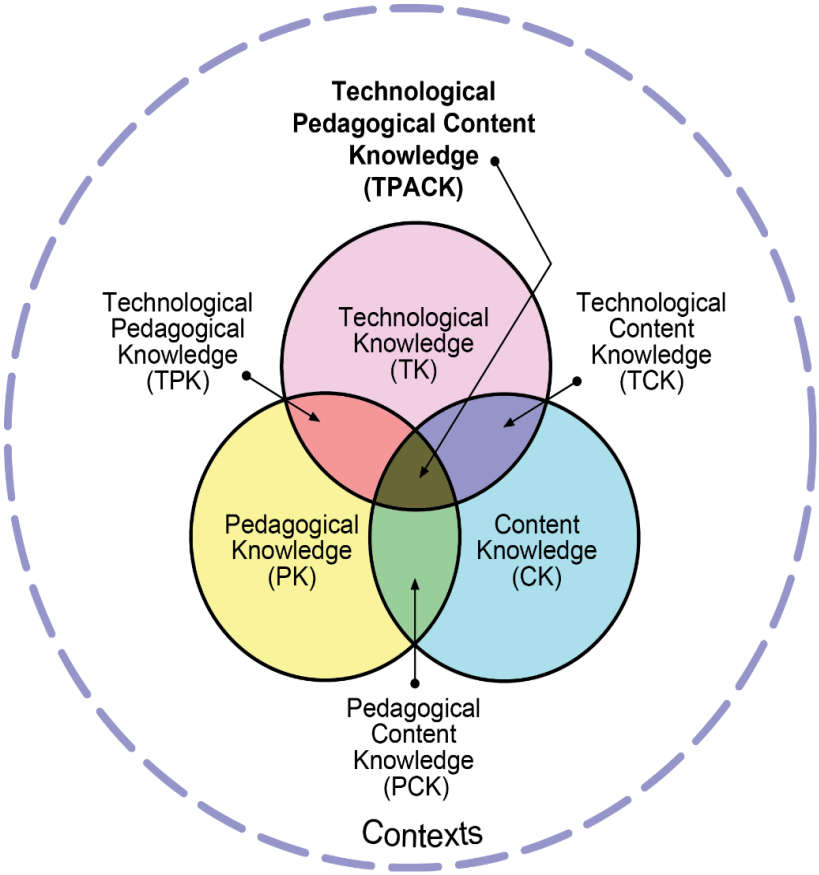


Figure 2-8: Technological Pedagogical Content Knowledge (TPACK)

However, early studies by Shulman (1986) discovered continued technical and pedagogical issues occur even with the TPCK framework in place, due in part to teachers experience in each of the primary forms of knowledge. The TPCK framework was later revised by Hofer and Swan (2008), confirming the need for training to address the need for technological pedagogy. By late 2009, with the increasing proliferation of mobile technology in education, Koole (2009) provided a pedagogical framework for mobile learning, the FRAME model, a framework for the rationale analysis of mobile learning.

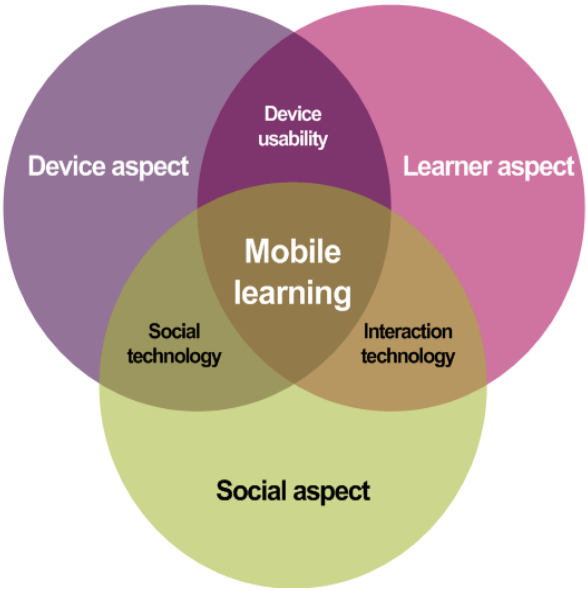


Figure 2-9: Koole (2009) FRAME model

Described as forming a more holistic framework for mobile learning, the three circle Venn diagram consists of (a) The Learner aspect (b) The Social aspect and finally (c) The Device aspect. As Koole suggests, mobile learning is ultimately a combination of interactions between the learners, their devices and other people.

'Mobile learning provides enhanced collaboration among learners, access to information, and a deeper contextualisation of learning. Hypothetically, effective mobile learning can empower learners by enabling them to better assess and select relevant information, redefine their goals, and reconsider their understanding of concepts within a shifting and growing frame of reference (the information context). Effective mobile learning provides an enhanced cognitive environment in which distance learners can interact with their instructors, their course materials, their physical and virtual environments, and each other' (Koole, 2009, p. 38).

Just two years later Park (2011) similarly developed a pedagogical framework in the context of mobile learning. As Park (2011, p. 1) advise, '…despite the great potential mobile learning has and the innovative development of mobile technologies, a theoretical framework in which to review diverse mobile learning projects in the context of distance learning has been lacking'.

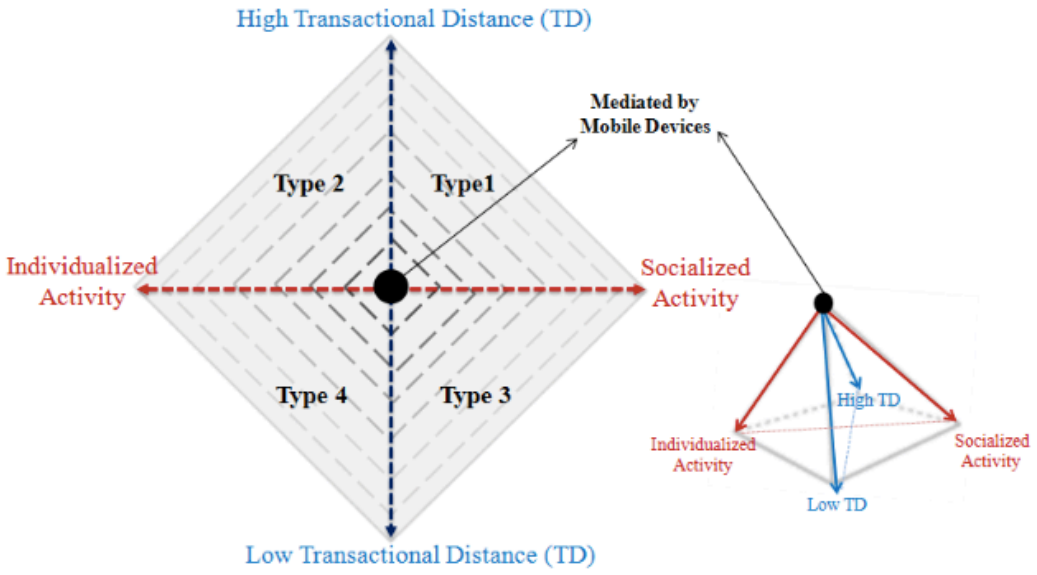


Figure 2-10: Park's pedagogical framework: Four types of mobile learning.

However as Khaddage et al. (2015, p. 9) claims, '…more guidance about how to utilise emerging mobile technologies and integrate them seamlessly into teaching and learning is still needed'. In response, Khaddage et al. (2015) propose a new Mobile Learning Framework to both analyse and govern the dynamics of challenges and factors identified in the literature, including pedagogical, technological, policy and research challenges. The SAMR model (Substitution, Augmentation, Modification, and Redefinition) developed by Dr. Ruben Puentedura in 2006, defines how teachers incorporate technology within their instruction (Psiropoulos et al., 2016).

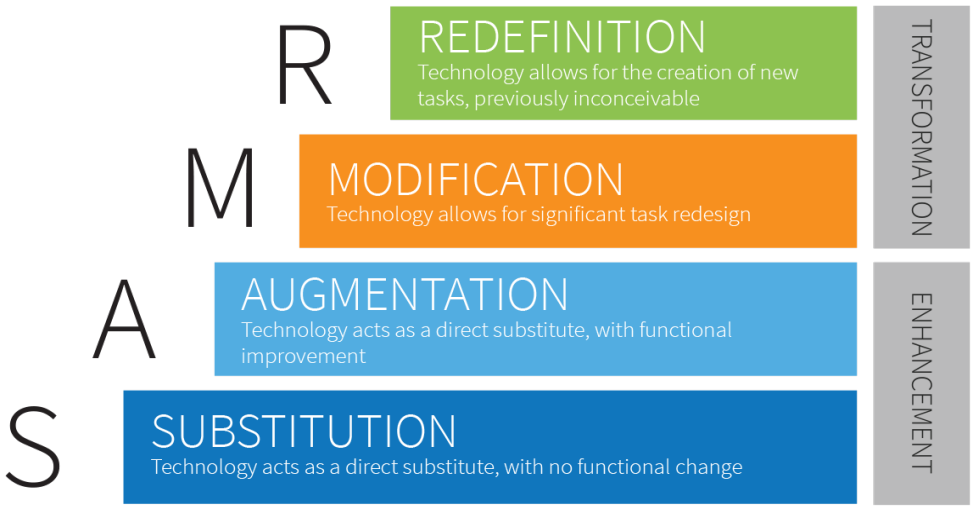


Figure 2-11: The SAMR model created by Dr. Ruben Puentedura

From the ‘Substitution’ level (S) where technology will not significantly impact student outcomes, to the ‘Modification’ (M) and ‘Redefinition’ (R) levels where it’s possible to accomplish tasks that could not have been possible before as the technology allows for significant task redesign, the SAMR model provides an opportunity to make technology integration within teaching and learning, more meaningful and purposeful. As discussed by Romrell, Kidder, and Wood (2014, p. 12), the SAMR model can assist teachers in the evaluation of potential instructional designs, whilst further suggesting that ‘…mLearning activities that modify or redefine traditional learning activities have the potential for transforming learning through the use of a mobile device’. Based on a European Commission framework (Promoting Effective Digital-Age Learning: A European Framework for Digitally-Competent Educational Organisations), SELFIE (Self-reflection on Effective Learning by Fostering the use of Innovative Educational Technologies) is a free tool specifically designed to assist schools embed relevant digital technologies within their teaching and learning and student assessment, (Kampylis, Punie, & Devine, 2015). In essence, the framework (DigCompOrg) encourages reflection and self-assessment within educational institutions to progressively deepen their engagement with Digital learning and the relevant pedagogical practices. The framework contains a number of key and sub-elements it believes are common to all education sectors, as detailed below.

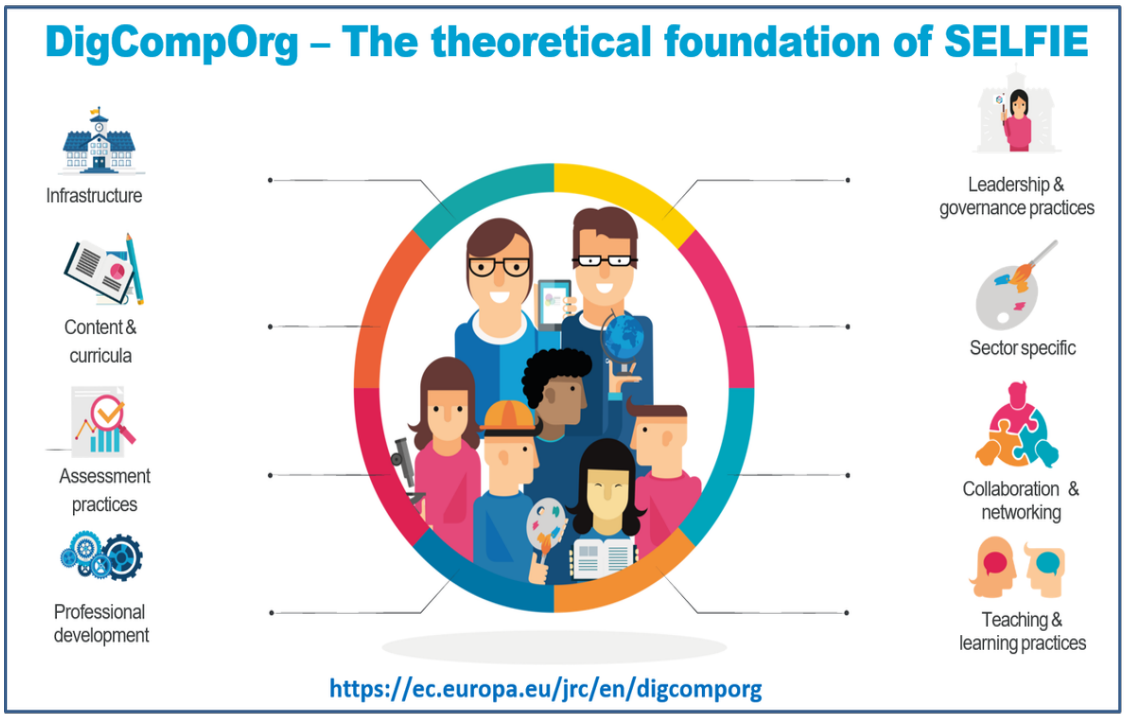


Figure 2-12: Key elements of DigCompOrg

In summary, the examination of pedagogical frameworks to underpin technological adoption and the potential complexities within a classroom, have primarily focused on models designed to support teachers by providing structure around the philosophy of teaching and learning. The literature confirms that technology adoption must be driven by pedagogical considerations (Ozdamli, 2012). As previous research also highlights, m-learning with tablet pcs can act as a catalyst for '…transforming pedagogy from instructivist lecturer-directed pedagogy to social constructivist pedagogy enabling student-generated content and student-generated contexts' (Cochrane, Narayan, & Oldfield, 2013, p. 51).

2.4.5. Mobile Pedagogical Studies

'*Integrating technology is not about technology – it is primarily about content and effective instructional practices. Technology involves the tools with which we deliver content and implement practices in better ways. Its focus must be on curriculum and learning. Integration is defined not by the amount or type of technology used, but by how and why it is used*.' (Earle, 2002, p. 7)

In 2011, an extensive UK study into tablet adoption by a secondary school for 11-18 year olds at Longfield Academy in Kent (UK), discovered significant and positive impact to learning when using the devices and further significant and developing changes in pedagogy (Heinrich, 2012, p. 14). While not necessarily the feeling shared by all, a quote by one staff member, '…the iPads have revolutionised teaching', sums up views held within the study, by many staff and students alike (Heinrich, 2012, p. 14).

Since the first introduction of hand-held mobile devices the area of pedagogy has been the focus for many studies. Within these studies there is broad agreement regarding potential affordances of such devices in the areas of accessibility (anytime, anywhere learning) and mobility. However, as Heinrich (2012) further suggests, this has not translated into radical pedagogical approaches when using such devices. Heinrich's findings lend support to the claim that many schools wish to continue in control of students learning, with restrictive access to the Internet, Virtual Learning Environments (VLE) and document repositories.

Subsequently, the impact to the students is that they have little or no direct participation as the learning is directed along preconceived '…narrow and sometimes shallow paths' (Heinrich, 2012, p. 9). In this respect the findings reflect earlier US research by Speak Up! National Research Project (Up, 2011). Notwithstanding, the main flaws to this study

are the time constraints and budget as highlighted by the author. Because of these constraints the study focused on questionnaire surveys (Survey Monkey) to staff, students and parents, supported by a site visit involving interviews, used as clarification of any issues arising from the questionnaire responses. Furthermore, a result of adopting the chosen instrument to measure feedback is the likelihood of a poor statistical response rate, with low statistical significance. In total 71 staff responded, 310 pupils and 23 parents from a school roll of 960 students. The study by Heinrich (2012), would have been more convincing if he had addressed the time constraints, response rates and limited qualitative data from interviews, to gain a more credible inquiry.

Nonetheless, the data collected from the study at Longfield Academy clearly demonstrated, both the value of mobile technology as an educational tool and the significant role it can play in learning and teaching. However, as echoed by Heinrich (2012) and earlier studies by Melhuish and Falloon (2010), the device is only as good as the tools or apps it uses, '…for applications to be effective as part of an individual's learning pathway they must be pedagogically sound in their design, foster interactions that is grounded . . . in m-Learning theory, rather than focusing solely on content, engagement or 'edutainment'', (Melhuish & Falloon, 2010, p. 11).

By 2012, a 'Bring your own device' (BYOD) strategy adopted by some schools afforded students the opportunity to access their own mobile devices when attending lessons. Whilst studies have shown BYOD can bridge formal and informal learning as described by Education (2012a), it has transformed the landscape of education as these factors shift the role of the student. However, this type of strategy ultimately entails additional challenges for teachers with the variance in the accessibility and applicability of learning.

To maximise the potential of mobile devices for teaching and learning in the 21st century, there is a definitive need for teachers to identify innovative pedagogy and practice as highlighted by early research findings by Melhuish and Falloon (2010). This is further reflected by Hallissy, Gallagher, Ryan, and Hurley (2013b, p. 15) suggesting mobile technologies '…do not come pre-loaded with a particular pedagogical preference', while also keenly aware of hype factor associated with such devices as described by Nguyen, Barton, and Nguyen (2015). As such, Nguyen et al. (2015) propose that schools must have a clear articulate vision as to how they view the adoption of mobile devices changing the role of students and teachers. They further argue that schools must take a

more holistic approach, moving beyond what device to choose, to how to access learning and the role of parents. As part of a 3 year Erasmus+ funded project, the MTTEP.eu project includes an International Mobile Learning Network for Teacher Educators and the development of a Mobile Learning Toolkit. The Mobile Learning Toolkit for teacher educators, includes a pedagogical framework (iPAC) around which teachers can evaluate and construct, '…meaningful and authentic mobile learning pedagogies'. Moreover, Hallissy, Gallagher, et al. (2013b) suggest, whilst citing November (2013) that teachers must 'reconsider pedagogy and weigh such options as flipped learning, self-directed learning, online learning and peer instruction'. Thus, they claim, the key starting point for a school is to '…focus on the key initiatives dominating discussion in second-level schools today', including the Junior Cycle Reform (Hallissy, Gallagher, et al., 2013b, p. 41). As education has evolved, so too has the philosophy of how an educator teaches. Practitioners today promote the adoption of the following key pedagogical models, including flipped classrooms, learner-centred approach, project-based learning, peer instruction and online learning.

2.4.6. Flipping the classroom

As described in an early study by Tucker (2012), the core idea with flipping the classroom, is to 'flip' the traditional instructional approach with interactive lessons and videos accessible at home, in advance of the class. Subsequently, the focus of the actual class becomes a place to work through problems, advance concepts and ultimately engage in collaborative learning. Many educators deem this integration of interactive material within the approach as the reasoning for this particular methods success when adopted in many schools.

Since the introduction of 'flipped' classrooms, students have been quite vocal in their approval of the novel approach, '…I like that we watched the concept at home, but then mastered the concept in class' (Fulton, 2012, p. 14). However as Fulton (2012, p. 14) reminds us, educators agree that one-size does not fit all, but they do all share that commitment to student learning and belief that they must '…guide students to use technology in ways they will embrace for future learning'. Similarly, research by Bishop and Verleger (2013) claims that students overall are generally positive and receptive to this pedagogical method but do however prefer 1-2-1 classroom based lectures over video lectures.

The literature clearly indicates that flipped classrooms provide an opportunity of flexibility to teachers when meeting the learning needs of students and subsequently affords students the flexibility to have all their needs met in multiple ways. In doing so, Sams and Bergmann (2013) believe this approach creates a classroom that is ultimately student-centred. Herreid and Schiller (2013) echo this belief and those of earlier studies, while also concluding that active learning works best for both teachers and students alike. Whilst connecting both inside and beyond the traditional classroom, flipped learning offers opportunities to students with access to their own devices to achieve goals set by their teachers and ultimately become more independent learners (Sharples et al., 2014).

2.4.7. Learner Centered

The learner-centred, also known as student-centred approach to education, encourages students to reflect on what they have learned and how they are in fact learning it. This approach firmly shifts the focus of any instruction away from the teacher to the student. An exploratory analysis of learner-centred education (LCE) policy in developing countries by Schweisfurth (2011) explored the recurrent theme of numerous issues and problems implementing LCE in particular settings. The study focused on 72 relevant articles published over the years within the International Journal of Educational Development (IJED). Schweisfurth clearly describes the unequivocal success in this approach for many schools as being few and far between, '…the history of the implementation of LCE in different contexts is riddled with stories of failures grand and small' (Schweisfurth, 2011, p. 425). However, Schweisfurth cites conflicting results and hotly contested evidence in many cases within the available research. Ironically, as Schweisfurth highlights, what is lacking within this and the wider literature available, is the voice and opinions of young leaners. As further contested by Thompson (2013b, p. 1) who claims that LCE is a western construct, and further argues that '…its specific forms will be more effective when introduced through small-scale institutional relationships than through large-scale contracts with national governments'. In traditional US and European countries, the learner-centred pedagogy adopted includes a blend of both instructor-centred and student-centred approaches. As the definition evolves, advocates of the approach highlight the following characteristics, including, personalised teaching and learning, flexibility to learn anytime and anywhere, choice of learning and contribution to the design of learning experiences.

2.4.8. Project based learning

As a teaching approach, project based learning engages students for extended periods whilst investigating complex challenges using problem-solving, investigative activities (Thomas, 2000). Earlier findings by Boaler (1997) indicate that students' subject matter knowledge is dependent upon the adopted approach within the classroom. This longitudinal study of two schools over a three-year period featured a cohort of 300 students, aged 13 to 16. With both schools comparable in ability, one cohort of students were subject to traditional didactic teaching methods while the second group were subject to a project based learning approach.

Results from the study highlighted how students under the traditional method '…regard mathematics as a rule-bound subject and they thought that mathematical success rested on being able to remember and use rules', in contrast the project based school regarded the subject matter as a '…dynamic, flexible subject that involved exploration and thought' (Boaler, 1997, p. 63). The study further noted that the project based students' out-performed students at the traditional school. As Boaler (1997) concluded, '…students taught with a more traditional, formal, didactic model developed an inert knowledge that they claimed was of no use to them in the real world' (Boaler, 1998, p. 129). As later studies by Marx, Blumenfeld, Krajcik, and Soloway (1997) and Barron et al. (1998) confirm, there is ample evidence that project-based learning is an effective method for teaching students complex processes, such as planning, problem solving, communicating and decision making.

In an Irish context, early studies by Conneely, Murchan, Tangney, and Johnston (2013), depict collaboration in project based learning, as a key contributing factor leading to students gaining enhanced research, observational and presentation skills. In the context of mobile learning, the core 21st century learning skills, collaboration, communication, complex problem-solving, critical thinking and creativity, reveal significant better communication, creativity and complex problem-solving competences for those students spending the most time on mobile learning activities (Lai & Hwang, 2014). As Pandey and Singh (2015) suggest, m-learning lends itself to both collaborative and project-based learning, whilst supporting groups of students in their collective communication needs.

With the focus on embracing 21st century learning, the reform process in the Irish educational system emphasised the development of core key skills as defined earlier. Subsequent research published by Johnston et al. (2015) describes the successful adoption of the Bridge21 model as a basis, in this instance, to facilitate 21st century pedagogical practice. The key elements to adopting the Bridge21 model is its underlying theme of Peer learning linked to a project-based approach. In this instance the teacher's role is shifted to a facilitator/guide than a traditional instructor. Within this model the technology embraced is only adopted when and where appropriate.

2.4.9. Peer instruction

Developed in the early 1990's by Harvard Professor Eric Mazur, peer instruction (PI) encapsulates an evidence based, interactive teaching approach. Essentially defined as a student-centred approach to learning that adopts a 'flipping' of the traditional classroom (Mazur, 1997). The pedagogy involves students reading and viewing material pre-class, subsequently the teacher will later engage the students by posing prepared structured questioning that involve all of the students within the class.

By 2001, Crouch (2001) reviewed 10 years of various results and tests, concluding that students' baseline test scores improved dramatically when using the adopted peer-instruction method of learning. Furthermore, the study claims increased student engagement and substantial gains in student understanding of the topics taught. Research by Zingaro and Porter (2014) confirms these earlier claims by Mazur (1997) by stating, '…PI has been shown to improve final exam performance over standard lecture, reduce failure rates, contribute to increased retention, and be widely valued by students' (Zingaro & Porter, 2014, p. 1).

2.4.10. E-learning

Online Learning or E-Learning (Electronic learning) is a diverse transformation of technologically enhanced instruction typically delivered and received remotely whilst using the internet and a personal pc. An early meta-analysis review of Online Learning studies from 1996-2008 by Means, Toyama, Murphy, Bakia, and Jones (2009), discovered that students involved in online-learning performed better than those who received typical face-face instruction. Later research by Salmon (2013) building on her 5-step scaffolding process to online-learning, highlighted the need for developed e-activities, '…frameworks for enabling active and participative online-learning by

individuals and groups' (Salmon, 2013, p. 5). Salmon perceived e-activities as enjoyable, productive and highly scalable activities, affording education at a lower-cost to a greatest number of participants.

Many institutions worldwide have adopted online-learning in an attempt to offer a blended learning approach to teaching and learning, with a combination of classroom and online delivery. More recently, many of these online courses have been developed and adapted for mobile digital devices to afford users an anytime, anywhere mobile learning experience. As suggested previously by Galvin, Coates, and Murray (2010, p. 90), if any technological program within education is to succeed, it must deliver '…a structured training programme that allows participants to work through pedagogical as well as technical issues is seen as the most valuable way forward'. In a broader context Traxler (2013, p. 247) summarises, '…mobile technologies are the global context and education should reflect that context. Learning processes will need to reflect that shift and so will teaching'.

Research by Rikala, Vesisenaho, and Mylläri (2013) propose that the devices have a positive but limited effect on teaching. However, the inquiry suggests tablets afford teacher opportunities to change their existing pedagogical practices and thinking, '…tablet pcs have activated teachers to think about pedagogy in a new way and [have] brought a new dimension to teaching', (Rikala et al., 2013, p. 124). In contrast, teacher and writer Elise Italiano believes that with teachers competing for attention with the device, they are in essence implicitly required to become entertainers (Olmstead, 2014). Whilst Olmstead (2014) continues to highlight the need for technological training for teachers, evidence by Ally, Grimus, and Ebner (2014) highlights the influence of the teachers' attitude in the successful use of such mobile technology has an ultimately knock-on effect on students enthusiasm within the classroom. As the literature further advocates, students' knowledge and skill when using mobile technology can also positively engage teachers, '…there is this natural intuition that [the pupils] seem to have ... this generation are almost born with a digital device in their hand ... That's why it's important for staff to have a go as the children are always two steps ahead of us', (Beauchamp, Burden, & Abbinett, 2015, p. 19).

As acknowledged by Beauchamp et al. (2015), this scenario is an inevitable development in education. Furthermore, this change in role for the teacher is, as Beauchamp et al. (2015) suggests, a completely different adoption model of other forms of technology in the classroom, such as the IWB, where teachers acquire knowledge and a level of competence before use in the classroom. As the study concludes, '…the iPad is merely a tool and it is how pupils and teachers use it that matters' (Beauchamp et al., 2015, p. 36).

2.4.11. Classroom dynamics

As part of this inquiry into the affordances and potential of mobile digital devices in supporting student learning in the context of the Junior Cycle framework, the research explores how the dynamics may have changed between the teacher and student as a result of using tablet pcs. However, research into the area of teacher-student relationships in the context of mobile technology adoption, continues to be in its infancy. Nonetheless, recent inquiries suggests teachers adopting mobile devices are afforded the opportunity and flexibility to teach anywhere in the classroom and furthermore provide a more personalised learning experience for their students (Henderson & Honan, 2008; Richardson, 2010). Thus, leaning towards a more meaningful interaction between both teacher and student, as first suggested in earlier studies by Barak, Lipson, and Lerman (2006).

In contrast some theorists see digital mobile integration as a disruptive technology, inherently leading a small number of educational establishments in banning digital devices (Ally & Prieto-Blázquez, 2014; Keskin & Metcalf, 2011; Sharples, 2002). However, as the literature highlights the majority of educationalists have clearly decided to establish digital classrooms, citing the many benefits of such adoptions, including the stronger teacher-student relationship (Van Maele & Van Houtte, 2011). Research by Burden, Hopkins, Male, Martin, and Trala (2012b) has shown how the portability of digital mobile devices has the ability to change the nature of learning within a classroom, and furthermore transform in a mutual and beneficial way, the relationship between teacher and students. This redefinition of the relationship highlights the movement in responsibility for learning, from the teacher, now as a co-facilitator, to that of the student.

From a more positive background, the eradication of teacher v student relationship as highlighted by Beauchamp and Hillier (2014) while evaluating iPad adoption, describes students feeling empowered with a willingness to support their teachers. As one student suggests, '…it's funny because if [they] don't know something and you do, it's like you are the teacher and they have been downgraded as a student. It makes me feel good that I know something that a teacher doesn't' (Beauchamp & Hillier, 2014, p. 19). Furthermore, today's social networks (Facebook, Instagram, Persiscope) afford teachers an opportunity to forge extended classroom learning and relationships with students whilst using mobile devices. As Nowell (2014) claims, these social relationships and connections outside of the classroom via social media, further strengthen a teacher's ability to teach within the classrooms. The study's findings furthermore demonstrates how teachers could, using mobile technology, tackle the digital divide and teach 21st century skills.

When adopting a BYOD framework students are afforded the opportunity to use their individual technologies within a classroom, changing the role of the teacher to that of '…managers of technology-enabled networked learners, rather than providers of resources and knowledge. This shift opens opportunities for connecting learning inside and outside the classroom', (Sharples et al., 2014, p. 4). Both Van Maele and Van Houtte (2011) and Beauchamp and Hillier (2014) have more recently fostered the debate on teacher-student relationships in the context of adopting mobile technology within the classroom. The question of whether the introduction of mobile devices enhances classroom relationships has caused much debate; the available evidence to date suggests that devices such as a tablet pc may afford the potential to enhance classroom relationships.

2.4.12. Peer Mentoring

Whilst most technology initiatives within schools present various challenges, tablet pcs '…have the potential of providing unique pedagogical strategies'. However, these require various types of support, including peer-mentoring to help deliver meaningful learning (Ostashewski & Reid, 2013, p. 2). Literature by Psiropoulos et al. (2016, p. 224) has further shown how peer-mentoring, particularly during technology adoption within classrooms, can ultimately provide '…effective informal learning alliances' aligned with the earlier findings of Potter and Rockinson-Szapkiw (2012).

2.4.13. Learners as content creators

The initial assumptions with the release of the iPad tablet device suggested it was primarily targeted to consume content and not viable as a tool used for creation or collaboration. This limitation as highlighted by Marmarelli and Ringle (2011) presented the device simply as a vehicle for content distribution when aligned with a learning management system. Similarly early findings suggested that early apps only provided help in the organisation of data but had not '…significantly contributed to improvement of student learning outcomes' (Thinley, Geva, & Reye, 2014, p. 19). However, this premise in both instances has developed in a positive manner with each iteration of the iPad operating system and the relevant input from freelance developers in availability of both content-creation and productivity apps.

Key findings by Goodwin (2012) highlight the proliferation of 'content creation' and 'productivity apps' available for tablet pcs, that foster higher levels of thinking and engagement when generating digital content. Goodwin (2012, p. 6) reported positive outcomes from 90 students in three Australian primary schools, '…optimal use of the iPads was attained when students used content-creation 'productivity' apps as this developed higher order thinking skills and provided creative and individualised opportunities for students to express their understanding'.

As the research suggests, using tablet pcs and content creation applications afford students an opportunity to become content publishers whilst also empowering them to develop their writing and technology skills can '…provide a powerful, authentic learning experience for students' (Encheff, 2013, p. 70). Whilst adopting both a constructivist and collaborative learning model, Encheff was to further conclude, '…they have learned invaluable skills that can be applied to their future academic endeavours and career opportunities'. Similarly, in an Irish context, research by O'Mahony (2014) in the development of interactive content using iBooks Author indicates high levels of motivation amongst content creators, with particular embedded widgets conducive to better recall by the participants. Moreover, as many in education have become aware, the adoption of tablet pcs and relevant apps, provide teachers a unique opportunity to become creators of curriculum and content whilst developing reusable learning objects (Frey, Fisher, & Lapp, 2015; Payne, Goodson, Tahim, Wharrad, & Fan, 2012). As concluded by Mac Mahon, Grádaigh, and Ghuidhir (2016, p. 21), whilst research on the use of iPad in initial teacher education is limited, the creating of resources as part of a collaborative design process, '…can also support student teachers in developing and

integrating technological, pedagogical and content knowledge (TPACK) within their approaches to teaching, learning and assessment'.

Transformative learning through content creation via tablet pcs is now a reality as content-creation apps such as Adobe's Creative cloud provide students '…opportunities to help sharpen their awareness of how the core components of audio and video and images come together into something that creates a more carefully crafted message' (Alexander, Adams, & Cummins, 2016, p. 2). While quoting ACU Professor Kyle Dickson, the report further suggests that these devices and incorporated apps afford students an opportunity to view themselves now as '…media producers, coders and makers'. The Digital Literacy NMC Horizon Project Strategic Brief in 2016 cited a number of key 'Best Practice' exemplars across the US, placing students firmly in the role as 'content creators'. The next section will address the perceived impacts of using digital devices as part of the curriculum.

2.4.14. Overview of iBooks Author

Traditional instructional delivery particularly in the areas of Science and Maths has been in a didactic format, delivered from the teacher to a student. Within this scenario the pupil is simply a passive consumer of the knowledge while not playing an active role in knowledge construction. It is also perceived that pupils enter the realm of instruction with pre-defined beliefs regarding the classroom environment. As an early study by Confrey (1990, p. 4) proposes, '…these beliefs can be identified and confirmed only through methods that encourage children to be expressive and predictive'. Whether didactic instruction is failing to serve the needs of 21st century learners is debateable. However, the students of today, as the research suggests, have since birth, been exposed to digital technologies which play an influential role in both their cognitive and particularly their social development (Duggan, Ellison, Lampe, Lenhart, & Madden, 2015). For these 'Net Generation' pupils the critical question is therefore how this exposure to digital technologies affects education, as Oblinger and Oblinger (2005, p. 1) questions, '…if the Net Generation values experiential learning, working in teams, and social networking, what are the implications for classrooms and the overall learning environment?'. As such, due to the acceptance by many in education of a need for change, a developing constructivist approach founded upon collaboration and the development of inquiry-based learning is at the forefront of current instructional practice.

By 2011, early research into iPad adoption within classrooms suggested that '…students were more immersed in their reading and creative activities. iPads have also worked well for independent tasks that students could help define (using a variety of Apps for creativity, 3D viewing, searching or simply working with curriculum)', (Gasparini & Culén, 2011, p. 4). Similarly, Reid and Ostashewski (2011, p. 5) asserts that '…devices that can support additional student inquiry and development of online research skills as well as put new digital construction tools in the hands of students, appear to be able to develop new 21st century skills in learners. The iPad may in fact be the right combination of mobile tool and connected device for the classroom to meet this kind of need.' Additionally, the research to date has clearly demonstrated an increase of student engagement, collaboration, productivity, technology competency, innovation, and critical thinking, as contributing factors with the introduction of iPad's aligned with relevant curriculum (Gertner, 2011; McConnell, McConnell, & McConnell, 2011; Shepherd & Reeves, 2011). In January 2012 as part of the Apple Education event, Apple Inc released a free eBook development platform, iBooks Author 2.0 (iBA). The application was dovetailed into the Apple iBooks online store. Users could now not only download books onto their mobile digital devices but could also have the opportunity to develop their own specific content to distribute freely or at a cost to interested parties. Documents developed using iBA could be exported in pdf format or published directly to the Apple iBooks online store (ePub) or to a VLE to be distributed to student devices within schools. By June 30th, 2015, Apple updated iBooks Author to version 2.3, adding two significant new features: iPhone compatibility for Multi-Touch Format for books created in iBooks Author, and the export of an EPUB-format, this output is a proprietary Apple file format. The significance of these new features affords both teachers and pupils the opportunity to develop content across multiple platforms including smartphones, tablets, computers and eReaders. Additionally, the terms and conditions of iBooks Author were changed to allow iBA users to monetise EPUB-format books exported out of iBA in any way they choose.

The iBA application includes an intuitive 'What you see is what you get' (WYSIWYG) development screen that allows the embedding of interactive components (widgets) into an iBook. The widgets are a critical component of both the application and their pedagogical underpinnings. In using reviews (learning checkpoints), iBA can afford users instant feedback allowing knowledge to be scaffolded. With this move towards a more student-centred learning approach, the development of eBooks also affords a user the opportunity to engage in online learning. However, due to its infancy, research in

this area is required in relation to both online and offline environments adopting this format of delivery. As Mills (2016b, p. 1) proclaims, '…no empirical studies currently exist to describe the impact of multi-touch interactive eTexts, which are only accessible on these latest tablet computers'. The researcher believes the comments from Mills clearly suggest a specific need to understand the various perceptions regarding the impact of such technology within the classroom. As such, the researchers study seeks to address the impact, in an Irish context, of the adoption of tablet pcs, such as the iPad within post-primary classrooms.

In heralding the evolution of eBook publishing, Warren (2010) envisioned the eBook of the future forming part of an extended global conversation as first depicted online by the Wall Street Journals '…think of it as a permanent, global book club. As you read, you will know that at any given moment, a conversation is available about the paragraph or even sentence you are reading. Nobody will read alone anymore. Reading books will go from being a fundamentally private activity—a direct exchange between researcher and reader - to a community event, with every isolated paragraph the launching pad for a conversation with strangers around the world', (Johnson, 2009). With the introduction of iBA, educators became quickly aware of the affordances and potential of this free eBook development platform. Noteworthy characteristics of the application included the interactive multimedia elements that Apple developed over various iterations of the software. Since its early inception, iBooks Author has developed into an intuitive media-rich application, currently at version 2.4 by 2016. An early conference paper by Bain (2012a) describes the appeal of using iBA as a multimodal approach with different modes to support student learning. These modes of support, the paper concluded, include visual, auditory, digital and linguistic. The paper furthermore foreseen the potential for students to develop their own portfolios while using the iBA application to develop content (portfolios). It is further suggested that eBook technology integrates two main trends within educational technology, m-learning and e-learning (Railean (2012, p. 21), '…e-book pedagogy can be viewed as an interdisciplinary science which provides new principles for cognitive activities through new methods of teaching, learning and assessment that affect knowledge, skills and competence development instead of a scholastic view of learning'. As a result initial research into educational and academic purposes of eBooks by Smith, Kukulska-Hulme, and Page (2012) identified six key use case areas for eBooks. These areas included,

- situational reading (portability)
- basic eBook use
- eBook & learning (learning resources)
- using multiple learning resources (multi-tasking issues)
- collaborative/group learning (using several devices)
- eBook production (using iBooks Author, Book Creator).

Unfortunately, the early versions of iBooks Author provided a limited range of features however the study did highlight the clear potential of the application. By the latter part of 2012 research concluded a clear requirement for more digitised learning resources, such as the availability of multi-media interactive books (Wang & Towey, 2012). For many, this requirement was a necessity to move teaching away from traditional instructional approaches to a more student-centred pedagogical model, thus eliminating the viewing of these tablet pcs as simply mere toys or as replacement technologies. In response, by October of 2012, Apple released a new version of the iBA software to include embedded fonts, mathematical equation rendering, and more importantly the option to include interactivity. Traditionally, mainstream eBooks were initially defined by many teachers as costly and not deemed affordable. To address this issue, continued research into the pedagogical applications of mobile learning by Oakley, Pegrum, Faulkner, and Striepe (2012) recommended encouraging teachers to develop their own curriculum content using iBA as the development platform of choice. As argued by Fletcher, Schaffhauser, and Levin (2012), the development of free open educational resources facilitates the reuse, remix and customization of material to suit specific needs.

Echoing an earlier study by Gasparini and Culén (2011), an inquiry by Heinrich (2012, p. 23) suggests when using material developed via iBA that '…the learning is far more varied and interactive. Electronic textbooks can be tailored to the group or even to the individual, so that iPads open the door to a genuinely individualised curriculum'. Additionally, the eBook has facilitated both teachers and students alike in developing material in a format that is easier to carry than traditional academic texts. The additional features such as bookmarking, annotation, zooming, searching and re-sizing of text '…forms a seamless blend of learning resources with all of the elements integrated at the appropriate point in the students' learning journey' (Smith et al., 2012, p. 51).

One such example of iBook development using iBA as a re-usable learning object was the subject of focus by Payne et al. (2012) within a medical education and healthcare setting. Their study demonstrated how this new technology has the capacity to shape how individuals access information. Moreover, the study highlighted the portability of the developed learning object and the reusable nature of iBA due in most part to its intuitive interface. However, in contrast, Burden et al. (2012b, p. 41) discovered some schools had less incentive to develop resources using iBA, especially '…when it is limited to a small group of teachers and is not perceived to be either a sustainable, or whole school approach'. For many early adopters of tablet pcs, the lack of appropriate educational content available from the iTunes iBook store became a contentious issue. Once again, the initial response by some teachers was to develop their own interactive content using iBA (Hallissy, Gallagher, Ryan, & Hurley, 2013a).

A further example by Encheff (2013) describes how a teacher facilitated students to design, develop and publish their own eBook using iBA. Interestingly, findings from the study clearly demonstrated an improvement in expository writing in multiple ways including '…better organization and connection of ideas; increased use of academic vocabulary; and an increased use of clarifying details and analogies' (Encheff, 2013, p. 1). Moreover, students within the study exhibited a deeper understanding of concepts within the curriculum and became more proficient in the use of technology, with the study reporting an '…increased sense of self-efficacy and confidence because they published a book in the iBookstore' (2013, p. 1). An enquiry into the area of digital reading by James and de Kock (2013, p. 121) acknowledged the shift within the reading landscape towards the digital sphere for many digital natives. The study suggests '…we now have the opportunity to connect with readers via a digital reading space in which engagement with both the text and the paratext (Genette 1997) is rendered easier and more fluid.' By 2013 eBooks were now formally described as a cost-efficient, convenient, accessible, interactive and engaging method of storing and delivery of curriculum content. Early eBook adopters were also quick to acknowledge and substantiate earlier claims made by Bain (2012a) that '…the exploration of e-textbooks offers the ability of students to become contributors of knowledge' (Moorefield-Lang, 2013, p. 18). Whilst developing a Digital Books Taxonomy, Kapaniaris, Gasouka, Zisiadis, Papadimitriou, and Kalogirou (2013) describe the move away from the previously traditional eBook to the more interactive digitally enriched books, made possible by the rapid advance in eBook development.

This study firmly situated iBooks, as facilitating the highest levels of interaction, exploration and reading, at the pinnacle of its eBook taxonomy. The study was to further suggest, '…the tool enhances content through exploration, discovery, consolidation, presentation and practise/training. Movies, diagrams, presentations, galleries, 3D objects and chapter reviews are easily introduced, enabling students to utilize multiple senses concurrently through touch and multitouch gestures (tap, drag, pinch, swipe)' (Kapaniaris et al., 2013, p. 320). Moreover, the obvious challenge for enriched interactive eBooks is, as the study highlights, whether these tools '…can be successfully incorporated in designing instructional interventions and whether teachers and students can themselves become creators of material that can be incorporated into enriched digital books' (Kapaniaris et al., 2013, p. 321) .

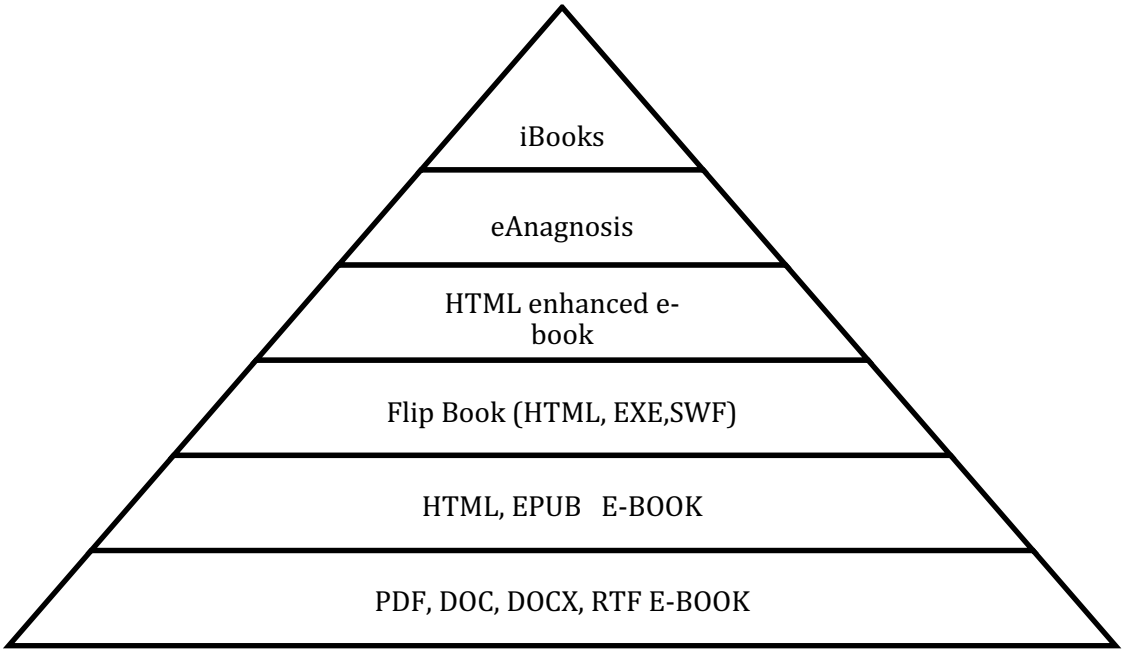


Figure 2-13: eBook Taxonomy: Kapaniaris et al. (2013)

With a plethora of potential learning tools within the area of mobile learning, Kim (2013) places iBA, as an initiative that may change the landscape of teaching and learning in the classroom. While highlighting the specific change in areas of pedagogy and differential instruction, alongside case studies from both South Korea and Malaysia, Kim (2013) calls for more detailed exploratory research into the affordances and potential of iBA to teach, assess students and furthermore collect related performance data.

Whilst developing an instructional module for teachers in how to create e-book content, Monkoski-Takamure (2014) adopting Kellers ARCS model of instructional design,

addressed the areas of attention (stimulate the user), relevance (make learning applicable to the users knowledge), confidence (eliciting performance) and satisfaction (feedback) for teachers using iBA to develop content.

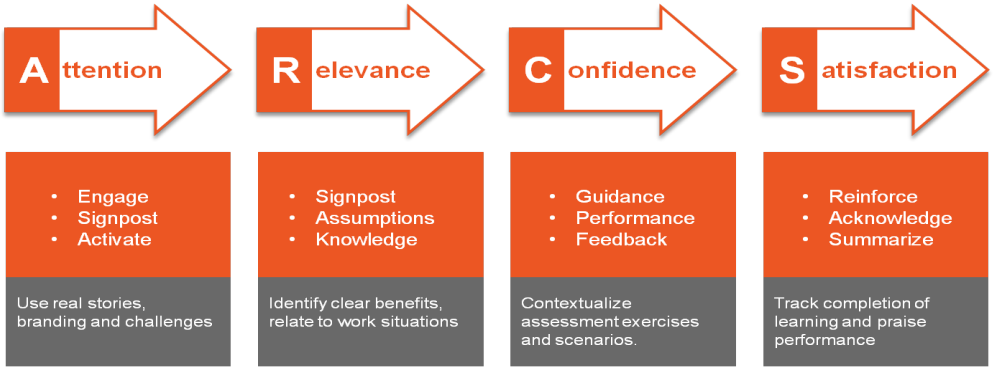


Figure 2-14: How we will use ARCS Model [Online image]. (2016).

Retrieved 1st October 2018 from https://pbl2educ5101.wordpress.com/2016/03/20/how-we-will-use-arcs-model/

Monkoski-Takamure (2014) highlighted the importance of critical thinking and 21st century skills necessary by both students and teachers in the development of eBooks. Similarly, an exploratory investigation into eBook formats (Epub & iBooks) by Bidarra, Natálio, and Figueiredo (2014, p. 12) suggested that both technologies '…have great usability and pedagogical potential for a learning ebook model'. Furthermore, as research by Huang, Chen, and Ho (2014) into the enhancement of learning outcomes via interactive eBooks suggests, subsequent scholars must ultimately explore, contemplate and innovate the potential uses of eBook development within the field of education.

To illustrate how mobile learning can facilitate authentic learning through collaborative curriculum design using iBA, research by Cochrane, Narayan, and Oldfield (2013) implemented over 60 mobile learning projects. The study's overall conclusion was that a combination of using iPads alongside iBA, ultimately and successfully fostered a social constructivist pedagogy. In the same year Bidarra et al. (2014) suggested that the iBook technology demonstrates both excellent usability and pedagogical potential as a learning eBook model. Experiences recorded by Juanes, Ruisoto, and Prats (2014, p. 26) in using iBA, establish the affordances of using this technology within an educational setting, claiming that '…the student motivation and implication is greater with digital formats. The active participation from both teacher and student makes them learn from one another. Moreover, digital books allow the inclusion of photos, videos, Internet links, amongst

others; it makes it more interactive'. Research by Area, Gonzalez, and Mora (2015) went even further by suggesting the necessity for many schools to substitute their traditional textbooks with digital educational materials, like many counties including South Korea, Japan and USA, who have already started this transformative process. As recent research by Figueiredo, Bidarra, and Bostad (2016) concludes, today's mobile technologies while being both flexible and interactive, will with adoption of the correct pedagogy, motivate students and afford them a more creative response to the world problems that surround them.

In reporting a more interactive and engaging experience for pupils using multi-touch eBooks, Mills (2016a, p. 1) suggests, '…authoring multi-touch interactive resources that are delivered to students as open-access may not only alleviate the financial burden many are faced with but also give teachers an opportunity to deepen their own content knowledge and efficacy through the act of authoring such resources'. As Mills (2016a, p. 7) further concludes, '…in contrast to traditional e-text publishing options, however, multi-touch e-text authoring programs, like iBooks Author, facilitate a deeper and more nuanced view of content for researchers and offer tools that better provide interactive features that benefit student engagement and accessibility'.

2.4.15. Impact on Curriculum

2.4.15.1. Literacy

Within a tablet device, one of the most notable applications that can enrich activities for teaching and learning is the e-book. The e-book is described as an electronic version of a printed book, developed in the 1960s. The technological advancement in the area of e-books has taken a book from a 2-dimensional to a 3-dimensional information tool, filling the screen with rich interactive multi-media material. Early research by Mercieca (2004) focused on e-book acceptance by students, specifically looking at the requirements needed to adopt digital textbook material, and what it would take to motivate the students to read electronic textbooks. The inquiry followed earlier studies by Nielsen (2000) and Krug (2005) who both suggested that the reading process is 25%-40% slower on screen than from traditional printed-paper. Both authors had initially identified areas of difficulty in early screen technology.

However, since the release of tablet pcs in 2010, it is not uncommon to find teacher literacy projects adopted in early years and postgraduate level schools and colleges across the USA. One such study in Cleveland Ohio by Harmon (2012), explored the tablet as a means to maximize instructional time and furthermore meeting the diverse needs of some students. Harmon was to discover that in all of the years of his career, he had never come across another pedagogical tool that could engage students so much than when using the device. The study's author highlighted the fun aspect to learning and the students' feelings of total control over their learning.

Keenly aware that such a technological device can have an initial novelty phase, Harmon was to note that it seemed that the tablet simply opened the door to self-directed learning. The research investigated levels of achievement by students after using the device, using control groups, one using the tablet, the other not using the device. Data from the study was accessible via end of year Ohio Graduation test results. The inquiry showed a significant enhancement in reading levels between the two groups, with those students using the device earning a significant beginning of year eighth grade level in reading, whilst those without averaged an end of year 6th grade level in their reading. This differential represents a significant full grade level between both control groups.

A second test on language skills, once again showed that students using the tablet gained at least one full grade level above those not using the device. As Harmon was to confirm, the study's results fell in line with those from an earlier 2011 report by NMC Horizon, Consortium (2011). The report concluded that the adoption of tablets played a significant impact in increasing student achievement in literacy. As Harmon (2012, p. 6) concluded, '…the data from both standardized/benchmark assessments and students' self-reporting indicates that iPads played a statistically significant role in increased student achievement in the area of literacy'.

Similarly, whilst exploring the integration of iPads into literacy instruction, in an effort to simultaneously teach both print based and digital literacy goals, Hutchison, Beschorner, and Schmidt-Crawford (2012) highlight the potential of digital interactive books. The study was to further focus on the use of apps to facilitate responses to text and note-taking capabilities. Findings from the study concluded that using a device such as an iPad in literacy instruction not only supported student learning but also confirmed that students were '…highly engaged and able to demonstrate unique and creative ways of

responding to text using a technology tool that offers some unique affordances to users' (Hutchison et al., 2012, p. 23). In contrast, whilst discussing the quality of learning, research by Mangen, Robinet, Olivier, and Velay (2014), depict pupils difficulty in remembering details when reading from tablets compared to that of print. While the validity of the study maybe questionable, especially so soon after the introduction of tablet pcs in 2010, it does however reflect earlier research which indicated that some pupils prefer print over screen reading for reasons of '…portability, dependability, flexibility, and ergonomics', (Spencer, 2006, p. 1). Reasons, that are not applicable today with the introduction of ubiquitous devices like the iPad.

In 2011, the Minister for Education and Skills in Ireland published a National strategy to improve Literacy and Numeracy following a decline in both standards. Since their introduction into schools, the emerging research of touch screen tablets suggest that children gain higher letter sound and name writing skills (Neumann, 2014), with 70% of parents believing that tablets help foster early literacy development.

2.4.15.2. Mathematics (numeracy)

Within an Irish context, author Alan November recounts a student engaging in deep learning during and after school (November, 2012). After solving a particular Maths problem, a student used her tablet pc and various apps to develop a tutorial for her peers. The students' video tutorial, like many others, was published to Mathtrain.tv, accessible by fellow classmates and others from around the world. Furthermore, when encountering technical issues with content creation, the students interacted with the teacher and/or their peers to resolve the problem. In essence, the students were learning from one another and taking responsibility for their learning. Moreover, by inherently engaging in these activities they have developed their key skills whilst extended their own knowledge of Mathematics. Hallissy, Gallagher, et al. (2013b) portrays a similar approach developed by teachers and students in Ratoath School, Co Meath, Ireland, to the sharing of students learning via http://www.mystudymate.ie/. As Hallissy, Gallagher, et al. (2013b) claim, students can engage in deep-learning while also developing their key skills. Additionally whilst using mobile technology they can open opportunities for themselves and teachers in the context of the Junior Cycle Reform. In their study examining mobile learning intervention on third grade Mathematics in the US, Kiger, Herro, and Prunty (2012) suggest the coupling of mobile devices within an existing curriculum, may be a cost effective lever in improving student achievement. In a similar

context in Holland, an inquiry by Khalid, Jurisic, Kristensen, and Ørngreen (2013) highlighted the success of integrating a Maths program called 'The Maths Professor' into the school curriculum. Whilst discussing the effect of m-learning (mobile learning) on mathematics learning, Taleb, Ahmadi, and Musavi (2015) explore the motivation, diversity of training methods and participation involved within their study. Their findings reveal a positive effect on motivation, a significant relation between mobile learning and participation in Mathematics and lastly a positive and significant relationship between m-learning and diverse training methods.

2.4.15.3. Science

Early tablet pc adoption by Simon, Anderson, Hoyer, and Su (2004) suggests mobile tablet technology can facilitate both active and collaborative learning activities. Furthermore the study highlights the rich environment for expressing ideas and the subsequent benefits from spontaneous activities derived from the technology. Similarly Knoop and van der Pluijm (2006, para. 11) describe favourable experiences using tablet pc devices in field science education. The study noted the students '…overwhelmingly positive feedback' and related assessment by teachers when highlighting both the capabilities and convenience of the devices.

Whilst Integrating Radio Frequency Identification technology (RFID) with a traditional mobile learning device, research by Chu, Hwang, Tsai, and Tseng (2010) highlighted students eagerness to engage with the technology. Alongside the need to acquire knowledge within complex learning scenarios, the study utilised student's responses to provide a more personalised-learning experience within a natural science course. Chu et al. (2010) conclude that their innovative approach is able to both improve the learning achievements of students and furthermore enhance their learning motivation.

In promoting the fast paced trends in ICT development, a project in 2015 by Clare Galway College in Ireland (adopting Microsoft surface tablets) in partnership with Learnovate (Trinity College, Dublin), created a number of digital teaching and learning apps in the areas of music and science. The project examined the move away from a passive model of one size fits all (in the text book) to a more student tailored fit, providing a more relevant and engaging education for the students. Whilst revolving around the debate of time-constraints in developing digital material, teachers within the College collaborate to curate a digital teaching and learning resource (app), with students

actively involved in that content creation. One of the key advantages highlighted by both staff and students was having the opportunity to have an active input into the apps developed, thus leading to a strong sence of both involvement and empowerment. Key areas addressed within this project included problem-solving, critical thinking and evaluation.

Whilst in agreement with Falloon (2015), many educationalists believe there is exciting potential for tablet pcs to support a blurring of the line between both formal and informal learning. In contrast, a report published in September 2015 by the OECD (2015, p. 3) from findings collected in 2012, show '…no appreciable improvements in student achievement in reading, mathematics or science in the countries that had invested heavily in ICT for education'. However the report does, as it strongly suggests, leave many unanswered questions, '…the impact of technology on education delivery remains sub-optimal, because we may overestimate the digital skills of both teachers and students, because of naïve policy design and implementation strategies, because of a poor understanding of pedagogy, or because of the generally poor quality of educational software and courseware' (OECD, 2015, p. 4).

2.4.16. Summary

This section has detailed the probable curricular impacts from using mobile digital technology. The key areas of literacy, numeracy and science have been explored. As clearly identified in research by Harmon (2010), the introduction of an iPad can play a significant role in increased student achievement in the area of literacy. This is further reflected in later research by Hutchison et al. (2012) who highlighted increased student engagement and the unique affordances of tablet pcs when responding to text. Notwithstanding, research into the areas of teaching numeracy and science also clearly demonstrate high levels of engagement, motivation and collaboration when adopting mobile digital devices (Khalid et al., 2013; Simon et al., 2004).

In reflecting earlier research, a comprehensive study of K12 students in the US by Liu et al. (2014) discovered 63 *exploratory* data-based research articles on the topic of mobile learning between 2007 & 2014. Whilst focusing on the educational affordances of using mobile devices, the majority of articles confirmed earlier studies, including positive feedback on capturing of content, facilitating communication and collaboration, content

creation, accessibility, extended after school learning and potential for artefact creation (Jahnke & Kumar, 2014). However, as Lindsay (2015, p. 8) claims, '…the opportunities mobile technology offers for both situated learning in context and connecting with experts appear to be largely unrealised'. This is later echoed by Mouza and Barrett-Greenly (2015) who claim research into mobile devices educational uses and student outcomes, continue to be in its infancy. In questioning technological adoptions whilst exploring the context of collaborative learning, a report by Thompson (2013c) for European Schoolnet claims there is no indication that a tablet device is more suitable for any specific subject. As such, Lindsay (2015) suggests, that most teachers use mobile technology to teach core subjects such as mathematics, reading, writing and social sciences. Using a similar framework as adopted in the Junior Cycle in Ireland, Falloon (2015) suggests that using digital mobile devices in conjunction with the myriad of cloud-based educational apps available on various platforms, extends collaboration to a much wider audience well beyond the school gates.

2.5. Conclusion

'The principle goal of education in the schools should be creating men and women who are capable of doing new things, not simply repeating what other generations have done; men and women who are creative, inventive and discoverers, who can be critical and verify, and not accept, everything they are offered.' Jean Piaget

Most of the research that has been reviewed to date reflects that mobile device adoption has assisted teaching and learning, whilst in contrast other studies present either inconclusive or even suggest mixed results. However, the evidence collated within the researchers' literature review, clearly demonstrates the continued importance of the topic area, as demonstrated by Male and Burden (2014a).

Furthermore, this review has detailed an historical analysis of technology in education up to the present day, the inevitable educational drive for change, as highlighted by Fullan (2013) and the subsequent development of required educational frameworks to meet this change, including in an Irish context, the Junior Cycle framework (NCCA, 2011). Many of the theorists reviewed within the literature, detail the enhanced features of mobile devices, such as the tablet pc. Whilst the literature to date covers many relevant unique perceived affordances of tablet pcs, the researchers review has focused particular attention to the areas of motivation, engagement, communication, collaboration, reflection and assistive learning in relevance to Junior Cycle key skills. As

such, the researcher has clearly demonstrated a clear linkage between the affordances of tablet pcs and the required Junior Cycle key skills as detailed earlier. As noted in early studies, the educational drive for change requires new teaching methods, '…not surprisingly, students today expect to learn in an environment that mirrors their lives and their futures—one that seamlessly integrates today's digital tools, accommodates a mobile lifestyle, and encourages collaboration and teamwork in physical and virtual spaces', (Apple, 2008, p. 19). As Richardson and Postman (2013, p. 2) further suggests, '…it's not about the tools. It's not about layering expensive technology on top of the traditional curriculum. Instead, it's about addressing the new needs of modern learners in entirely new ways'. Furthermore, this review has explored the perceived impact on school curriculum within a mobile device adoption, such as tablet pcs. As the literature demonstrates, tablet pcs can facilitate increased student achievement in the key areas of literacy, numeracy and science (Harmon, 2012; Hutchison et al., 2012; Thompson, 2013c).

Moreover, the review has addressed the lack of research into the area of classroom relationships between teachers and students once mobile digital technology has been introduced. Although this area is still in its infancy, initial findings from the literature suggest a more meaningful interaction between both parties. As the OECD report in 2015 concludes in regard to the combination of students, computers and learning, '…we need to get this right in order to provide educators with learning environments that support 21st-century pedagogies and provide children with the 21st-century skills they need to succeed in tomorrow's world. Technology is the only way to dramatically expand access to knowledge.' (OECD, 2015, p. 4).

By late 2015 a critical review of the evidence for learning outcomes related to tablet use highlighted the scarcity of rigorous studies within this domain. As a consequence, it has been difficult to draw firm conclusions within this area of inquiry (Haßler, Major, & Hennessy, 2016). However, research suggests a distinct shift has formulated away from the traditional pedagogical practice to a more student-centred digital content delivery affording creators the opportunity to develop meaningful relevant lessons that integrate successfully with mobile digital devices (Baab, Bansavich, & Souleles, 2016). As suggested by Falloon (2017), apps such as iBooks Author contribute to higher order thinking and collaborative development. Furthermore, the inquiry also highlights the need for teachers to '…align with the curriculum, pedagogical and assessment designs'

where they are intended to be used. Whilst investigating how teachers are adopting technology to change assessment and feedback, Higgs, Groessler, Macaulay, and West (2017, p. 5) declare that their study can establish '…a transformation and redefinition of student learning through the synthesis of strong pedagogy and the affordance of technology'. However, Higgs et al. (2017, p. 11) further conclude, '…if the mLearning activities are not included in the graded assignments and assessments of the course, students are less likely to take full advantage of the learning opportunities they provide'. The key findings from recent research reports clearly suggest that mobile digital devices have the potential to compliment all areas of the curriculum with most schools unaware of this significant potential. On one hand the teachers witness a positive impact to their own motivation and enthusiasm, while students acquire higher levels of engagement and communication skills alongside an '…increase in confidence and ownership of the learning process' (Gray, Dunn, Moffett, & Mitchell, 2017, p. 4).

Adapting to a curriculum developed for and by mobile digital devices, such as iPads, includes many distinct challenges but alternatively can offer increased potential to enhance learning for those early adopters (Stec, Bauer, Hopgood, & Beery, 2018). In contrast, a distinct lack of research into the effectiveness of interactive ebooks for learning remains. However, one recent innovative study by O'Bannon, Skolits, and Lubke (2017) suggests a significant difference in the achievement of students receiving instruction via interactive iBooks. Echoing this shift, a later inquiry by Liu, Ko, Willmann, and Fickert (2018) highlights the need for instructional material developed by teachers alongside the development of learning artefacts by students.

The adoption of early traditional eBooks as part of instructional activities as discussed by Schuh, Van Horne, and Russell (2018) echoes the earlier studies by Cuillier and Dewland (2014) and Van Horne, Russell, and Schuh (2016), highlighting students' lack of interaction with early eBooks. This has been further compounded by their lack of findings related to the potential affordances of non-interactive eBooks. In comparison, the measurement of engagement and learning processes of those students today with access to customised interactive digital textbooks, with the focus on perceived flexibility and learner control, clearly demonstrates increased engagement and interest (Bikowski & Casal, 2018).

Ultimately, this gradual shift away from direct instruction is believed to be as a result of an initial change in pedagogical practice alongside the affordances and capabilities of digital mobile devices. As a consequence, learners are now formally positioned as content creators and knowledge makers, where they are conclusively positioned to become responsible for their own learning (Thumlert, Owston, & Malhotra, 2018). However as clearly demonstrated by Anderson, Chung, and Macleroy (2018), the development of a project based curriculum is fraught with high expectations that are demanding in terms of time and resources, with an additional element of risk.

Within this chapter a comprehensive review of the relevant literature has been presented to further enhance an understanding of integrating mobile digital devices in classrooms. What is clear is that the essence of education has not changed, equipping students with the 21st century skills needed to be successful. However, what has changed is society. As a result of this change, education today must afford students the relevant 21st century skills required in the workplace. In an Irish context, it is therefore of importance to highlight any perceived technological affordances available to students from within the Junior Cycle framework while using tablet pcs. Furthermore, this extensive review of relevant literature has underpinned the formulation of the research questions detailed within Chapter 3.

Chapter 3. Methodology

3.1. Introduction

This chapter details the research approach utilised in the study. Furthermore, the chapter contains details of the various stages of the research process, the participants, data collection tools and analytical processes adopted. This chapter ends with a discussion on triangulation of the available evidence, its validity and relevant ethical issues. This study utilised a case study approach to address if mobile digital devices (such as tablet pcs) can contribute to the realisation of the aims of the new Junior Cycle Educational framework in Ireland. The research approach adopted within this study firstly includes a survey approach (***Stage 1***) followed by a multiple case-study methodology approach (***Stage 2***). In (***Stage 1***), the researcher utilised a survey of post-primary schools identified as having recently adopted digital tablet technology. Next, (***Stage 2***) entailed a multiple case-study design, this approach will evaluate the effectiveness of an intervention. The case study approach included a pre and post-test online survey (via Survey Monkey) with teachers and students within each schools intervention. Each intervention within (***Stage 2***) included three phases.

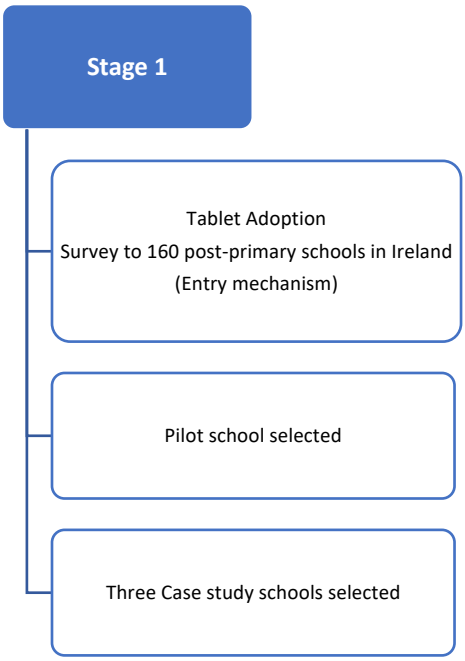


Figure 3-1: Research Overview – Survey Approach

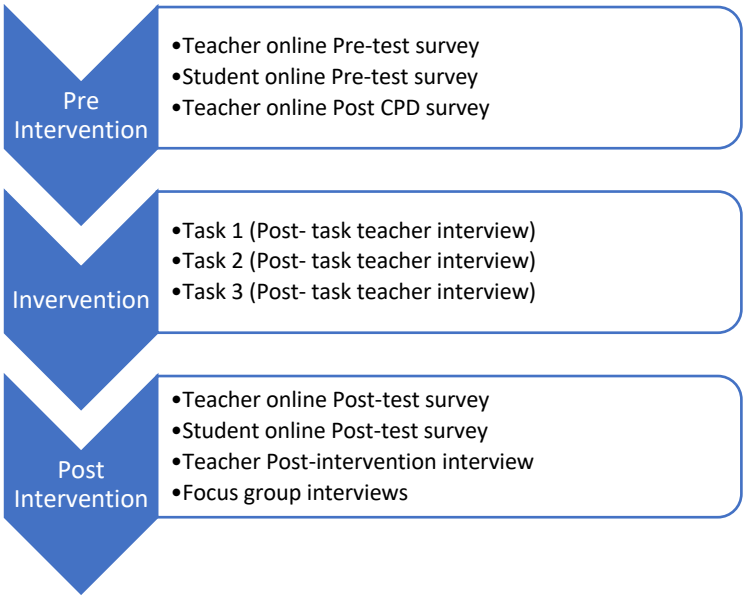


Figure 3-2: Pre and Post Intervention Data Collection (Stage 2)

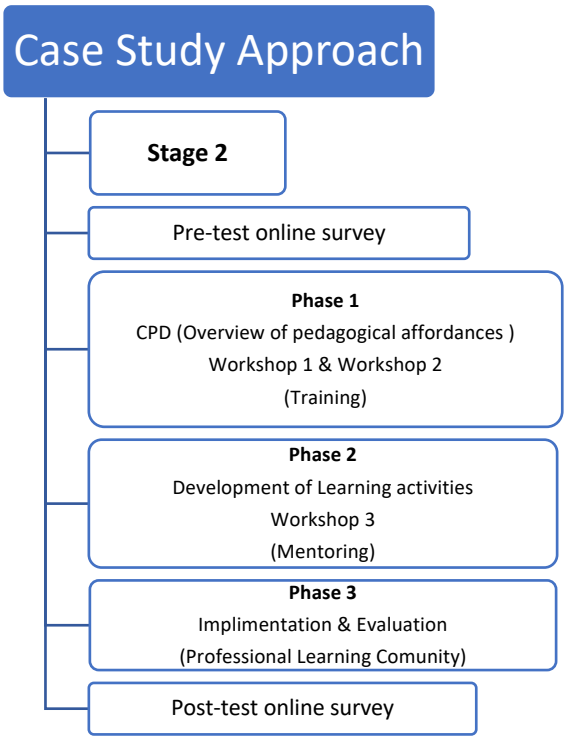


Figure 3-3: Research Overview – Case study approach

The data collected in the study (as depicted above) included evidence derived from three post-primary schools that have adopted mobile technology within their classrooms. Other data collection methods used included surveys, one-to-one interviews and focus groups with participating teachers and students. As described in Chapter 2, this study is presented against a backdrop where research in the topic area is in its infancy and under-examined.

3.2. Research Questions

This inquiry is set to address the following research questions:

- How can teachers take advantage of the affordances of mobile devices and in particular the iBook Author application in their instructional activities, so as to address the aims of the new Junior Cycle (*motivation, engagement, communication, collaboration, reflection and assistive learning*)?
- What pedagogies fully leverage using iBooks Author content on mobile devices for teaching & learning in the context of the new Junior Cycle framework?
- As a consequence of using iBooks Author with tablet pcs, in what ways have the dynamics changed between the teacher and student?

3.3. Methodology

The following chapter will describe the philosophical assumptions and paradigms underpinning this research process. Whilst developing this research, the researcher began with an over-arching research problem that needed to be addressed: if mobile devices can contribute to the realisation of the aims of the new Junior Cycle Educational framework in Ireland.

As Crotty (1998) advocates, within the foundations of social research, the methods adopted are selected in the context of the research methodology chosen, which in turn will be influenced by the theoretical perspective endorsed from a researcher's particular epistemological stance. As Crotty further advocates, the justification in our choice and use of a particular methodology '…is something that reaches into the assumptions about reality that we bring to our work'. Moreover it also reaches into the researchers understanding of '…what human knowledge is, what it entails, and what status can be ascribed to it' (Crotty, 1998, p. 2).

Ultimately, the researcher now must focus on answering the following questions, as suggested by Crotty;

- *What **methods** do we propose?*
- *What **methodology** governs our choice and use of methods?*
- *What **theoretical perspective** lies behind the methodology in question?*
- *What **epistemology** informs the theoretical perspective underpinning the research?*

These four elements, which Crotty describes, are at the heart of the research process, affording a view that researchers' can draw upon whilst organising their research efforts. These theoretical four stages in social research as depicted below, include Epistemology, Theoretical perspective, Methodology and lastly Methods. However, this hierarchal framework to research design is a reversal of the earlier sequence of questions that Crotty believes a researcher must focus upon.

Epistemology	**Theoretical perspective**	**Methodology**	**Methods**
Objectivism Constructionism Subjectivism (*and their variants*)	Positivism (and post-positivism) Interpretivism • Symbolic interactionism • Phenomenology • Hermeneutics Critical inquiry Feminism Postmodernism etc.	Experimental research Survey research Ethnography Phenomenological research Grounded theory Heuristic inquiry Action research Discourse analysis Feminist standpoint research etc.	Sampling Measurement and scaling Questionnaire Observation • participant • non-participant Interview Focus group Case study Life history Narrative Visual ethnographic methods Statistical analysis Data reduction Theme identification Comparative analysis Cognitive mapping Interpretative methods Document analysis Content analysis Conversation analysis etc.

Table 3-1: Crotty's' hierarchal framework to research design

Therefore, we can conclude that a research process is ultimately not a distinctive neat linear path but rather as Crotty was to later confess, '…not too many of us embark on a piece of social research with epistemology as our starting point … We typically start with a real-life issue that needs to be addressed, a problem that needs to be solved, a question that needs to be answered'. As Crotty was to further conclude, '…this suggests that, to mark the chronological succession of events in our research, the arrows may need to be drawn from right to left as well' (Crotty, 1998, p. 13). The first of four theoretical stages in social research, Epistemology, describes the theory of knowledge with regard to its methods, its justification and rationale.

3.4. Epistemology

Derived from the Greek word 'episteme', meaning 'knowledge, understanding', epistemology is the doctrine or study of knowledge, often referred to as the 'theory of knowledge'. This theory of knowledge attempts to answer a number of fundamental questions, for example, the origin, nature and justification of human knowledge (Hofer & Pintrich, 1997). Within research literature the term 'Ontology' is frequently mentioned, this is described as the study of meaning. This term firmly sits alongside epistemology, informing the theoretical perspective. As Crotty suggests, each of these '…embodies a certain way of understanding *what is (ontology)* as well as a certain way of understanding what it means to know (epistemology)' (Crotty, 1998, p. 10). Epistemology deals with '…the nature of knowledge, its possibility, scope and general basis' (Hamlyn, 1995, p. 242). Elaborating further, Maynard states that epistemology, '…is concerned with providing a philosophical grounding for deciding what kinds of knowledge are possible, and how we can ensure that they are both adequate and legitimate' (Maynard, 1994, p. 10). Because of this we therefore need to identify, explain and justify the adopted epistemological standpoint adopted within our inquiry.

Ontology	**Epistemology**	**Methodology**	**Methods**	**Sources**
What's out there to know? ➔	What and how can we know about it? ➔	How can we go about acquiring knowledge? ➔	What procedures can we use to acquire it? ➔	Which data can we collect? ➔

Table 3-2: Epistemological standpoint: Adapted from Hay (2002, p. 64)

The concept of epistemology was first introduced by Scottish philosopher James Frederick Ferrier (1808-1864). This branch of philosophy, questions what knowledge is and how it is acquired. While explaining '…how we know what we know' (Crotty, 1998), epistemology offers the researcher the opportunity to justify their adopted stance while exemplifying its philosophical importance in the conduct of research. The epistemological position for many researchers reflects three commonly adopted, yet very distinct positions: objectivism, constructivism and subjectivism.

3.5. Objectivism

A philosophical system first developed by Rand (1990, p. 5), the objectivist epistemology holds that all knowledge is based on perception, '…percepts, not sensations, are the given, the self-evident.' As Carson (2005) was to later suggest 'objectivism also holds that humankind takes in data through the senses and uses reason to obtain knowledge.' Whilst describing objectivism, Crotty (1998) further advocates the epistemological view that things '…exist as meaningful entities independently of consciousness and experience', and furthermore suggests that they '…have truths and meaning residing in them as objects' and that such objective truth and meaning can be identified via pertinent methods of inquiry. Within this position, researchers will try to find causes, effects, and explanations. Carson was to conclude that in relation to education, '…objectivism is more reasonable from a theoretical and practical perspective than constructivism.'

3.6. Constructivism

Constructivism is founded in the early writings of Dewey (1938) whose viewpoint on learning, suggests we construct knowledge, as a reconstructing of our experiences. Early philosophers Piaget (1964) and Vygotsky (1964) proposed alternative definitions, while Piaget defines constructivism as producing knowledge and the forming of meaning based upon our experiences, Vygotsky suggests that the knowledge produced is related primarily to a social activity. In sharing a constructivist connotation of learning whilst irrespective of the circumstances, constructionism as described by Papert and Harel (1991, p. 2), '…boils down to demanding that everything be understood by being constructed'. Crotty (1998, p. 42) further defines constructivism as '…the view that all knowledge, and therefore all meaningful reality as such, is contingent upon human practices, being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context'. Maclellan and Soden (2004) suggest that knowledge is not passively received but rather constructed

by individuals. In essence constructivism with its myriad of varieties, is related to how and where we construct knowledge. If a philosophical epistemology argues that we generate knowledge from our experiences, what if that knowledge is based upon our feelings or intuition, thus leading us to subjectivism.

3.7. Subjectivism

This philosophical theory suggests that truth is subjective and is dependent on the person's mind and experience, that there is no truth outside one's own experience. The focus of subjectivism as articulated by Richardson and Bowden (1984), describes this distinct philosophical approach whereby '…our own mental activity is the only unquestionable fact of our experience', (Richardson & Bowden, 1984, pp. 552-553). In essence, all of our knowledge collected, is limited to experiences by ourselves and is based in feelings or intuition, a theory of knowledge and how it is achieved. In this instance, knowledge is subjective and relative, never objective. As discussed by Gray (2013), the research process will require engagement at some point with theoretical perspectives. Grey suggests this will occur prior to undertaking the research, adopting a deductive approach, while at other times after it, inductive.

3.8. Theoretical Perspective

Defined by Crotty as '…the philosophical stance informing the methodology and thus providing a context for the process and grounding its logic and criteria' (Crotty, 1998, p. 3), the theoretical perspective describes the adopted philosophical stance that lies behind our chosen methodology. As a theoretical framework underpinning the research design, its application aims to ensure consistency between the problem and the relevant questions, to the methods adopted in addressing the research problem (Crotty, 1998). In essence, it defines our assumptions, which we as researchers bring to the inquiry. Ultimately, this then becomes reflected in the employed methodology. Therefore, the theoretical perspective '…has implications for every decision made in the research process' (Mertens, 1998, p. 3). As Gray (2013, p. 16) highlights, Crotty's work demonstrates the issue of the '…bewildering array of theoretical perspectives and methodologies', but also the inconsistency applied to the terminology, which at times is almost contradictory. Whilst discussing theoretical perspectives and research methodologies, Gray (2013) furthermore reflects on Crotty's assumptions that an interrelationship exists between an adopted theoretical stance, the methodology and subsequent methods used to collect data and a researchers view of the epistemology.

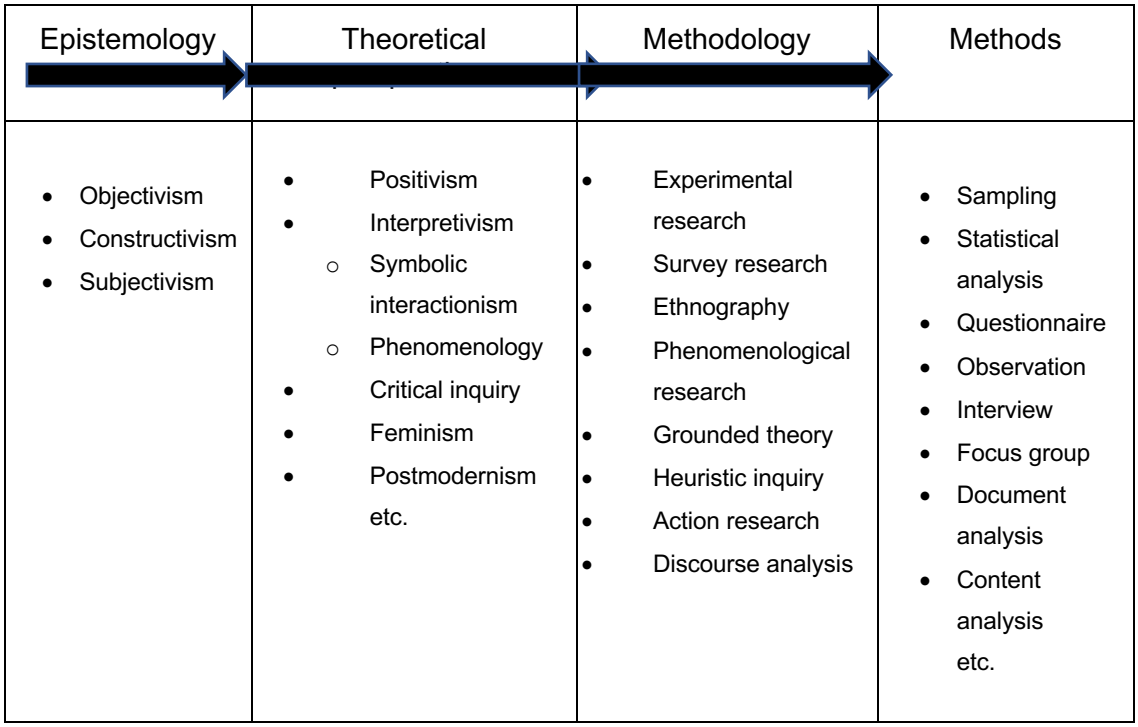


Figure 3-4: Theoretical perspectives and research methodologies (D. E. Gray, 2013, p. 19)

Gray further clarifies that in the context of research, the choice of methods employed to gather data will be influenced by the adopted methodology, which in turn will be influenced by the theoretical perspectives endorsed and subsequently in turn by the researchers' epistemological stance. In a similar stance, the core principle adapted by Crotty (1998) suggests that the research methods adopted are selected in the context of the research methodology chosen, which in turn will be influenced by the theoretical perspective endorsed from a researcher's particular epistemological stance. Therefore, it is important '…to find a method which is compatible with the kind of thing [one is] trying to investigate' (Mackay & Conn, 1993, p. 300). As Crotty (1998) further suggests '…our interest in the social world tends to focus on exactly those aspects that are unique, individual and qualitative, whereas our interest in the natural world focuses on more abstract phenomena, that is, those exhibiting quantifiable, empirical regularities' (Crotty, 1998, p. 68). The pillars of theoretical perspective include; positivism (based on numbers, statistical values), interpretivism (qualitative research) and critical paradigm (critique of society and culture). Of the various theoretical perspectives available to researchers, Gray (2013) highlights positivism and the various strands of interpretivism as having (arguably) been the most influential in educational research.

3.9. Research Paradigms

3.9.1. The Positivist paradigm

To begin with, described as the scientific paradigm, the sole purpose of positivism is to either prove or disprove a particular hypothesis. With an emphasis on the scientific method alongside statistical analysis, positivism typically contains a control and experimental group. Philosopher and founding sociologist Auguste Comte developed positivism in the early 19th century. The heart of Comte's thinking is based on an assumption that it is possible to observe life and from these observations establish reliable valid knowledge as to how it works (Comte, 1868).

This knowledge can subsequently be used to affect the course of social change. Some of the best ways to achieving this knowledge is by scientific methods or experimental testing. This philosophical paradigm recognises only that which can be scientifically verified or can be proven logical or by mathematical proof. As such, this paradigm favours the use of collecting quantitative data. This quantitative data is typically collected as statistics using questionnaires with close-ended questions and structured interviews. In contrast interpretivism, integrates human interest within a study to gain a deeper understanding of a phenomenon.

3.9.2. The Interpretivist paradigm

Founded by Franz Boaz and described as the 'Father of American Anthropology', interpretivism attempts to '…understand and explain human and social reality', (Crotty, 1998, p. 66). Ultimately, the researcher's position is to interpret social action. Interpretivism with its close links to constructivism is characterised by Collins (2010) as '…associated with the philosophical position of idealism, and is used to group together diverse approaches, including social constructionism, phenomenology and hermeneutics; approaches that reject the objectivist view that meaning resides within the world independently of consciousness' (Collins, 2010, p. 38). Interpretivism has its roots often linked to the beliefs of Max Weber (1864-1920), who advocated that within human sciences we are concerned with interpreting social action in a process known as *Verstehen* (understanding). This perspective looks at culture and how people live their lives, using interviews and observations, whilst investigating meanings and motives behind a person's actions and behaviour. As Weber (1978) suggests, '…we can accomplish something which is never attainable in the natural sciences, namely the subjective understanding of the action of the component individuals' (Weber, 1978, p.

158). We are reminded of the distinction when adopting an interpretivist approach in that '…research can never be objectively observed from the outside rather it must be observed from inside through the direct experience of the people' (Mack, 2010, p. 8).

As Orlikowski and Baroudi (1991, p. 28) further suggest, interpretivism offers '…rather than having to compromise and use what may be unworkable positivistic assumptions, a more appropriate stance may be to adopt a different philosophical approach whose premises are more suited to the research intention'. Depicted as the 'anti-positivist' paradigm, with the ability to '…understand, explain, and demystify social reality through the eyes of different participants' (Cohen, Manion, & Morrison, 2000), interpretivism as suggested by Crotty (1998, p. 67) '…looks for culturally derived and historically situated interpretations of the social life-world'. However, as noted by Thomas (2008, p. 1), '…the problem with research in the interpretivist paradigm is that it involves people. Consequently, things rarely go completely according to plan, and interpretivist researchers should expect surprises'.

As Orlikowski and Baroudi (1991, p. 5) advocate '…interpretive studies assume that people create and associate their own subjective and intersubjective meanings as they interact with the world around them', thus, the key role of the researcher in interpretive research is to attempt to understand phenomena by '…accessing the meanings participants assign to them'. As further debated by Walsham (2006, p. 321), the choice of fieldwork employed within an interpretive study is context-dependent, therefore a researcher must '…make their own choices in the light of their own context, preferences, opportunities and constraints'. Whilst an interpretivist viewpoint tries to make sense of a particular phenomena through the eyes of a participant, the alternative critical theory paradigm suggests that '…reality is socially constructed through the media, institutions and society', (Pham, 2018, p. 4).

3.9.3. The Critical paradigm

Having both a narrow and broad meaning in philosophy this paradigm has its origins in both sociology and literary criticism. This is a school of thought promoted by several generations of German philosophers and social theorists. These theorists from the Marxist tradition known as the 'Frankfurt School' (Jurgen Habermas, Herbert Marcuse, Walter Benjamin, Max Horkheimer, and Theodor Adorno), illustrated critical theory as providing both descriptive and normative bases for social inquiry with the aim of

decreasing domination and increasing freedom, thus critiquing and changing society as a whole.

Theorists from this tradition align themselves firmly with those opposed to a dominant order within society, challenging how and why conflicts are resolved in favour of specific groupings, aligning itself firmly as both political and economical in nature. Using a qualitative research approach within this critical paradigm, a researcher attempts to '…critically evaluate the social reality under investigation' and furthermore is '…concerned with critiquing existing social systems and revealing any contradictions and conflicts that may inhere within their structures', (Myers & Avison, 2002, p. 70). A study by Cannella, Lincoln, Denzin, and Giardina (2009) identifies' two foundational questions in critical perspectives;

- Who/What is helped/privileged/legitimated?
- Who/What is harmed/opposed/disqualified?

When adopting such a critical approach to inquiry, each part of the research process comes under particular scrutiny. Dryzek (1995, p. 99) describes the tasks of the social scientist as, '…1. to understand the ideologically distorted subjective situation of some individual or group; 2. to explore the forces that have caused that situation; 3. to show that these forces can be overcome through awareness of them on the part of the oppressed individual or group in question'. In conclusion, the researcher has presented each unique paradigm, highlighting both their advantages and disadvantages. While in agreement with Pham (2018, p. 5), the researcher echoes the statement that each archetype '…has its own unique role contributing to provide researchers with a holistic framework and multiple view to address key social issues, specifically in educational context'.

3.10. Integrating Positivist and Interpretivist approaches

Originating from a constructivist epistemology, whilst adopting a combination of both positivist and interpretivist perspectives, the researcher's study sourced both qualitative and quantitative data to address the research questions guiding the inquiry, as detailed at the start of this chapter. A synthesis of positivist and interpretivist theoretical approaches affords the researcher an opportunity to increase confidence in the overall findings via triangulation (multiple data sources within the study of a single phenomenon), providing a more comprehensive picture of the results (Heale & Forbes,

2013). Furthermore, adopting methodological triangulation will reinforce validity by enhancing the analysis and interpretation of the findings. As concluded by Bryman (2006, p. 111) '…there is considerable value in examining both the rationales that are given for combining quantitative and qualitative research and the ways in which they are combined in practice'. The positivist perspective focused on the aspect of statistical analysis using quantitative data collected via online surveys. The researcher developed a series of Likert scale questionnaire items in both pre and post-test surveys to calculate and compare values and to discover any statistical significance and effect size as a consequence of the intervention. In contrast, the interpretivist perspective focused on qualitative data accumulated through a consolidation of student focus groups and teacher interviews. Following completion of individual learning tasks by students, the researcher arranged a series of semi-structured interviews with each teacher within the inquiry.

Epistemology	**Theoretical perspective**	**Methodology**	**Methods**
Constructionism	Positivism Interpretivism	Survey Research Case Studies	Surveys Focus Groups Interviews

Table 3-3: Schema outlining the theoretical framework of the researcher's inquiry

3.11. Research Approach Overview

Similar to the researcher's study, earlier analysis by Russek and Weinberg (1993) describes the fusion of the different approaches as providing a complete picture but also the ability to show convergence, inconsistency and complimentary results. Whilst conducting a review of 48 peer-reviewed articles into technology adoption and usage between 1985 and 2003, Choudrie and Dwivedi (2005, p. 10) describes how '…the extent to which a researcher can be a part of the context being studied may be relevant in the choice of research method'. As highlighted later by Gilbert (2008), this can be also be attributed to issues such as cost, time, convenience and also accessibility. Similarly, an earlier study by Orlikowski and Baroudi (1991), reflecting on research approaches, examined 155 research articles between 1983-1988. The study was to conclude that researchers '…are influenced to a greater or lesser extent by the various institutional

contexts within which they are trained and work' (Orlikowski & Baroudi, 1991, p. 24). In conclusion, Choudrie and Dwivedi (2005) findings suggest approx. 80% of the peer-reviewed literature in relation to technology adoption, contained some form of empirical research, with very dominant approaches in the areas of surveys, interviews and case studies to the fore.

3.11.1. Philosophical approach

The philosophical assumptions underpinning this research process were based upon integrating both positivist and interpretivist approaches. Firstly, the positivist perspective focused on the aspect of statistical analysis using quantitative data collected via surveys**.** Continuing on from Crotty's theoretical four stages in social research, the research methodology is portrayed as '…the strategy, plan of action, process or design lying behind the choice and use of particular methods and linking the choice and methods to the desired [research] outcomes', (Crotty, 1998, p. 3). Inherently, the research methodology is the conceptual framework, which guides research practice. Research takes a researcher beyond their personal knowledge and experiences and is undertaken to explore an issue, problem or new idea.

Conducting research requires a researcher to produce substantive evidence and to subsequently empower them to communicate these coherent ideas and findings amongst their peers, described by Creswell and Garrett (2008) as a process of steps used to collect and analyse information to increase our understanding of a topic or issue. It consists of three steps: Pose a question, collect data to answer the question, and present an answer to the question. Secondly, the interpretivist perspective implies a social constructivist epistemological stance, a view that '…all knowledge, and therefore all meaningful reality as such, is contingent upon human practices, being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context', (Crotty, 1998, p. 42).

3.11.2. Research Approach

The research approach adopted within the researcher's inquiry included a survey and multiple case-study methodology approach. In ***Stage 1*** the researcher utilised a survey of post-primary schools identified as having recently adopted digital tablet technology. This specific survey served as an entry mechanism to establish base line data regarding

tablet pilots, device adoption and initial perspectives of those at the cusp of the decision-making process with regard to their introduction in post-primary schools within Ireland.

Next, ***Stage 2*** entailed a multiple case-study approach to evaluate the effectiveness of an intervention (Campbell & Stanley, 2015). This intervention (***Stage 2***) included three phases. The first phase (***Phase 1)*** focused on the area of Continuing Professional Development (CPD) and primarily upon the affordances of iBooks Author (iBA) and the potential for its use within a teaching and learning context. With the researcher adopting the role of mentor, (***Phase 2)*** included the development of agreed learning activities (using iBooks Author) by teachers. The implementation phase of the research study (***Phase 3***) measured the degree of change occurring as a result of the intervention. Ultimately, this approach will address if mobile digital devices (such as tablet pcs) and specifically the iBooks Author application can contribute to the realisation of the aims (*motivation, engagement, communication, collaboration, reflection and assistive learning)* of the new Junior Cycle educational framework in Ireland.

In the context of the researcher's study and using supporting literature, the researcher has described the reasoning behind the adopted intervention and pedagogical strategies adopted. Furthermore, as previously outlined, data collection methods included surveys, interviews, CPD workshop consultations and observations from participant teachers and students. As suggested earlier, this study is presented against a backdrop where research in the topic area is in its infancy and under-examined (Male & Burden, 2014a).

3.12. Stage 1: Survey Approach

Historically, survey research has used representative sampling methods as an essential element '…to permit confident generalization of results', (Krosnick, 1999, p. 538). As Krosnick clarifies, the thinking adopted by many researchers previously was that not only was representative sampling essential but also that '…high response rates must be obtained, and statistical weighting procedures must be imposed to maximize representativeness'. This 'standard practice' has been relatively unchallenged until the late-nineties. Surveys are regarded as one of the most popular forms of data collection. While easy to compare and analyse, surveys can also be administered from various sample sizes. In particular, surveys are deemed inexpensive, ensuring confidentiality or anonymity and can be administered quite quickly with ease. In contrast, the disadvantages of using this type of method may include poor response rates, ambiguous

replies and incomplete or omitted responses Creswell and Garrett (2008). Previous literature has demonstrated how they have primarily used surveys to collect factual data in a quick and affordable manner to answer the 'what' questions highlighted within research (Choudrie & Dwivedi, 2005; Kothari, 2004).

Kotrlik and Higgins (2001, p. 1) advise however that '…inappropriate, inadequate, or excessive sample sizes continue to influence the quality and accuracy of research'. Conventional wisdom has it that survey research, in broad terms, encompasses any procedure of measurement that typically involves the asking of questions from specific respondents. Kerlinger (1973) chronicles survey research as social scientific research, which focuses on people, their vital facts, beliefs, opinions, attitudes, motivations and behaviour. Regrettably, the core disadvantage with postal surveys is the historical low response rate, compared to interview surveys. If a low response rate occurs the initial respondents may not be totally representative of the general population, as research by Phellas, Bloch, and Seale (2011) advocates. Some of the factors that influence response rates include, length of the questionnaire, ease of use (is it easy to answer, is there a flow). Also, of equal importance is the offer of incentives to complete the questionnaire, from the option to share the research outcomes to the opportunity to win a prize.

Using an electronic online survey instrument (Survey Monkey), Burden et al. (2012b) afforded teachers, students and parents across six schools the opportunity to provide anonymous information, which contributed key numerical data for the researchers to draw upon in their analysis. In particular, the survey instrument provided unique insights into access to ubiquitous technology, frequency of use, interest, motivation, engagement and disposition to learning using tablet pcs, use of apps, use of tablets across the curriculum and finally pedagogical advantages derived from using the devices. In the context of the researcher's own inquiry and following in the footsteps of similar explorations by (Beauchamp & Hillier, 2014) and (Male, Burden, Martin, Hopkins, & Trala, 2012) the researcher utilised a survey of post-primary schools identified as having recently adopted digital tablet technology (n=160). This specific survey served as an entry mechanism to establish base line data regarding tablet pilots, device adoption and initial perspectives of those at the cusp of the decision-making process with regard to their introduction in post-primary schools within Ireland. It was anticipated by the researcher that the survey provided the best method to address staff and student perceptions of how teachers can take advantage of the affordances of mobile devices in

their instructional activities, so as to address the aims of the new Junior Cycle. The survey sent to School Principals included a number of background demographic questions related to the type of school, age group, and current status with the piloting of tablet pcs. Details of the complete survey are available in (Appendix H). The survey then asked the School Principals to rank the main reasons for their adoption of tablet pcs within the school. Following on, the survey made enquiries into details on the stakeholders and reasoning to such an adoption. Lastly, the survey focused on performance expectancy as to how the devices were being used in the classroom, levels of CPD afforded to teachers and the impact on students as a consequence of the deployment of tablet pcs.

A total of twenty-seven questions, informed by Hallissy, Gallagher, et al. (2013b), were developed as part of the introductory survey to gather data on their perceived affordances to mobile adoption within post-primary educational institutions in Ireland. The survey data was expected to yield evidence relevant firstly to how students are motivated upon using tablet pcs. The survey focused on key areas such as informal learning, a sense of ownership, communication (supporting collaboration), entertainment value, accessibility to resources and lastly portability. Furthermore, survey questions related to engagement will address tablet viability to enhance engagement, both in the classroom and at home. Questions from the surveys related to communication were expected to confirm how staff and students used the devices to communicate with each other and their peers, and if the tablets provided an opportunity to extend their relationship outside of the classroom.

In relation to collaboration, the surveys examined if tablet pcs facilitated collaboration due to their accessibility (size, portability, versatility and tactile nature) and/or the inclusion of 3rd party apps (Google Docs, Drop box) developed for this sole purpose. The survey also addressed if using digital devices (such as the tablet) can provide the opportunity for students to develop reflective skills. Lastly, questions related to assistive learning were posed to examine if digital devices such as a tablet, using accessible interactive touch screens, could remove that layer of abstraction (mouse and keyboard) for those with disabilities and further provide an opportunity to develop literacy skills. Finally, feedback from the survey highlighted those schools that were interested in taking part in a further in-depth case study to acknowledge their acceptance. In summary, the initial survey adopted within this study formalised a broad approach of enquiry into the decision-making process and initial thinking into tablet adoption. Primarily quantitative in design, the survey also afforded the School Principals the opportunity to provide

qualitative data with their comments on the devices and subsequent adoption within their schools.

The data collected was subsequently analysed using both built-in Survey Monkey and SPSS analysis tools to produce descriptive statistics and graphs from the survey instruments. For the surveys to be both reliable and valid, it was imperative that the questions asked were constructed properly and ultimately clear and easy for the recipient to comprehend (Beauchamp & Hillier, 2014; Burden et al., 2012b; Heinrich, 2012). The validity of the survey questions was related to the accuracy of our measurement and the design on the instrument. The reliability is concerned with the consistency of our measurement, as a change in wording and structure can ultimately elicit different responses to the questions. As Jackson (2010, p. 94) further advocates, '…open-ended questions allow for a greater variety of responses from participants but are difficult to analyse statistically because the data must be coded or reduced in some manner. Closed-ended questions are easy to analyse statistically, but they seriously limit the responses that participants can give. Many researchers prefer to use a Likert-type scale because it's very easy to analyse statistically'. As part of the researcher's inquiry, Likert scale and open-ended questions were utilised to generate data to address the overarching research question. This data was additionally enhanced at a later date by those schools who took part in the further in-depth case study, with the use of sequential focus groups and semi-structured interviews which are discussed later in the chapter.

3.13. Stage 2: Case Study Approach

3.13.1. Research participants

The following tables depict the overall numbers of teachers, students and mentors within each of the three adopted case studies alongside total pre and post-test sample sizes. Mentors within each class further played the role as focus group participants within each case study.

Case Study 1	Teacher	Gender	Subject	Students (n)	Mentors (n)
(Voluntary all-girls Catholic Secondary school)	Teacher A	Male	Religious Education – 1st year	17	6
	Teacher B	Female	Religious Education – 2nd year	18	6
Case Study 2					
(Private all-girls secondary school)	Teacher C	Female	Science – 1st year	22	6
Case Study 3					
(Mixed co-educational, multi-denominational community school)	Teacher D	Female	Science – 2nd year	20	5
	Teacher E	Female	Science – 1st year	22	5

Table 3-4: Research participants

	Pre-test (n)	Post-test (n)
Case Study 1	46	41
Case Study 2	20	19
Case Study 3	37	37

Table 3-5: Research pre and post-test sample size

3.13.2. Exploratory research

A case study is defined as an '…empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident' (Yin, 2013, p. 13). Commonly a case is associated with the in-depth examination of a singular location. However, the aim of the researcher's study is to explore the potential impact of adopting mobile digital

devices (such as the tablet pc) in the context of the Junior Cycle Framework across three locations. The literature has clearly shown that a case study is best suited to this type of exploratory research, providing rich in-depth and detailed data (Creswell, 2013; Stake, 1978; Yin, 2013). For many years three prominent methodologists in educational research, namely Sharan B Merriam, Robert E Stake and Robert K Yin, have presented their own diverse views regarding case study approaches (Merriam, 1998; Stake, 1995; Yin, 1994). Research by Yazan (2015) clearly provides an assessment of each approach and related adopted techniques, which collectively focus on key themes of epistemological commitments, defining and design of a case study, data collection, analysis and finally the need to guarantee validity.

There are three distinctive types of case study research design, they include, exploratory, explanatory, and descriptive. The researchers' adoption of an exploratory design is because this type of design will '…seek to establish cause-and-effect relationships. Their primary purpose is to determine how events occur and which ones may influence particular outcomes', (Hancock & Algozzine, 2016, p. 33). As depicted in (Appendix B), previous literature from a number of key research studies related to the impact of mobile technology adoption (tablet pcs), clearly demonstrate a preference in using multiple-site Case Study approaches, with the primary goal to understand the selected cases in depth (Bryman, 2016).

3.13.3. Sample Selection

A sample is defined as a subset of a population. The core function of the sample selection is to grant the researcher the opportunity to conduct their study with individuals to gain results that can be used to derive conclusions that apply to the entire population. In research there are two types of population, target, which refers to the entire population and accessible population, a subset of the target population from where the researcher can draw their sample data. Regardless of the type of sampling adopted, the steps involved are essentially the same. First the researcher must identify the specific target population, secondly identify the accessible population, thirdly determine the size of the actual sample and lastly select a sample of predetermined size from the accessible population identified. This can be achieved by using simple random sampling, systematic sampling, stratified and clustered sampling (van Teijlingen & Hundley, 2001a). As detailed, there are many different types of sampling methods within research. Each of these methods differ considerably in their suitability to ultimately provide unbiased data (Yount, 2006). Unfortunately, due to varying constraints, researchers

must typically compromise when unable to employ 'simple random sampling', when a whole population is available. Samples can be selected using, random, stratified or convenience sampling.

A research population is defined as a collection of subjects who may have similar characteristics. Due to the size of the populations, researchers cannot test every individual, which necessitates the use of sampling techniques. The study's target population included 300 schools derived from a database supplied by an I.T company who had deployed the tablet pcs to each of the post-primary schools across Ireland. The rationale targeting behind the adopted research approach is a deliberate attempt to connect with schools that have engaged in this specific area of mobile technology adoption (tablet pcs). Furthermore, it could be proposed that these schools selected could be described as 'early technology adopters'. A subset of the population were chosen as a representative sample of the overall population. Following on, the results from the sample can be inferred to the population. The researchers inquiry adopted a variety of research instruments which were piloted to gather data at both pre-test and post-test stages of the inquiry.

3.14. Rationale for using iBooks Author

In the context of the researcher's study, the initial phase of Stage 2 offered a program of planned CPD to those teachers (Digital Leaders) who previously volunteered for participation via the Survey instrument in (*Stage 1*). Within this initial Phase 1*,* a series of workshops developed by the researcher in the role of designer/leader, engaged participant teachers with the iBooks Author application and its potential in teaching and learning contexts. The workshops ultimately afforded the participant teachers experience and support with the iBooks Author application and provided them with access to sample resources and activities compiled by the researcher.

Furthermore, the researcher discussed with teachers the pedagogical affordances and innovative ways of using and developing content using iBook Author. Lastly, the researcher highlighted to teachers the potential linkages between the perceived affordances of mobile learning and in particular the iBooks Author application and the

six Key Skills of the Junior Cycle educational framework. The key phases of research are as set out in the following sections.

3.15. Phase 1 – Overview of pedagogical affordances

3.15.1. Continuing Professional Development

In the context of teaching, continuing professional development (CPD) is defined as '…all natural learning experiences and those conscious and planned activities which are intended to be of direct or indirect benefit to the individual, group or school, which constitute, through these, to the quality of education in the classroom' (Day, 1999, pp. 221-223). Dexter, Anderson, and Becker (1999, p. 223) further elaborate, by suggesting that '…for teachers to implement any new instructional strategy, they must acquire new knowledge about it and then weave this together with the demands of the curriculum, classroom management, and existing instructional skills'. By the late 1990's, however, it was generally acknowledged that traditional technology-training programs did not facilitate educators with the required skillset needed to use technology in ways that '…facilitate fundamental, qualitative changes in the nature of teaching and learning' (Richmond, 1998, p. 33). But as an inquiry by Schrum (1999), highlighting an earlier review by Lewis (1999) suggests, less than 20% of teachers felt prepared to integrate educational technology into their classroom instruction by the late nineties. In presenting a new model to examine how teachers make sense of CPD, Solomon and Tresman (1999, p. 307) argue that successful CPD must be focused '…on means of enabling professional judgement (and thus identity and values) to flourish alongside new science knowledge, through opportunities for combining its application with an evaluation of practice'. However, as Solomon and Tresman (1999, p. 316) clearly contend, any CPD offered to teachers must not only teach them new skills and content knowledge but also offer '…effective and imaginative ways of reflecting on the application of their learning in the context of the classroom'. While questioning the effectiveness of CPD, Garet, Porter, Desimone, Birman, and Yoon (2001) identify three core activities that offer significant positive effects in attained knowledge, skills and classroom practice. These include;

- Focus on content knowledge
- Opportunities for active learning
- Coherence with other learning activities

Garet et al. (2001) furthermore believe it is through these core features that the following structural features play a significant factor in teacher learning;

- The form of the activity (workshop vs. study group)
- Collective participation of teachers from the same school, grade or subject
- The duration of the activity.

Garet et al. (2001) conclude by highlighting the importance of both collective participation and the coherence of CPD activities necessary to support a change in teacher practice. However, the challenge in providing this type of high quality CPD is the factor of cost. In the context of the researchers' inquiry, in 2016 the Teaching Council of Ireland developed Cosán, a National framework for teachers' learning. While forming part of an overall framework of standards in all stages of teachers' learning, Cosán actively acknowledges, encourages and promotes teacher learning and the fostering of public recognition. Furthermore, Cosán acknowledges the many formal and informal ways that teachers' learn, the need for quality learning opportunities, engagement in professional conversations and collaborative reflection (National Forum, 2016).

As part of the research process, a total of nine key models of Continuing Professional Development were identified by the researcher. These included, Award bearing, Deficit, Cascade, Standards Based, Action Research, Transformative, Training, Coaching & Mentoring and Communities of Practice (Kennedy, 2005; National Forum, 2016). In considering the context and circumstances that each model can be adopted as depicted by the literature, the researcher then chose two key models that he believed could support both transformative practice and contribute to an educationalists personal and professional development in relation to the multiple case-study approach adopted.

3.15.2. Teacher Professional Learning

From a technological perspective early research by Fullan (2006) indicated that to effectively integrate technology within the classroom there is a distinct necessity for competent teacher professional development. As defined by Darling-Hammond and McLaughlin (2011), professional development is primary designed to improve teaching practice and outcomes. By 2014, research from Nabhani, Nicolas, and Bahous (2014) had identified a number of key models shown to have enhanced pedagogical practice, including action research/inquiry, coaching strategies, self-monitoring/reflection. In 2015, the key to facilitate impactful Teacher Professional development as suggested by

Patton, Parker, and Tannehill (2015), included helping teachers rethink their pedagogical practice and furthermore provide opportunities to gain social capital from their colleagues. Responding to the earlier research by Fullan, an inquiry by Tondeur, Forkosh-Baruch, Prestridge, Albion, and Edirisinghe (2016, p. 118) in relation to PD and ICT integration, clearly suggests that '…transformation will be effected through what teachers do with the technology that is available to them' and not simply by its availability. However, in an Irish context, unfortunately the evidence suggests a considerable mismatch between policies and educators current capacities, (Gleeson, Sugrue, and O'Flaherty (2017).

Extending teaching and research capacities as highlighted by Patton et al. (2015, p. 359) describes the significant and advantageous social dynamics attained from the adoption of a communities of practice model in relation to TPD. Describing such a CoP as '…a place where ideas belong to the group and where learning is promoted and valued'. While drawing from five Irish case study schools, research by King (2016) provides evidence of successful implementation and sustainability of practices from the application of an evidence-based Professional Development planning framework. Success was achieved while bridging the gap between PD and new practice, resulting in improved student outcomes.

Meanwhile, research by Darling-Hammond, Hyler, and Gardner (2017) highlighted the importance of PD for teachers and the wide variance in the extent that many PD programs try to accomplish high level student outcomes. In particular the study was to highlight successful PD by means of a well-designed model linked to teacher needs which affords the educator an opportunity to choose a type of learning that will best support their students. Moreover, a model that is regularly evaluated and continually improved. Similarly, a recent review of forty three articles related to TPD by Postholm (2018) indicates the need for teachers to firstly develop their learning processes and furthermore engage in formative intervention studies, if they wish to formulate the necessary improvements within their schools.

3.15.3. Coaching & Mentoring

Much of the research to date regarding the topic of mentoring focuses upon the relationships between elder more experienced teachers with their younger less

experienced counterparts (Grove, Odell, & Strudler, 2006; Grove, Strudler, & Odell, 2004). As discussed by Callahan (2016, p. 7), '…teacher-mentoring programs must provide clear and concise goals for mentors to impart basic information and solicit feedback from the new teachers'. Early studies depict mentoring as having a significant positive effect in encouraging teachers to begin with the integration of technology within their classrooms (Thompson, 1995). During the late nineties, with the 21st century approaching, an increased emphasis on educational technology thus formulating '…a new insistence that teachers must become technologically literate' (Plotnick, 1996, p. 33).

In identifying potential barriers to technology use within classrooms, a study by Franklin, Turner, Kariuki, and Duran (2001) describe access, time, vision, assessment and professional development, as the key barriers to integration. However, the study concluded that the mentoring relationship adopted within their study '…provided the professional development support needed to promote opportunities for modelling the curriculum integration of technology, redesigning lessons around technology-rich resources, and overcoming barriers to technology use' (Franklin et al., 2001, p. 1) . The provision of a mentor in this case, ultimately allowed teachers the vision in designing their lessons around technology rich resources whilst also providing a cost-effective means of obtaining technical support alongside professional development. Research by Rhodes and Beneicke (2002, p. 301) distinguished between both coaching and mentoring, describing the former as more skills based, while the latter is depicted as a '…counselling and professional friendship'. The benefits of employing a mentor have been widely acclaimed within the subject literature (Cole, Simkins, & Penuel, 2002; Sprague, Kopfman, & Levante Dorsey, 1998; Swan et al., 2002). In discussing mentoring models, Chuang, Thompson, and Schmidt (2003) proposes that while various options are available, each of the models include a common theme or elements. These characteristics include; providing visions, individualising support, the formation of collaborative relationships with an emphasis on creating learning communities between the teachers and mentors. A cross-disciplinary literature review of formal mentoring programs by Ehrich, Hansford, and Tennent (2004) based upon over 300 research papers, compliments early research by describing the enormous potential mentoring offers in learning, personal growth and development of professionals. The review findings highlighted critical issues including program support, mentor training, the selection of participants and the need for on-going program evaluations as key for all educational administrators to consider when adopting a mentoring program. However,

in an Irish context, recent research by Harford (2010) highlights the lack of a systematic statutory system of induction for new teachers in Ireland, with only half of the countries in Europe providing any type of induction for their teachers in their first few years.

For many teachers, the adoption and integration of technology within their classrooms is quite a daunting task. Within a mentor-teacher relationship, the mentor will adopt a number of roles, including; '…reviewer, director, monitor, facilitator, and evaluator' (Smith, 2000, p. 168). The key ingredient within this relationship, is collaboration (Sugar, 2005). As Sugar (2005) further advises, teachers face two groups of obstacles, namely external (hardware & software) and internal factors (such as lack of confidence). Interestingly, the teachers involved within the study by Sugar, placed a high degree of emphasis on the mentors 'people skills', describing the mentor's patience, listening skills and 'reassuring coaching style', as important factors in their own development. Echoing earlier findings by Hughes (2005), the enquiry further suggests the focus of any new technology introduced should be linked to a specific purpose that is aligned to a teachers inherent beliefs correlated with teaching and learning. In the context of the researcher's own study, an initial Training CPD model was firstly adopted in Workshops 1 & 2, instructing attendees in the use of the iBA application. Following on, the researcher endorsed a mentoring model initiated in Workshop 3 in the development of learning activities linked to attendee's curriculum. This mentoring relationship between the researcher and teachers was further extended beyond the workshops via phone calls, skype chats and subsequent school visits.

3.15.4. Professional Learning Community

As a result of the teacher's engagement with the CPD workshops, the researcher's intervention provided the necessary conditions for the digital leaders to develop collectively as a professional learning community. Early research by Laurillard (2013, p. 5), suggests adopting a PLC is the most supportive model for the learning of professionals. Defined by DuFour (2004, p. 6) as a profound grand design that affects the practices of schooling and further advocates that it '…requires the school staff to focus on learning rather than teaching, work collaboratively on matters related to learning, and hold itself accountable for the kind of results that fuel continual improvement'. Expanding this further, (DuFour, 2004, p. 6) cordially identifies eight characteristics and four key processes of a PLC model, including;

- Shared values and vision
- Collective responsibility for pupils' learning
- Collaboration focused on professional learning: individual and collective
- Individual and collective professional learning
- Reflective professional enquiry
- Openness, networks and partnership
- Inclusive membership
- Mutual trust, respect and support
- Optimising resources and structures
- Promoting individual and collective learning
- Evaluating and sustaining a professional learning community
- Leading and managing a professional learning community

The evidence further suggests that developing a PLC holds significant promise Bolam et al. (2005). A cumulative review of studies into PLC adoption reveals that well-developed PLC's positively impact both teaching practice and student achievement (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006).

Similar in context to the researcher's own inquiry, the introduction of a PLC supporting a technology adoption as described by Vescio, Ross, and Adams (2008) builds upon the existing positive body of evidence, demonstrating the capacity of PLC's in having a positive impact on teaching practice and student achievement.

3.15.5. CPD Workshops

In an Irish context, an evaluation of a national 9-year Continuing Professional Development programme, described the change process as being dependent upon a number of interwoven factors including; teacher, school and policy level contexts and characteristics (Murchan, Loxley, & Johnston, 2009). As the evaluation was to further suggest, '…consideration needs to be given to the format of group workshops and their role in promoting knowledge and understanding of curriculum reforms', (Murchan et al., 2009, p. 468). The evaluation further highlights the important role of school Principals in leading change by inspiring and motivating their teachers and helping to generate a

shared vision within each school that ultimately incorporates the desired curriculum reforms. In the context of the researchers own inquiry, CPD workshops afforded each educator an opportunity to both investigate and experiment with instructional strategies that could potentially maximise digital technology use and transform learning within their daily classroom instruction whilst using iBA. The CPD workshop schedule included four workshops over a four-month period. During this time the researcher met with the digital leaders collectively for a series of workshops in October & November of 2018.

3.15.6. Workshop 1

While conscious of the availability of many teachers, the researcher provisioned 3 x ½ day workshop sessions, affording teachers and students the opportunity to practice with the technology. All three workshops were available to teachers, with *Workshop 2* repeated on a second occasion with student mentors only in attendance on this occasion. Each workshop was presented from 9:00 am – 1:00 pm. Upon completion of each workshop the researcher would follow up (via email, skype, or 1-2-1 site visits) with any queries from attendees. During each workshop each participant was provided with relevant tutorials developed by the researcher. This material was supplemented with sample media files and relevant sampled examples of the software features.

The overall professional development and workshop design were informed by previous literature by Tondeur et al. (2016), and Postholm (2018), encompassing; a) an online resource to support the intervention https://ipadstudy.moodlecloud.com/, b) workshops, c) the provision of consultancy sessions related to application design and pedagogical practice as informed by Garcia (2012), Melhuish and Falloon (2010) and Psiropoulos et al. (2016). Firstly, the researcher met with the digital leaders with the purpose of conferring an overview of iBA as an eBook authoring development application. Initially the researcher presented a number of both basic and elaborate examples of popular interactive multi-touch eBooks currently available as standalone eBooks or available via the iBooks service, to provide a firm indication of what is possible.

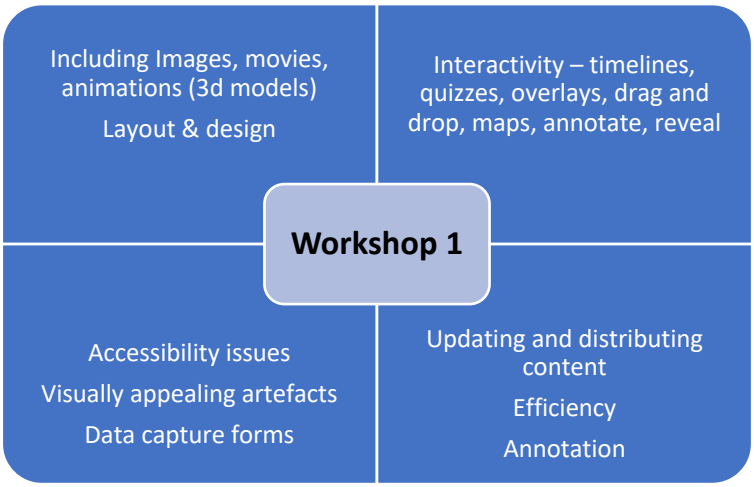


Figure 3-5: Workshop 1 components

Furthermore, the workshop encompassed the available features within iBA and the subsequent opportunity to develop a sample iBook. Following on from this the researcher highlighted in detail the principles of adopting an engaging layout and design (Rossello, 2012) and the interoperability of digital eBooks (Bläsi & Rothlauf, 2013). Consequently, this afforded the digital leaders the principles related to best practice when adopting and designing artefacts using iBA, particularly in relation to accessibility guidelines (Buzzi, Buzzi, Donini, Leporini, & Paratore, 2013; Pérez, 2013; Pollitt, 2013).

3.15.7. Workshop 2

In highlighting both advanced features (widgets) and pedagogical affordances of developing iBooks using iBA, the researcher trained the participants on the how to incorporate the varied interactive multimedia features into a sample iBook. The researcher demonstrated how iBA could supplement content with learning activities that incorporated images and interactive galleries from pre-defined installed widgets within the application, affording an educationalist the opportunity to transmit information, explore ideas and ultimately provide students with a variety of ways to learn. Another example included demonstrating how with the use of figures, graphics and 3-D modelling can help explain detailed concepts to students. The researcher further highlighted how embedding recorded audio and video content within iBooks can facilitate autonomous learning opportunities for those students who wish to take control of their own learning (Cripps, 2012).

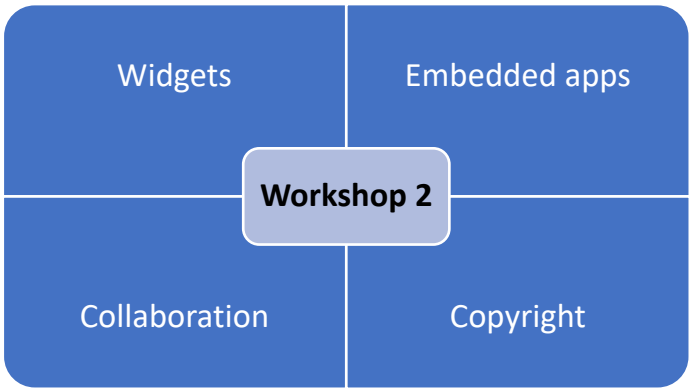


Figure 3-6: Workshop 2 components

From a pedagogical perspective, the advent of iBA provides an influential method of embedding multi-media and interactive multi-touch content and its flexible distribution to students. As such, while conscious that professional development courses tend to be technocentric, initial training of the digital leaders demonstrated a number of practical and effective pedagogical affordances of integrating iBooks into their teaching practice as informed by previous literature in this area (Anderson, 2013; Baldwin, 2015; Cripps, 2012; Johnston & Marsh, 2014; Kim, 2013; O'Mahony, 2014; Parrott & Holvig, 2013; Peraza-Garzón et al., 2013).

Early research by Murray and Olcese (2011) depicted iPad apps as out of sync with modern learning theories and 21st century skills required by students, with the study further concluding that early apps targeted the consumption, rather than the creation or collaboration of said content. In targeting the delivery and interactivity of content, apps developed more recently are focused on affording users the ability to take control of their own learning (Tseng, 2012). The building of interactive and vocabulary exercises as demonstrated by Cripps (2012, p. 1), affords students '…the creation of self-study materials that provide exposure to authentic situations'.

For many teachers the benefit of using iBA reflects research that it is '…connected implicitly with its multimodality and the diverse range of resources that can be included therein' (Bain, 2012b, p. 10). The widespread use of eBooks also reflects their portable accessibility alongside the opportunity and possibility of enriching text with various digital content to facilitate teaching and student learning (González, Guzmän, Dormido, &

Berenguel, 2013). Furthermore, as recent research by Hopkins and Burden (2016) suggests, that ibooks not only offer an interactive experience between the user and consumer of the book, it also affords the reader an opportunity to become a co-author, thus potentially transforming it into a personalised learning tool.

In leveraging the affordances of iBA, the researcher further exhibited how the embedding of review questions could promote and encourage critical reflection by students and ultimately facilitate immediate feedback (Bidal, 2013; Kumar, 2013; Mentor, 2014; Nortcliffe, 2015; Oomen-Early & Early, 2015). The researcher targeted the ability of iBA in creating more personalised and meaningful content (Aamoth, 2012; Baldwin, 2015; Carroll, Thomas, & Ware, 2013; Fenwick Jr, Kurtz, Meznar, Phillips, & Weidner, 2013; Mikroyannidis, Domingue, Third, Smith, & Guarda, 2015). Moving the student away from a passive recipient of information to a more active participant in their own learning (Caldwell & Bird, 2015; O'Mahony, 2014; Parkinson, 2013), the researcher demonstrated to teachers how it was possible for students to develop and integrate their own audio and video recordings into the learning artefacts created in iBA. In another example, the researcher demonstrated how to make the books accessible to visually-impaired students using a feature called Voiceover. As discussed earlier, studies have demonstrated that to ensure effective mobile learning, it is necessary to adopt effective pedagogical approaches in conjunction with the technology (Nanney, 2004). Whilst leveraging the affordances of the iPad, iBooks created using iBA as reusable learning objects, can as the research suggests, significantly enhance existing teaching practice and support a shift to a more student-centred approach to learning (Kim, 2013; Railean, 2012).

Recent research by Hopkins and Burden (2016) highlights the extended opportunities that the eBook offers, in comparison with the more traditional based digital or printed book. The study suggests that with some teachers' use of technology being limited to interactive whiteboards or presentation packages, the level of interactivity within classrooms has ultimately decreased. Digital eBooks, the study advocates, encourages many of the elements suggested in earlier research by Burns* and Myhill (2004) in relation to development of independent voices, student participation, collective thinking, but especially that of student autonomy. Most educators historically prefer to publish developed eBooks locally within their schools (retaining all their rights to the content of

their work) rather than via iTunes and subsequently do not have to worry about licencing issues. However, the Digital leaders within this session were supplied detailed information by the researcher regarding copyright, licensing and fair use with regard to publishing both publicly and privately. Adopting iBA as a platform in the delivery and distribution of curriculum content clearly demonstrates the applications wide versatility (Beránek, Bory, & Vacek, 2016).

3.16. Phase 2 – Development of Learning Activities

3.16.1. Workshop 3

Similar in duration to earlier workshops, Workshop 3 was completed between 9 – 1 pm. The researcher firstly discussed the affordances of adopting a 21st century learning framework as part of the intervention. With its project-based approach and underlying theme of Peer learning, the researcher advised teachers to adopt the Bridge 21 model as part of the intervention (Johnston et al., 2015). With the necessary framework in place and access to apps to facilitate and foster creativity, collaboration and reflection, the researcher set in place a structure and range of tools to help students develop and manage their own learning (Jahnke & Kumar, 2014; Leinonen et al., 2014; Pegrum et al., 2013).

Figure 3-7: Bridge 21 model

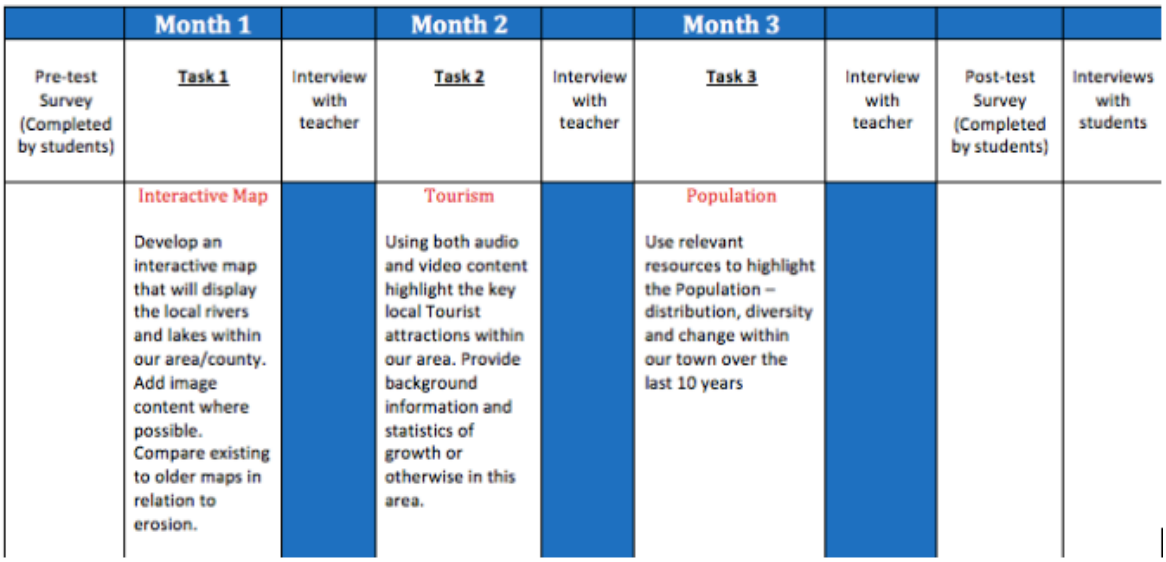
Next, while adopting the role of mentor, the researcher scaffolded the teachers in the augmentation of authentic learning activities related to developing content within iBooks (Cochrane, Narayan, & Oldfield, 2013; Hutchison et al., 2012; Johnston & Marsh, 2014). While moving to a more student-centred approach, the researcher collectively mentored the digital leaders in Workshop 3 in developing a learning activity related to their specific curricular needs, in which their students would be afforded the opportunity to develop their own unique iBook. As Edelson (2001, p. 1) argues, '…integrating content and process together in the design of learning activities offers the opportunity to increase students' experience with authentic activities while also achieving deeper content understanding'. Identification of the intended learning outcomes constituted the starting point for the design of these activities.

The researcher mentored the digital leaders in developing their own ideas to create unique learning artefacts linked to their specific curriculum using the varied characteristic widgets within iBooks Author. Additionally, the researcher guided the digital leaders in Workshop 3 by demonstrating examples of how students could independently integrate recorded content into developed iBooks using iBA or using an app like Book Creator. Upon completion of the digital artefacts, each of the teachers were afforded the opportunity to share these with their peers thus facilitating a peer-learning dimension. As a consequence of this dimension, the researcher suggested that the teachers could usefully develop a professional learning community, as a teaching and learning model, sharing their expertise and working collaboratively in the development of artefacts and learning activities relevant to their curriculum. Finally, each digital leader was afforded an opportunity to receive feedback on their completed developed task from the researcher. Each teacher in Workshop 3 was provided with access to relevant documentation, resources, lesson plans and video tutorials available from a resource developed by the researcher for the study at https://ipadstudy.moodlecloud.com/ Following on from Workshop 3 the researcher continued ongoing contact with each of the teachers, this included via email, 1-2-1 school visits or via Skype.

3.17. Phase 3 – Implementation & Evaluation

3.17.1. Feedback and Pedagogical guidance

This third and final phase disposed the teachers to implementing the learning activity they had previously designed with a select group of their own students, as depicted below.



	Month 1		Month 2		Month 3			
Pre-test Survey (Completed by students)	Task 1	Interview with teacher	Task 2	Interview with teacher	Task 3	Interview with teacher	Post-test Survey (Completed by students)	Interviews with students
	Interactive Map Develop an interactive map that will display the local rivers and lakes within our area/county. Add image content where possible. Compare existing to older maps in relation to erosion.		Tourism Using both audio and video content highlight the key local Tourist attractions within our area. Provide background information and statistics of growth or otherwise in this area.		Population Use relevant resources to highlight the Population – distribution, diversity and change within our town over the last 10 years			

Figure 3-8: Example learning activity template (Geography)

Whilst reflecting the Bridge 21 model, each teacher provided the necessary instructional scaffolding within their classrooms. Firstly, students in each class were put into groups of 3-4 participants (*Setup*). Secondly, each group/team was provided with detailed information from each teacher on the specific requirements for the completion of the 1st task and subsequently asked to discuss ideas with other group members, to develop as creative thinkers and innovators (*Warm Up*). Thirdly, students were asked to define their specific problem within the task and develop a research strategy (*Investigate*). Following on, each of the group members agreed upon their roles and their specific allocated tasks. Students were provided with a time schedule to complete the task (*Plan*). Subsequently, each group began to research, collect and develop relevant digital content (*Create*) and provided opportunities to present their completed iBooks content to their peers (*Present*) and reflect upon these (*Reflect*). As part of this process, student participation entailed the inputting of relevant digital material, by developing their own multi-media content using Apple Pages and/or the Book Creator App (accessible on their own tablets) and/or using the iBook Author software. Apple Pages and the Book Creator app dovetail with the iBook Author application thus positioning student participants as curators of their own literacy content. During the intervention the researcher provided feedback and pedagogical guidance to each teacher in relation to each of their three learning activities and use of iBooks Author. Following the completion of the 1st task the teachers would reflect upon the process and outcomes with the researcher and make any necessary

agreed adjustments (team members, group numbers, content) before moving on to the 2nd and 3rd task.

3.18. Empirical elements: Instrumentation and Data Collection in this Study

In providing an insight into the impact of mobile digital devices on pedagogical practices, the data collection process in Stage 2 included pre-test & post-test digital surveys for teachers and students and semi-structured interviews/focus groups with both teachers and students. The data collected from both teachers and students adopted previously validated data instruments (Ravitz, Hixson, English, & Mergendoller, 2012) and (Monkoski-Takamure, 2014).

3.18.1. Data Collection Methods and overview

The table below provides a mapping of the methods the researcher believes are most appropriate when answering specific research questions, using the 'Evaluation crosswalk' table as developed by O'Leary (2004, p. 171).

	Data Collection Methods (*Teachers & Students*)		
Research Questions	**Pre & Post Survey**	**Focus Group**	**Interview**
1. How can teachers take advantage of the affordances of mobile devices and in particular the iBook Author application in their instructional activities, so as to address the aims of the new Junior Cycle (*motivation, engagement, communication, collaboration, reflection and assistive learning*)?	**X**		**X**
2. What pedagogies fully leverage using iBooks Author content on mobile devices for teaching & learning in the context of the new Junior Cycle framework?		**X**	**X**

3. As a consequence of using iBooks Author with tablet pcs, in what ways have the dynamics changed between the teacher and student?		X	X

Table 3-6: Data Collection Methods addressing the research questions

In the context of the case study a number of data collection methods were utilised by the researcher to collect data on how device affordances would be best employed, subsequent pedagogy's adopted by teachers and the effect of changing dynamics when adopting mobile digital devices, such as tablet pcs. As a range of approaches employed within educational research, methods are adopted to gather data that can be subsequently used as a basis for inference and interpretation, for explanation and prediction. The following are the methods adopted in context of the multiple case study approach employed by the researcher and include online surveys taken by both teachers and students, followed by semi-structured and focus group interviews. According to Creswell and Garrett (2008, p. 321) an educational researcher requires '…a large toolkit of methods and designs to address complex, interdisciplinary research problems'. Both qualitative and quantitative skills were included in the toolkit for this study. The data collected was subsequently analysed using both built-in Survey Monkey and SPSS analysis tools to produce descriptive statistics and graphs from the survey instruments. For the surveys to be both reliable and valid, it was imperative that the questions asked were constructed properly and ultimately clear and easy for the recipient to comprehend (Beauchamp & Hillier, 2014; Burden et al., 2012b; Heinrich, 2012). The validity of the survey questions is related to the accuracy of our measurement and the design on the instrument. The reliability is concerned with the consistency of our measurement, as a change in wording and structure can ultimately elicit different responses to the questions. As Jackson (2009, p. 89) further suggests, '…open-ended questions allow for a greater variety of responses from participants but are difficult to analyse statistically because the data must be coded or reduced in some manner. Closed-ended questions are easy to analyse statistically, but they seriously limit the responses that participants can give. Many researchers prefer to use a Likert-type scale because it's very easy to analyse statistically'.

3.18.2. Case Study Data Analysis

3.18.2.1. Quantifiable results – Quantitative analysis

Quantitative analysis is defined as a systematic approach to an investigation whereby numerical data is collected to support or contradict a hypothesis. Quantitative analysis is described as both reliable and objective and affords the researcher an opportunity to generate statistics from the data collected (Maxwell, 2012). In the literature, Creswell (2002) describes quantitative research as explaining a phenomena by the collecting numerical data which are subsequently analysed by mathematical methods such as statistics and graphs. Furthermore, non-quantitative data collected can be converted into a quantitative format using instruments such as Likert scales. Research by Aliaga and Gunderson (2000) advocates the theory that quantitative researchers promote objectivity and contend that is possible to answer research questions without bias. As part of the researchers' study, analysis of the teachers surveys using SPSS & Survey Monkey provided analysis of pre and post data in relation to each teachers awareness and support of technology adoption, teaching methods, effectiveness of using iBooks Author and measurement of their perceived development of student key skills as a consequence of the intervention. The students pre and post-test intervention questionnaire provided an opportunity to analyse and compare confidence levels in motivation, engagement, collaboration, communication, technology and reflection. In adopting an analytical tool such as SPSS, the researcher in this instance was in a position to perform a series of robust parametric testing of the data, in relation to normality (normally distributed), paired sample t-test (determine if there is a significant difference between two groups) and Cohen's d (effect size indicating the standardised difference) using the mean of both pre and post-test values. SPSS further presented descriptive statistics and graphs whilst providing rigour analysis of the data. From this collective data amassed the researcher is able to present statistical evidence that can be inferred (or generalised) to larger populations. The researcher attended classes in Statistical Analysis using SPSS from December 2015, to gain the necessary skill-set required to complete a thorough analysis of the compiled quantitative and qualitative data. In conclusion, as the literature suggests, to do good research we need a combination of both quantitative and qualitative data analysis (Sampson Jr, 2012).

3.18.2.2. Theming & coding – Qualitative data analysis

Qualitative data is defined as an umbrella term encompassing knowledge collected from case studies, interviews, focus groups and any non-statistical data. When dealing with

research evidence from e.g.: interviews, a researcher is looking for particular concepts or categories (codes). These codes put together create themes within the analysis. Creswell (2013) first identified two types of coding; open coding and axial coding. Within open coding, a researcher will code or label words and specific phrases recorded within the transcripts of interviews. Axial coding is creating themes or categories by grouping together the codes collected previously and assigned to words and phrases. As a fundamental task within this qualitative research, the coding involved gathering of material from semi-structured interviews as a means to explore the participant's perspectives and assumptions in relation to the themes identified from the research questions adopted.

As part of the researcher's inquiry into tablet adoption, from an interpretivist theoretical perspective, the semi-structured interviews focused on the important role of the researcher to decipher the multiple meanings and formulated perspectives of the interviewees. As a primarily qualitative analytical tool, Nvivo facilitates the organising of research data using 'nodes' whilst also expedites comparing and synthesising of collective data to create queries, models, graphs and reports. The transparency provided by Nvivo when importing data is an iterative process when importing, coding, theming and analysing data continuously. The research methodologies, qualitative and quantitative, are distinctly associated with the adopted epistemological and theoretical perspective endorsed by a researcher. As the literature suggests, the synthesis of both qualitative and quantitative data can accomplish different, yet complimentary purposes when adopting a survey and case study approach (Teddlie & Tashakkori, 2003). The data collected in the study included evidence derived from post-primary schools that have adopted mobile technology within their classrooms. Other data collection methods included surveys containing Likert-scale and open-ended questions, face-to-face interviews, focus groups, CPD workshop consultations and observations from participant teachers and students, as detailed below. In the reporting and evaluation of research, a number of key approaches are available to the researcher to choose from as part of their analytical approach. These include;

- Scientific approach: Observing a phenomenon, formulation of an hypothesis, experimentation to test the hypothesis and formulation of a conclusion.
- Theoretical approach: A researcher starts, ends or modifies an existing theory based upon the views of participants.
- Thematic approach: Examining themes or patterns of meaning from within the data.

In choosing to adopt a thematic approach as defined by Braun and Clarke (2006), the researcher believed this approach provided a rigorous methodical manner in which to yield meaningful, trustworthy and insightful findings from the research data.

Phase	Description of the process
1. Familiarizing yourself with your data:	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report:	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

Figure 3-9: Braun and Clarke (2006): Phases of Thematic analysis

Braun and Clarke (2006) distinguish between a deductive and an inductive analytical focus as part of the thematical analysis process. While committed to an interpretive and positivist constructionist epistemology, the researcher adopted both a deductive (driven by the research questions) and inductive (driven by the data) approach to analysis of the data. In employing the Braun and Clarke (2006) six-step guide to conducting thematic analysis the researcher first began working through each of the recommend phases as detailed below.

Phase 1

Following the initial processing and recording of data, the researcher began the first phase within the thematic process of becoming familiar and immersing with the data. The researcher became familiar with the recordings by firstly listening to the audio content. Initial written notes and comments were taken in a notebook highlighting potential items of interest. The researcher repeated this process on a number of occasions for each recorded interview in an observational and casual manner. These notes and comments provided triggers for later coding and analysis. Following on, the researcher transcribed the data from all of the interviews verbatim. Once transcription was complete the researcher again reviewed the audio content to ensure validity of the data.

Phase 2

The second phase to thematic analysis began with a systematic analysis of the data through the use of 'coding' within Nvivo to develop potential patterns of interest. Following the import of the transcribed documented interviews the researcher applied 'labels' to data potentially relevant to the key research questions adopted in the study. The codes derived from analysis of the data provided descriptive and interpretive explanations. During this process the researcher repeatedly read the transcriptions to ensure clarity during the coding process.

Phase 3

The third phase of the analysis included the transformation of grouped codes into 'themes'. In this instance a theme 'captures something important about the data in relation to the research question, and represents some level of *patterned* response or meaning within the data set', (Braun & Clarke, 2006, p. 82). The researcher subsequently organised the collective codes into meaningful groups by identifying areas of similarity. In adopting an interpretive approach, the researcher was positioned to identify and construct specific themes from within the data.

Phase 4

The fourth phase related to quality checking and refining of the existing themes to ensure they were both distinctive and coherent. The researcher returned to the raw data to ensure referential adequacy existed.

Phase 5

In the fifth phase of the thematic process, the researcher defined and named the most relevant themes. Subsequently, dominant themes were identified by the researcher, providing a meaningful descriptive overview of the collective data.

Phase 6

The sixth and final phase of the thematic analytical process typically includes a report. In this instance the researchers inquiry provides a 'compelling story' related to the data analysis, (Braun & Clarke, 2006, p. 69).

As previous literature confirms, conducting a trustworthy thematic analysis with this framework can provide a rich and detailed perspective of research participants and any unanticipated insights (Braun & Clarke, 2006; King, Cassell, & Symon, 2004; Nowell, Norris, White, & Moules, 2017).

3.18.3. The Case Study Surveys

Discussing good practice in the conduct and reporting of survey research Kelley, Clark, Brown, and Sitzia (2003) highlight the steps required when developing and conducting survey research, and further describe how researchers '…should be systematic and thoughtful in the planning, executing and reporting of the project' (Kelley et al., 2003, p. 266). The belief is that survey research should not be deemed as a 'quick and easy' option, but rather will be able to stand up to scrutiny from the academic fraternity, regarded with a high value that contributes to knowledge. The survey as an instrument usually takes the form of quantitative analysis within a specific area or topic. In the area of social science, the methodology will rely heavily upon the survey methods to obtain relevant, unbiased data. Survey based research provides a snapshot of '…how things are at a specific time', (Denscombe, 2014), common methods of inquiry include postal questionnaires, face-to-face and telephone interviews.

Using a representative sample, it is possible one can draw conclusions upon the responses. This can be further used to compare similar responses in other areas. As an inquiry by Groves (1990) suggests that for a survey to succeed it is necessary to minimise the risk of two types of errors (a) poor measurement of cases (errors of observation) and (b) omission of cases that should be surveyed (errors of non-observation). Typically, there are two types of data collection tools used to gather information; surveys and interviews.

As Burton (2007) suggests, the typical characteristics of good survey research will include; quantitative data that is both impartial and representative. As Creswell (2013) further advocates, surveys inform trends in data with the focus directed toward learning about a specific population. A survey will allow a researcher to collect significant data in quite a short period of time. Furthermore, they can be used as a broad data collection tool while at the same time, with the creation and administration less expensive and time-consuming than other methods. With the relative ease and manner of the creation

of surveys, the focus therefore is on data collection on a wide range of topics, including attitudes, opinions and facts. However, answers collected may not fully represent/reflect the feeling of the population surveyed. A survey that is poorly designed and administered will lose any credibility and will typically undermine the research questions asked. The response rates are typically varied and hence may include bias. The best designed surveys are those with specific objectives, they will include straightforward questioning and include a sound research design alongside both reliable and valid instrumentation, (Fink, 2003). As a method of data collection, surveys maintain popularity amongst researchers due to both their versatility and efficiency. A well-designed survey can afford and most often enhance a unique understanding of the educational issue being investigated. As such, surveys lend themselves towards large populations of users, enabling a broad representative feedback to the subject matter in question by collecting sociological, statistical, and demographic data. Furthermore, statistical surveys afford the researcher statistical inferences regarding the population studied. By using a quantitative survey method to collect data, a quantitative survey as Silverman (2013, p. 7) proposes '…can be used on much larger samples than qualitative interviews, allowing inferences to be made to wider populations. Moreover, such surveys have standardized, reliable measures to ascertain the 'facts' with which this study is concerned'.

Defined by Check and Schutt (2011, p. 159) as '…the collection of information from a sample of individuals through their responses to questions', survey research affords the researcher both quantitative (using questionnaires with numerically rated items) and qualitative (using open-ended questions) strategies to explore behaviour and responses. For that reason, surveys are particularly adopted within social and psychological research. As further suggested by Toepoel and Ludtig (2015, p. 155), '…survey research is changing in a more rapid pace than ever before, and the continuous and exponential growth in technological developments is not likely to slow down'. Within the researcher's own inquiry, each of the case studies contained a number of surveys for teachers and students to complete. Following completion of a post-CPD survey of teachers, both students and teachers were asked to complete a set of pre and post-test (intervention) online Likert scale-based surveys developed using Survey Monkey. While previous research suggesting that due to its historical low response rate, surveys can negatively affect the final results, (Cook, Heath, & Thompson, 2000), in contrast, the researcher's own case studies received high level response rates across all surveys.

3.18.4. Teacher Data

3.18.4.1. Teacher - Pre-test & Post -test Survey data

Prior to starting the CPD workshops, each teacher was asked to complete a digital survey developed using Survey Monkey. The focus of this main survey was to discover the teachers' attitudes and perceptions towards teaching and learning, existing pedagogical approaches, technology adoption within the classroom and prior CPD training related to key skills. The pre-test attitudinal survey furthermore ascertained teachers' attitudes and perceptions to using and developing iBooks. In particular teachers were asked for details on their prior experience and perceptions of iBooks and student interest and motivation to using iBooks Author to develop curriculum content and the general adoption of iBooks within the classroom.

Teacher Pre-test survey:
https://www.surveymonkey.com/r/ipadstudy_Teacher_Pre_test

Teacher Post-test survey:
https://www.surveymonkey.com/r/ipadstudy_Teacher_Post_test

3.18.4.2. Teacher – Post-CPD survey data

Following attendance at the CPD training sessions, teachers were requested to complete an evaluation survey. This fed into the provision of subsequent supports by the researcher. Each teacher was asked for their feedback on the effectiveness, usefulness and relevance of the CPD training provided by the researcher in relation to training in the use of iBooks Author. Furthermore, teachers were asked about the relevance of the training within their classrooms, possible pedagogical affordances, their levels of confidence in teaching students in the development of eBooks using iBA and their perceived thoughts on student interest and motivation with eBooks in general. In both cases, pre-test and post-test, the research adopted a previously validated instruments (Ravitz et al., 2012) and (Monkoski-Takamure, 2014)

CPD Survey:

https://www.surveymonkey.co.uk/r/HWFSW2N

3.18.4.3. Teacher – Post task interview

In a similar context to the researchers inquiry, previous research has shown the advantages to using structured or semi-structured interviews as a successful research method, (Beauchamp & Hillier, 2014; Burden et al., 2012b; Clarke et al., 2013; Goodwin, 2012; Heinrich, 2012; Rapley, 2001). Similarly, the researcher developed a series of questions as part of semi-structured site visit interview with teachers, to address a number of research questions within the inquiry. After completion of each of the three individual tasks the researcher met with each teacher to discuss the learning unit and subsequent breakdown of the tasks required. Following on from this teachers were asked to comment on any change to their pedagogical practice as a consequence of the intervention. Furthermore, teachers were also asked to discuss any change in confidence levels in relation to student key skills and any subsequent change in classroom dynamics as a consequence of their engagement with the intervention. Following each task interview the teachers gave the researcher a completed copy their learning activity template containing full details of their proposed learning unit. Each teacher interview was recorded and transcribed verbatim. The transcript of each interview was imported into Nvivo for analysis.

3.18.5. Student Data

3.18.5.1. Student – Pre-test & Post-test survey data

In a similar format to the teachers' digital survey, prior to the workshop training on using a Mac IOS and iBooks Author to develop interactive eBook content, students completed an online pre-test questionnaire. Reflecting the earlier pre and post-test surveys, the intent in this instance was to reveal insights into student perceptions into the impact of the intervention by first assessing and subsequently comparing changes in their confidence levels in relation to a number of skills. Students were requested via the questionnaire to indicate their fundamental attitudes and perceptions towards technology and learning. Furthermore, students were asked to complete Likert scale questions to measure their confidence levels in the areas of motivation, engagement, communication, collaboration, reflection, assistive-learning, creativity and innovation, critical thinking, self-direction and using technology as a tool for learning, to address the development of key skills pre and post intervention. Students were also asked for details on their own experience and perceptions of iBooks and any subsequent interest and motivation to adopting iBooks within their classroom. Correspondingly, the students were also requested to complete a post-test questionnaire. In both pre and post-test

cases the surveys reflected the teacher questionnaires in relation to eBook development and adoption pre and post intervention.

Student Pre-test survey:

https://www.surveymonkey.com/r/ipadstudy_student_pretest

Student Post-test survey:

https://www.surveymonkey.com/r/ipadstudy_Student_Post_test

3.19. Interviews

An interview can provide a rich insightful depth of information particularly when using open-ended questioning. Research interviews are typically of a structured, semi-structured or unstructured format, commonly used to answer the 'why' and 'how' questions within complex issues. Semi-structured interviews are based on a commonly open framework, allowing for a conversational and focused two-way communication. In the context of a case study, the rationale for interviews is to afford informants the opportunity to respond to an agenda set by the researcher and furthermore raise any issues they may deem appropriate.

Previous literature by Creswell has shown that with interviews '…the intent is not to generalize to a population, but to develop an in-depth exploration of a central phenomenon', (Creswell, 2002, p. 193). Furthermore as a qualitative methodical approach to investigation, an interview involves the challenging '…cultivation of conversational skills' (Creswell, 2002, p. 203). Typically, structured interviews are based upon a list of pre-defined questions allowing little or no scope for further elaboration by the participant. The result, however, is limited participant responses to questions, which consequently are of little use if the subject matter requires some depth. The semi-structured approach typically contains several key questions but will also by nature afford the researcher scope for some divergence if exploration is required into a specific topic area.

In contrast, the unstructured interview contains no preconceived questions or conceptions, containing many open ended questions, preferably fluid in nature (Kvale & Brinkmann, 2009). The obvious disadvantage to using this type of survey is that it is time-consuming, expensive and can lead to an off-topic, unmanageable and sometimes

confusing process. Within the area of qualitative research, the use of focus groups and interviews remain the most common methods of data collection (Rubin & Rubin, 1995). As suggested by Golafshani (2003, p. 604), '…engaging multiple methods, such as, observation, interviews and recordings will lead to more valid, reliable and diverse construction of realities'. As noted in the previous key inquiries highlighted in (Appendix B), a number of research studies have employed interviews extensively with teachers, students, parents and school principals. In particular interviews were used to answer specific questions related to app content, engagement, motivation, content creation, impact on personalised learning and alignment to syllabus in relation to teaching and the integration, pedagogical practice and support when using the tablet pcs.

In the context of the researcher's study, the semi-structured interviews with teachers and focus groups provided a unique opportunity for each interviewee to elaborate upon and clarify their initial survey responses. Secondly, it was also anticipated that the semi-structured interviews would address any subsequent change to classroom dynamics and will furthermore gain an understanding of the participant's unique thoughts and perceptions. As such, the targeting of specific staff and focus groups would help the researcher understand '…the interviewee's perceptions of the phenomena' (Creswell, 2002, p. 217).

The data collected provided an opportunity to gain a more in-depth understanding of specific questions from the initial surveys and furthermore address how dynamics between the teacher and student have changed, positively or negatively, from the adoption and use of tablet pcs. In particular, it was anticipated that the interviews will reveal if tablet pcs can provide a more personalised learning experience with a more meaningful interaction between teacher and student. As this area is deemed by the literature to be in its infancy, the interviews with staff and focus groups would address if using the devices can transform learning in a mutual and beneficial way whilst extending well beyond the classroom walls.

While highlighting the comparisons between in-depth interviews and focus groups, Creswell (2002) concludes that this type of qualitative research is particularly effective whenever the investigation is adapted to determine, perceptions and/or beliefs and motivation among the studies participants. Similarly the combination of interviews and focus groups as discussed by Milena, Dainora, and Alin (2008) describes how the

merger of these methods contributes to knowledge in a productive iterative process, identifies circumstances surrounding the phenomenon and lastly converges characteristics of the phenomenon to enhance trustworthiness of the findings.

3.19.1. Teacher - Interviews

The quantitative results from digital surveys were supplemented by data from interviews to address the core research questions outlined above. In both teacher and focus group cases, the adopted strategy of conducting semi-structured interviews with open-ended questions afforded the researcher a rigorous method to ensure cross checking and triangulation across the various data sources (Fraenkel, Wallen, & Hyun, 1993). The post-test interviews with teachers also provided a rich insightful depth of information, particularly when utilising open-ended questioning. In the context of each of the researcher's multiple-site case-studies, the endorsement of semi-structured interviews afforded each teacher an opportunity to further expand on previous responses from the earlier survey completed in Stage 1. Additionally, the interviews also provided evidence to address pedagogical affordances of interactive eBook adoption due to the teacher intervention. Furthermore, as a consequence of the intervention, each teacher was asked to comment on their own changing role within the classroom, the development of student key-skills, their experience and those of their students with the iBooks Author application.

The researcher arranged interviews with each teacher upon the completion of the individual learning activities scheduled between January and May of 2019. None of the teachers were informed of the questions prior to any of the interviews. Furthermore, teachers on each occasion were offered a transcript from the interviews, none were requested. Each interview was recorded using an iPad, transcribed by the researcher within days of the initial meeting and subsequently analysed using Nvivo 12 (Mac). In this instance, a total of six interviews were conducted, recorded and transcribed verbatim.

Firstly, while adopting a thematic analytic approach, a series of codes were derived from initial analysis of the transcribed interviews and subsequently imported as Word documents into NVivo. From these codes, the researcher was able to identify and explore a number of key emerging themes and relevant sub themes from within the qualitative data collection.

3.19.2. Conclusion

In advocating and applying Braun & Clarke's thematic analysis framework to data drawn from the intervention, although initially challenging, has illustrated the credible process of rigorous and relevant analysis of translating data to catalogue related patterns and to address the key research questions of the existing study (Maguire & Delahunt, 2017). In addressing the overarching question within the researchers inquiry, if mobile devices can contribute to the realisation of the aims of the new Junior Cycle Educational Framework, the findings have highlighted a number of distinct affordances of mobile devices to potentially address a number of aims promoted within the framework. Further analysis of the findings has also positively positioned students as content creators and knowledge makers and not simply as passive consumers of information; as a consequence of a distinct change in pedagogical practice.

3.20. Focus Groups

Described as a form of qualitative research in which a number of people are questioned about their views, experiences, perceptions, opinions, attitudes and beliefs regarding a specific subject matter, focus groups are depicted in the literature as an excellent method in obtaining several perspectives about the same topic. Jackson (2009) suggests that focus groups are probably the most appropriate method to answer particular types of questions. Whilst interviews as Kitzinger further suggests, may be more appropriate for tapping into individual biographies, '…focus groups are more suitable for examining how knowledge, and more importantly, ideas, develop and operate within a given cultural context' Kitzinger (1995, p. 302).

Moreover, Powell, Single, and Lloyd (1996, p. 499) define the term 'focus groups' as '…a group of individuals selected and assembled by researchers to discuss and comment on, from personal experience, the topic that is the subject of the research'. As the literature further suggests, the use of focus groups can be used in research as a method in its own right or as a compliment to other existing methods, especially in the areas of validity checking and triangulation. In one example, previous research has used focus groups as a method to engage both staff and students in an interactive group setting to gain multiple perspectives as they brainstorm (Morgan, 1996).

In the context of the researcher's study, within each case study, it was agreed to create a focus group for students. Each study's focus group typically included four or five

students. With the researcher acting as group facilitator using documented questioning, the specific function of the focus group was to allow those attending to openly debate issues and voice any problems or concerns. It was anticipated by the researcher that using the focus group method would address the issue of what pedagogies fully leverage mobile devices for teaching & learning in the context of the new Junior Cycle framework.

Similar to teacher interviews, the interviews with students within each focus group firstly afforded each student an opportunity to further expand on previous response's from the earlier survey completed in Stage 2. Questions formulated within the focus groups were also anticipated to answer if tablet pcs inherently enable, from a student perspective, a transformation in practice for teachers. Finally, it was anticipated that the focus group would provide an opportunity to discuss issues related to evaluation of mobile learning activities and the level of support provided to students by each of the schools. Furthermore, the semi-structured interviews post intervention afforded the researcher an opportunity to gain an understanding of the students' unique thoughts and perceptions on iBook development and eBook adoption. In particular, it was anticipated that the interviews with both teachers and students would reveal if tablet pcs can provide a more personalised learning experience with a more meaningful interaction between teachers and students.

3.21. The Pilot Study

'…do not take the risk. Pilot test first', De Vaus and de Vaus (2013).

The piloting of research instrumentation; interviews and questionnaires, provided validation and appropriateness of the adopted instruments to address the primary research questions, thus ensuring content validity of the inquiry. Firstly, this validation provisioned an opportunity to detect and ultimately correct any issues with the instrumentation or data collection techniques. Secondly, it also provided detailed feedback in relation to CPD workshop content, the artefacts and learning material therein, provided to teachers and those students acting as mentors. The importance of pilot studies as described by Van Teijlingen and Hundley (2001b, p. 1) essentially provides an advance warning as to where the main research study could fail and where '…research protocols may not be followed, or whether proposed methods or instruments are inappropriate or too complicated'.

The pilot study began in November 2017 and continued until May of 2018 at an all boys' voluntary secondary school in the south of Ireland. The pilot study consisted of five teachers, two male and three females, teaching History, Geography, English, Irish and French and Art. The teacher and student pre and post-test questionnaires and interview questions were also reviewed ensuring appropriateness and clarity. Each teacher and focus group interview were recorded and transcribed verbatim. Interview transcripts were imported into NVivo for preliminary analysis which was intended to inform any necessary refinement of the interview schedule. The researcher trialled the audio-recording hardware and software along with qualitative and quantitative data analysis tools, including SPSS and Nvivo. Defined as a 'crucial element of a good study design', the process of conducting a pilot study 'does not guarantee success in the main study, but it does increase the likelihood', van Teijlingen and Hundley (2001a, p. 1). Firstly, the pilot provided an opportunity to make some minor refinements in relation to the content presented within the workshops, moreover, the pilot participants provided complimentary feedback in relation to the CPD workshops. Secondly, the pilot confirmed the suitability of the adopted research instruments. Thirdly, the pilot further provided the researcher an opportunity to develop their analytical skillset from analysis of data collected within the intervention.

3.22. Ethical Approval & Considerations

An application for ethical approval containing full details on the research study was submitted to and granted by the School of Education's research ethics committee at Trinity College Dublin. During initial contact with each school it was made very clear to the Principal as to the intentions, purpose and subsequent demands required from the school and its teachers in the completion of this case study research. As such, social research involves the inclusion of ethical considerations which must be taken into account and conducted rigorously (Golafshani, 2003). In line with ethical requirements written permission was initially obtained from each students' parent or guardian after completion of a consent form (Appendix G). Furthermore, informed consent was sought and obtained from each of the teachers before the study began and during each point of data collection. Both students and teachers were made aware of the option at any time to 'opt-out' of the research and terminate their inclusion within the study. Data collected in the study was firstly password-protected and subsequently held in secure storage.

As part of the current research into tablet adoption within secondary schools in Ireland and as a PhD student within Trinity College Dublin the researcher was keenly aware of the over-arching ethical principles promoted by the College with regards to research ethics policy and procedures. These include:

- Respect for the individual subject or population
- Beneficence & the absence of maleficence (research should have the maximum benefit with minimal harm)
- Justice (all research subjects and populations should be treated fairly and equally)

In each instance, the invitation to take part in a semi-structured interview and/or internal school survey to either/both staff and students', provided each individual with a detailed statement introducing the research topic whilst also affording the necessary ethical assurances. To ensure the formation of a constructive, critical and collaborative relationship between the researcher and the interviewees a number of protocols were defined within the statement. The invitations included an account of the research principles and subsequent procedures, based on the principal of informed consent.

3.22.1. Informed Consent

Research typically necessitates obtaining informed consent and ultimately gaining the cooperation of the subjects involved within a study. Defined by Diener and Crandall (1978, p. 58) as '…the procedures in which individuals choose whether to participate in an investigation after being informed of facts that would be likely to influence their decisions'. Diener and Crandall (1978, p. 57) further suggest informed consent arises from the subjects' principle '…right to freedom and self-determination'. How researchers conduct themselves whilst overseeing a research inquiry is covered by a set of principles. These principles include gaining the consent of study participants, ensuring that our methods and findings are transparent and that our data is secure and confidential. An ethical requirement in research is that of informed consent, a voluntary agreement to participate in research, where the subjects have an understanding of the inquiry and the risks it may entail (Altmann, 1974). As Gilbert (2008, p. 46) advocates, '…the social research community has responsibilities not only to the ideals of the pursuit of objective truth and the search for knowledge, but also to the subjects of their research'. Moreover, Wiles, Heath, Crow, and Charles (2005, p. 20) conclude that '…decisions

about informed consent are increasingly driven by the legal, ethical and regulatory frameworks in which social research takes place. Typically, informed consent includes detailed information supplied to subjects on the following points; purpose and consequence of research procedures, foreseeable risks, the right to voluntary withdrawal and re-joining of the study, rights and obligations regarding confidentiality and anonymity, storage and use of data'. Cementing earlier remarks, Sibinga (2018) argues that researchers also need to consider a broad range of issues, including style, format and timing of information provision and the appropriate form of consent.

3.22.2. Confidentiality and anonymity

The literature has highlighted the specific need for confidentiality of subjects' identities as part of a research study (Cohen et al., 2000). In essence, the data collected from the subjects involved within the study should not in any way reveal their identity. This is typically achieved by not using names or any identifiable information. As part of the existing researcher's study, each participant's anonymity was guaranteed when responding to surveys.

3.22.3. Research Bias

In qualitative research, bias ultimately affects the reliability and validity of the studies findings, as research suggests, by distorting the truth. In the context of an interview these forms of bias emulate from a moderator (interviewer), the questions asked, and answers received. A biased interviewer can influence in a number of ways, including, facial expressions, tone, body language, age or gender. Therefore, the interviewer whilst remaining neutral must control these influences. Furthermore, biased questioning may influence a respondent's answer; using neutral questioning also can reduce this. Ultimately a researcher can significantly reduce bias using a variety of methods, but unfortunately not completely eradicate it within their studies. In the context of the existing inquiry, the researcher aimed to eliminate any potential bias that could weaken or invalidate findings by ensuring they were mindful of the archetypical sources of analytic bias - Holistic fallacy, Elite bias, Personal bias, Going native, (Miles, Huberman, & Saldaña, 2020).

3.23. Triangulating Evidence

With the sole purpose of increasing the possibility of credibility and validity of results obtained, the triangulation of data from multiple sources in qualitative research holds the key to strengthening the inquiry in a persuasive and powerful manner. The researcher embraced this strategy as part of this multi-site case study approach to the adoption of tablet pcs, to triangulate evidence with the aspiration to increase the validity of evaluation and the subsequent research findings (Denzin, 1970). As Mathison (1988, p. 13) further elaborates, '…triangulation has risen an important methodological issue in naturalistic and qualitative approaches to evaluation [in order to] control bias and establishing valid propositions because traditional scientific techniques are incompatible with this alternate epistemology'. This is further advocated by Mathison (1988, p. 13), who states, '…triangulation strengthens a study by combining methods. This can mean using several kinds of methods or data, including using both quantitative and qualitative approaches'. Some of the benefits of triangulating data include the obvious confirming of the data from multiple origins, to viewing any obvious inconsistencies forthcoming in accumulated data sets.

As Patton (1990, p. 247) further clarifies, '…triangulation is a method used by qualitative researchers to check and establish validity in their studies by analysing a research question from multiple perspectives'. However, some researchers caution our goal to arrive at consistency across multiple datasets, believing that '…such inconsistencies may be likely given the relative strengths of different approaches', Guion, Diehl, and McDonald (2011, p. 1), argue that this in turn does not weaken the evidence accrued, but rather creates an opportunity to delve deeper within our research.

When analysing data derived from multiple perspectives, the researcher fundamentally increases the validity of a research study when embracing triangulation. Thurmond (2001, p. 254) highlights the benefits of triangulation as '…increasing confidence in research data, creating innovative ways of understanding a phenomenon, revealing unique findings, challenging or integrating theories, and providing a clearer understanding of the problem'. Moreover, Thurmond (2001), describes how researchers employ one or more of the following procedures, triangulations, member checking, thick description, peer reviews, and external audits within their investigations in an attempt to validate their research. Triangulation in particular as a validity procedure, searches for the convergence attained from various sources attained to form categories or themes

that run throughout a study. This becomes a systematic process of filtering data to find common themes, which can be collaborated through evidence from observations and in particular interviews with subjects. Expanding on this theme, Creswell and Miller (2000) inherently believes that a combination of reliability, validity and triangulation must be redefined to reflect the multiple ways of establishing truth within a research study. As further stated by Maxwell (2012, p. 93) triangulation '…reduces the risk that your conclusions will reflect only the systematic biases or limitations of a specific source or method, and allows you to gain a broader and more secure understanding of the issues you are investigating'.

3.24. Methodological limitations

The study has focused on three post-primary schools to allow for a more in-depth analysis of experiences by both teachers and students alike. The sample will include both students and teachers within each researched post-primary school. As in the case of most research conducted, the validity of the results in this study could be negatively affected by a number of aspects including levels of technology experience. Results could be further affected by the experience of staff and students in the roll-out of mobile devices within the schools. Furthermore the impact on different teaching styles adopted could also negatively affect results collected. The use of surveys and responses collected could also negatively affect the results as historically this method of research typically generates a low response rate (Cook et al., 2000). This was reflected In the context of the researchers study when only n=39 Post Primary schools from a total of n=160 had replied to the initial survey sent to early adopters. As such, with a limited sample size results from the survey must be viewed with caution. Moreover, the interviews conducted with both teachers, students depend upon the honesty of the participants interviewed and their subsequent unbiased opinion towards mobile technology. Furthermore the interviews conducted are susceptible to both primer and interviewer effects. Finally, interpretations of the data collected were subject to the views of the researcher.

3.25. Validity & Reliability

In relation to data collection, validity determines whether research findings truly represent what you are attempting to measure (Frankfort-Nachmias & Nachmias, 1992). As such, validity involves the collection of data and its subsequent analysis, to determine the accuracy of the instrument adopted. Typically, accessing the validity of an instrument

involves the use of pilot testing. Moreover, reliability is determined by the measured consistency of an instrument. As Lincoln and Guba (1985, p. 316) states, '…since there can be no validity without reliability, a demonstration of the former [validity] is sufficient to establish the latter [reliability;]'.

3.26. Transferability & Generalisability

Within research, generalisation is defined as the extension of a researchers findings within a study of a sample population to the population at large. Thus, the larger the population the more a researcher can generalise the results as being statistically probable. Transferability is defined as applicable to readers of research inviting them to make connections between the researchers results and those of their own experience. With a large and varied sample population, the readers of research can confidently generalise and subsequently transfer the findings to other contexts. As such, in the context of the existing study transferability and generalisation are likely to be impacted due to the limited participants and particular school contexts within the research study.

3.27. Summary & Conclusion

This research set out to address the contribution of mobile digital devices to improve teaching and learning in the context of the new Junior Cycle educational framework in Ireland. The researcher's chosen constructivist epistemology and combined theoretical perspective (positivism and interpretivism) informed the methodology to answer the research questions guiding the enquiry, as detailed at the start of this chapter. The positivist perspective focusing on quantitative data collected via surveys, with the interpretivist perspective focusing on qualitative data collected from focus groups and interviews. The researcher has presented and advocated utilising a survey and case study pre and post-test design, applying both quantitative and qualitative methods within the research inquiry.

The proposed adopted methods firstly included pre and post-test online questionnaires answered by teachers and students. Secondly, individual teacher interviews (following completion of each of the three individual learning activities by their students) and finally a series of focus group meetings with students within each case study. Moreover, the researcher discussed the rationale for each adopted method employed. Data collection occurred between November 2018 and July 2019. As described earlier, a number of key research studies in the last ten years related to the impact of mobile technology adoption

(tablet pcs), clearly establish a preference towards using multiple-site case study approaches, which include use of the following instruments, surveys, focus groups, interviews, observations and field notes (Beauchamp & Hillier, 2014; Burden, Hopkins, Male, Martin, & Trala, 2012a; Clarke et al., 2013; Heinrich, 2012).

This chapter has outlined and discussed the research design, data collection methods and subsequent analysis endorsed to address and answer the research questions. While consolidating data from surveys, interviews and focus groups, the researcher was able to gain significant evidence from using triangulation of the varied sources of rich data to facilitate its verification and validity (Creswell & Miller, 2000). Unfortunately, as the research evolved it was not possible for the digital leaders to develop collectively as a professional learning community. In conclusion, whilst addressing the methods involved in this study, the researcher has provided detailed information to afford anyone who so wishes, the opportunity to replicate this study at a later date.

Chapter 4. Findings

4.1. Survey – Data Analysis Findings

4.1.1. Background

The following section considers the analysis from the Survey approach adopted within this study, serving as an entry mechanism and related to base line data on tablet adoption and initial perspectives across post-primary schools in Ireland. A total of (n=160) schools were contacted via email to answer the online questionnaire in November 2016. A total of (n=39) schools completed the survey of which 14% Single-sex Male, 19% Single-sex Female, 67% Mixed. A total of 21% of the schools were Community/Comprehensive, 62% were Secondary, with 17% Private/Fee paying schools. A total of 99% of the respondents to the survey held the position of Principal within the school. Link: https://www.surveymonkey.com/r/Tablet-Adoption

The survey contained a total of (n=26) questions. Some early adopters first introduced tablet pcs as early as September 2012, with the devices introduced primarily to 1st, 2nd and 3rd year groups within each school. Almost 78% of all tablet pcs were purchased by parents or through localised funding organised by schools (with Credit Union or similar). Cost of the initial tablet pcs and relevant subject eBooks were of particular concern for schools. Using an online questionnaire tool, Survey Monkey, the researcher developed a series of questions including ranking questionnaire items to calculate a weighted average, listed as follows;

- Daily, Few times a week, Once a week, Monthly, Never (Measure *Purpose* of device)
- Strongly Disagree, Disagree, Unsure, Agree, Strongly agree. (Measure *Impact* of device)

As such, the findings reflect the principals' views and perceptions regarding mobile device adoption in their schools.

4.1.2. The core reasoning behind tablet adoption

The following data provides a ranking of the main reasoning for the adoption of tablet devices by 'early adopters', where '1' is the most important.

Reason	Ranking
Providing easy access to the internet	1
Improve student performance in state examinations	2
To introduce a more personalised learning approach	3
To provide a more up to date and modern school environment	4
To modernise teaching and schooling	5
To improve students and teachers' technology skills	6
To reduce the weight of school bags	7
To provide access to digital content including apps and eBooks	8
To improve engagement in class	9

Table 4-1: Survey data - reasoning behind tablet adoption

It is interesting to note the top key reasons behind tablet adoption relate to internet access and performance in state examinations, with the provision of a more meaningful personalised teaching and learning experience for students taking a distinct third. Some of the obvious interesting points is the lack of provisioning access to digital content (potentially due to security reasons) and in relation to adoption of the devices to improve class engagement.

4.1.3. Consequences of tablet adoption

The following displays results in relation to teachers level of agreement with the following statements.

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
The adoption of tablet devices caused us to re-evaluate our school vision for learning in the 21st century	3.70%	11.11%	3.70%	55.56%	25.93%
This vision was outlined in a 'School Vision' or similar type document prior to adoption of the tablet devices	7.41%	25.93%	11.11%	37.04%	18.52%
The ability of the selected device to support this vision for learning was a key consideration in its adoption	3.70%	22.22%	0.00%	44.44%	29.63%
Changing roles for teachers and students is a likely consequence of tablet adoption in the context of learning for the 21st century	0.00%	7.41%	14.81%	40.74%	37.04%

Table 4-2: Survey data - consequences of tablet adoption

As a consequence of the tablet adoptions, the survey highlighted the necessity for many schools to re-evaluate their vision for learning in the 21st century. Moreover, the device was chosen for its ability to support the school vision. Potential changing roles for teachers and students alongside the importance and relevance of 21st century skills were also seen as important consequences of tablet adoption.

4.1.4. Purpose of tablet pcs (Teachers)

Schools were subsequently asked as to the frequency (on average) that teachers and students use the tablet pcs for the following purposes;

	DAILY	A FEW TIMES PW	ONCE A WEEK	MONTHLY	NEVER
To communicate with parents	18.52%	18.52%	7.41%	18.52%	37.04%
For assessment and feedback to students	37.04%	7.41%	22.22%	33.33%	0.00%
To share resources with colleagues	29.63%	37.04%	7.41%	11.11%	14.81%
To prepare lesson materials/resources	34.62%	46.15%	7.69%	3.85%	7.69%

To facilitate active learning/group work by students	48.15%	22.22%	25.93%	3.70%	0.00%
For in class teaching purposes e.g. teacher presentations	51.85%	29.63%	14.81%	0.00%	3.70%
To research lesson content online	44.44%	48.15%	3.70%	0.00%	3.70%
To communicate with students e.g. via email	48.15%	44.44%	0.00%	3.70%	3.70%

Table 4-3: Survey data - purpose of tablet pcs (Teachers)

It is interesting to note from the findings that teachers used the devices on a daily basis primarily for teaching purposes, particularly related to research and content delivery, but also as a mechanism to communicate with students, facilitating active group work, assessment and feedback.

4.1.5. Purpose of tablet pcs (Students)

Participants were subsequently asked as to the frequency (on average) that students would use the devices for the following purposes.

	DAILY	A FEW TIMES PW	ONCE A WEEK	MONTHLY	NEVER
For social networking/gaming	22.22%	14.81%	3.70%	3.70%	55.56%
To make videos	7.41%	18.52%	37.04%	22.22%	14.81%
To take photographs	18.52%	29.63%	29.63%	14.81%	7.41%
For group work with other students	25.93%	33.33%	22.22%	18.52%	0.00%
For creating presentations	25.93%	37.04%	18.52%	18.52%	0.00%
To communicate with teachers e.g. via email	25.93%	44.44%	18.52%	3.70%	7.41%
For completing assignments	40.74%	25.93%	25.93%	7.41%	0.00%
To take notes	59.26%	22.22%	3.70%	7.41%	7.41%
To access educational apps	55.56%	33.33%	11.11%	0.00%	0.00%
For researching online	74.07%	14.81%	3.70%	7.41%	0.00%
To access eBooks	84.00%	8.00%	4.00%	0.00%	4.00%

Table 4-4: Survey data - purpose of tablet pcs (Students)

The student findings related to primarily using the devices on a daily basis for using eBooks, research purposes, note taking and access to educational apps. It is interesting to note that the findings suggest that the potential to create and develop content was considered quite low.

4.1.6. Barriers and challenges to tablet adoption

Initial findings in relation to potential barriers and challenges to tablet adoption for many of the schools were related from the highest to lowest as follows;

1. Potential theft of the device
2. Student preference for hard copy books rather than eBooks
3. The availability of good educational apps
4. Existing exam pressures
5. Low teacher confidence in using the devices
6. Concerns related to cyberbullying.

The findings show that while provision of CPD to teachers was available in various formats, it was not 'subject specific'.

4.1.7. Impact on teachers

In this instance, it is interesting to note that the findings reveal the impact on early tablet adopters was both significant in how teachers collaborated and communicated with colleagues and their students and how they subsequently realised the potential in adopting a more student-centred to teaching and learning.

	STRONGLY DISAGREE	DISAGREE	UNSURE	AGREE	STRONGLY AGREE
Teachers are using a greater range of resources in their lessons	0.00%	0.00%	4.17%	70.83%	25.00%
Teachers are collaborating more with their colleagues e.g. sharing ideas and resources	0.00%	4.17%	8.33%	58.33%	29.17%
Teachers are communicating more with their students i.e. via email	4.17%	4.17%	4.17%	50.00%	37.50%
Teachers are facilitating more	0.00%	4.35%	8.70%	60.87%	26.09%

student centred learning					
Teachers are experimenting with the layout of their classrooms	0.00%	4.17%	16.67%	54.17%	25.00%
Teachers are creating more interactive lessons	0.00%	8.33%	16.67%	54.17%	20.83%
Teachers are facilitating more collaboration between students	0.00%	8.33%	20.83%	45.83%	25.00%
Teachers are able to do classroom administration more efficiently	4.17%	8.33%	12.50%	45.83%	29.17%
Teachers are experiencing less difficulties due to students mislaying their books and other materials	0.00%	8.33%	20.83%	50.00%	20.83%
Teachers are providing more feedback to students	4.17%	4.17%	25.00%	41.67%	25.00%
Teachers are able to provide more individualised instruction for students	0.00%	4.17%	33.33%	45.83%	16.67%
Teachers are experiencing a new role as co-learners alongside their students	0.00%	4.35%	39.13%	39.13%	17.39%
Teachers are better organised	0.00%	16.67%	25.00%	33.33%	25.00%
Teachers are able to monitor student progress more closely	0.00%	21.74%	21.74%	39.13%	17.39%
Teachers are giving students more personalised attention	0.00%	20.83%	37.50%	25.00%	16.67%
Teachers are better able to tell if students are having difficulty with the content	0.00%	20.83%	37.50%	25.00%	16.67%
Teachers are experiencing less classroom management issues	4.35%	26.09%	26.09%	34.78%	8.70%

Table 4-5: Survey data - impact on teachers teaching and learning

4.1.8. Impact on student teaching and learning

The survey data suggests that the impacts on student teaching and learning, are related to the importance of the devices in provisioning access to educational content, the development of ICT skills and their affordance in providing students with the ability to participate in inquiry based learning. In essence, the tablet pcs provided unique opportunities for students to experience both individualised and personalised learning whilst developing their creativity within group activities.

	STRONGLY DISAGREE	DISAGREE	UNSURE	AGREE	STRONGLY AGREE
Students have easy access to educational content and resources	0.00%	0.00%	4.17%	50.00%	45.83%
Students are developing their ICT skills	0.00%	4.17%	4.17%	54.17%	37.50%
Students are participating more in inquiry based learning i.e. doing independent research	0.00%	4.17%	4.17%	66.67%	25.00%
Students have experienced more individualised and personalised learning	0.00%	8.70%	8.70%	56.52%	26.09%
Students are participating more in project based learning	0.00%	8.33%	25.00%	33.33%	33.33%
Students are developing their creativity	0.00%	0.00%	25.00%	62.50%	12.50%
Students are participating more in group activities	0.00%	4.17%	25.00%	50.00%	20.83%
Students are working together more often	0.00%	4.17%	33.33%	37.50%	25.00%
Students are more motivated to learn	0.00%	8.33%	33.33%	37.50%	20.83%
Students are more engaged with their learning	0.00%	4.17%	41.67%	33.33%	20.83%
Students have a more positive attitude to school	0.00%	4.17%	45.83%	29.17%	20.83%
Students are better organised as all their materials are stored on one device	0.00%	20.83%	16.67%	37.50%	25.00%
Students are developing their problem-solving and critical thinking skills	0.00%	8.33%	45.83%	33.33%	12.50%
Students are taking more responsibility for their own learning	0.00%	16.67%	37.50%	29.17%	16.67%
Students are creating their own learning resources	4.17%	16.67%	29.17%	33.33%	16.67%

The standard of students work has improved	0.00%	12.50%	41.67%	41.67%	4.17%
Students are showing evidence of improved academic achievement	0.00%	16.67%	37.50%	41.67%	4.17%
Students are more prone to distraction in class from online games and social networks	4.17%	37.50%	8.33%	29.17%	20.83%
Students are learning more deeply	12.50%	8.33%	50.00%	12.50%	16.67%

Table 4-6: Survey data: impact on student teaching and learning

4.1.9. Overall perception to tablet adoption

The feedback within the findings suggest an initial overall positive experience for those schools who adopted digital tablet pc's. The following collective comments from participants are provided as an indication of their perceptions and conclusions as a result of early adoption;

Implementation

- *'…I believe it has been a very positive experience for all involved. I believe that the success is due to the implementation model chosen. Teachers opted in rather than finding themselves forced to participate. Dealing with small numbers allowed us to respond to the issues which did arise quickly'*
- *'…I feel management have to drive it and am happy to now be in that position. Now on my way home from a full day of CPD in ICT for school leaders, I feel enthused about driving the project forward again. Unfortunately, we have teachers who have been insisting students bring hard copies of books to class and I am only now in a position to address the issue. Key to success is teacher engagement and time has to be available for their CPD. They also need to be convinced of the benefits and adopting the new Junior Cycle should help this'*
- *'...our deployment of the devices has improved dramatically over the years and we now have a very efficient set-up, deployment, training and maintenance system. Our teaching staff is slowly increasing their use of the devices in a creative way however, the current exam system is a barrier to maximising their potential. A significant number of students would say they prefer paper books, however in many cases this can be put down to the influence of parents and teachers. I would like to see the Dept. of Education develop and issue free content to schools to replace the ridiculously expensive eBooks'*

Issues

- *'...we jumped in too quickly and the iPads were only used as expensive book holders by most teachers. We should have spent a year in advance of launch working with our teachers on pedagogy. The first group to get JC Results were the 2016 class (they had used iPads for their 3 years) and these were disappointing'*
- *'…staff and pupils are hugely in favour of the success but a small number of parents are still resistant due to cost. We now provide the eBook on the tablet and also provide a physical book for home'*
- *'...the tablets have huge potential to make a difference to the learning experience for students. Technical difficulties and practical day to day administration and support for all the devices is the major problem we have. I underestimated the time spent supporting the devices themselves despite having a managing company to support them'*

Teaching and learning;

- *'…as the school's digital champion I'm delighted with its continued operation and success. It has made a huge difference to some people's teaching and had no impact for others. For me and my classes it has been an amazing revelation'*
- *'...we did a study of our first junior cert class results who used iPads. We found little or no difference between the results of students who used iPads in comparison of students who used textbooks. We still give a choice to our students to opt for iPad scheme. Many students who used iPads for their Junior Cert have opted for textbooks now for their Leaving Cert as many find it easier to study from an actual textbook. The jury is out as to whether they are beneficial or not to student learning in the long term'*
- *'...it is working very well in the school. We are all still learning but the use of the tablet as a tool along with the new pedagogies is changing our role'.*
- *'...great success and significant learning since first implementation. More active classrooms as a direct result of use of technology - specifically around student-led learning'*

4.1.10. Summary

In summary, whilst initially acting as an entry mechanism to post-primary schools adopting tablet pcs, the survey approach provides a unique insight into their collective thoughts on tablet affordances, their potential within teaching and learning and development of student creativity, whist further highlighting the need for relevant CPD and pedagogical practice in adopting digital technology. The reasoning behind tablet adoption for many schools has focused on student internet accessibility and furthermore related to student performance within summative examinations. As a consequence of the this early adoption many schools have become aware of a subsequent change in roles for both teachers and students alike, with the focus on 21st century skills. This

adoption has furthermore prompted schools to re-evaluate their current visions for 21st century learning. The purpose of tablet adoption for teachers revealed an opportunity to facilitate active learning and group work, whilst providing opportunities to communicate with students. In contrast the devices were adopted to provide student's access e-Books and to use for research purposes. Key barriers and challenges to tablet adoption interestingly highlighted student preference for hard copy books, the availability of relevant apps and low teacher confidence levels with the adoption of new technology. The findings also clearly demonstrate teachers embracing the potential in adopting a more student-centred approach to teaching and learning. The survey also revealed the potential ability for students to participate in inquiry based learning. Following on, a Pilot school and three case study schools were selected within the researchers case study inquiry.

4.2. Case Study 1 – Data Analysis Findings

4.2.1. Background

The remainder of this chapter considers the analysis of teacher and student questionnaires during the period of the intervention within Case Study 1 (CS1). The first of three schools involved within the researcher's study (School A) is a Voluntary Catholic Secondary school for girls situated in a rural area within the North East of Ireland. The school first adopted iPads in 2015. Two teachers agreed to take part in the study, one male and one female, both teaching Religious Education to 1st and 2nd year students. Class A (Teacher A - Male) had an enrolment of 17 students, while Class B (Teacher B - Female) had an enrolment of 18 students. The researcher first met with the Vice-Principal in September of 2018 to discuss the logistics of running a study within the school. After initial agreement, Continuing Professional Development (CPD) for both teachers and students began in November 2018. The CPD took the form of workshops in the Case Study school focusing on the use of Mac desktop computers and familiarisation with the software application "iBooks Author". This afforded both staff and students the ability to design and develop interactive iBooks content of relevance to the Junior Cycle curriculum.

In each instance, students collected and/or created video, audio and text resources via their class iPads. Following on from this, they subsequently transferred this information to a Mac desktop (via Airdrop) to amalgamate all of their group content into the

development on an interactive iBook while using iBooks Author. In the overall case study there were three participant case-study schools, Case Study 1 (CS1), Case Study 2 (CS2) and Case Study 3 (CS3). Each of the three case study schools had one Mac desktop to share amongst all of their classroom groups.

As detailed in the previous chapter, data was generated from both teachers and students using validated data instruments, both pre and post-test online surveys. The current study proposes to explore and investigate possible linkages between each of these previously discussed characteristic affordances of mobile learning (Motivation, Engagement, Communication, Collaboration, Reflection, Assistive learning) to specific key skills in the context of the new Junior Cycle educational framework in Ireland. Data generated in this phase included both quantitative and qualitative data.

Timetable of events – School A – Case Study 1 (CS1)

Initial discussions related to study	September 2018
Pre-test survey (Teachers & Students)	November 2018
CPD (Teachers & Students)	November 2018
Post CPD survey (Teachers)	December 2018
Tasks (3) as part of the intervention	January – May 2019
Teacher Interviews (on completion of each task)	January – May 2019
Post-test survey (Teachers & Students)	May 2019
Focus Group interview (Students)	May 2019

The multiple case study approach adopted by the researcher focused on two distinctive areas, each with their own advantages and weaknesses, quantitative and qualitative analysis. Following on the author concluded the analytical phase with a cross-case analysis chapter of all the combined studies.

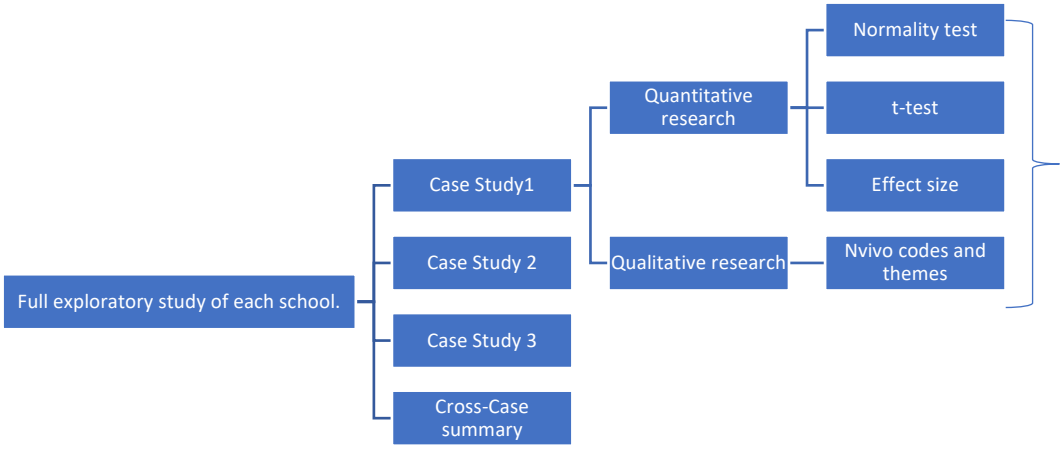


Figure 4-1: Case Study: Data Analysis

As a prerequisite, the researcher assessed the normality of the data to determine if it has been drawn from a normally distributed population, both graphically and numerically. Following on, the researcher employed a Paired sample t test within SPSS to analyse and compare the confidence levels in both pre and post-test surveys. As the literature suggests, the t-test employed within the student survey data is extremely robust against non-normality (Guiard & Rasch, 2004). For the t-test analysis four assumptions were made;

- *The dependent variable must be continuous (interval/ratio)*
- *The observations are independent of one another*
- *The dependent variable should be approximately normally distributed*
- *The dependent variable should not contain any outliers.*

In each instance the effect size, Cohen's *d* (Cohen, 1992) was also calculated. The key for interpreting such data is 0.2 = Small effect, 0.5 = Medium effect and > 0.8 = Large effect.

This chapter presents the findings from the primary data developed through the distribution of two questionnaires pre and post intervention; an initial questionnaire to teachers within the research school and a second questionnaire to students in the research school. The teacher questionnaire consisted of (n=24) questions, while the student questionnaire consisted of (n= 28) questions in total. Within their questionnaire, Teachers were initially asked to confirm if they had attended any professional learning

activities and its subsequent impact. Teachers were also asked to indicate their beliefs related to teaching and learning, highlight their preferred adopted teaching methods, approaches and strategies and thoughts on technology integration within classrooms. Lastly, teachers were asked to confirm if they had any experience in using eBooks and the development of interactive iBooks. The second questionnaire asked students to indicate their attitudes and perceptions towards technology and learning. Specifically these areas included; motivation, engagement, communication, collaboration, reflection, assistive-learning, creativity and innovation, critical thinking, self-direction and using technology as a tool for learning, to address the development of key skills pre and post intervention. Lastly, students were also asked for details on their own experience and perceptions of iBooks and any subsequent interest and motivation to adopting iBooks within their classroom. This chapter will lastly present the findings from semi-structured interview with both teachers and focus group students. In utilizing both substantive research instruments and a number of semi-structured interviews, has provided the researcher with multiple exploratory avenues to address the studies research questions.

4.3. Quantitative analysis

While the total pre-test sample size within the current inquiry was initially deemed small (n=113), unfortunately a number of students were also unable to complete the post-test surveys across all three case studies for various reasons. As a consequence, it was therefore important for the researcher to ensure the data was normally distributed, (Mendenhall, Beaver, & Beaver, 2009). A total of (n=97) students completed the post-test surveys across all three studies. As discussed previously, while using SPSS, the researcher was in a position to perform a series of robust parametric testing of the data; normality (normally distributed), paired sample t-test to determine if there is a significant difference between two groups (Guiard & Rasch, 2004) and adopt Cohen's d (effect size indicating the standardised difference) using the mean of both pre and post-test values, (Field, 2013). Whilst the researcher followed the appropriate analytical testing of each case study dataset, the following analysis of student survey data is presented 'with caution'.

4.3.1. Teacher survey data

The following section considers the findings and analysis of both teachers' questionnaires pre and post intervention in Case Study 1. In November 2018 teachers (n=2) from Case Study 1 completed an online pre-test survey (Appendix E) prior to the

intervention. Whilst adopting an online questionnaire tool, Survey Monkey, the researcher developed a series of Likert scale questionnaire items using the following answer format: Very confident – Confident – Neutral – Not confident – Not confident at all. This was followed in May 2019, upon completion of an online post-test questionnaire. Firstly, the teachers were asked to discuss the effectiveness of using iBooks, subsequent to the intervention. Whilst both teachers describe various levels of effectiveness, their feedback suggests that they uniformly agree that the iBook enhances the effectiveness in their teaching, and subsequently how they perceived its effectiveness with their students, which is detailed below.

Primarily, the interactive iBooks created by students were used within each class as a summative revision tool. Teachers were then asked to reflect upon their thoughts with regard to iBooks, Powerpoint, a textbook and Search engines and their usefulness in terms of supporting their teaching. In this instance, both teachers clearly identified the iBook as having equal importance and usefulness in relation to supporting their teaching as Search engines, Textbook and Presentations (PowerPoint). Feedback from both teachers suggests that they intend to adopt iBooks more frequently within their classrooms, with both agreeing that they are an invaluable instructional tool.

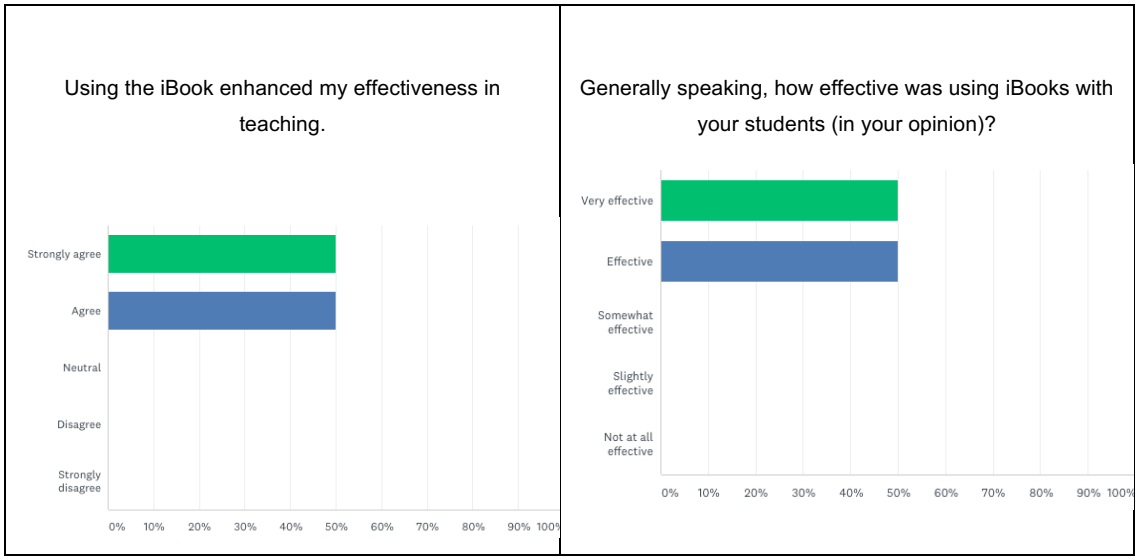


Figure 4-2: Case study 1 - iBook effectiveness

In relation to their students, both teachers agree that the iBooks improved the students understanding of the course and indicate that all of the key skills were increased

considerably following the intervention. Motivation, engagement, communication, collaboration and using technology were foremost in their minds, as detailed below.

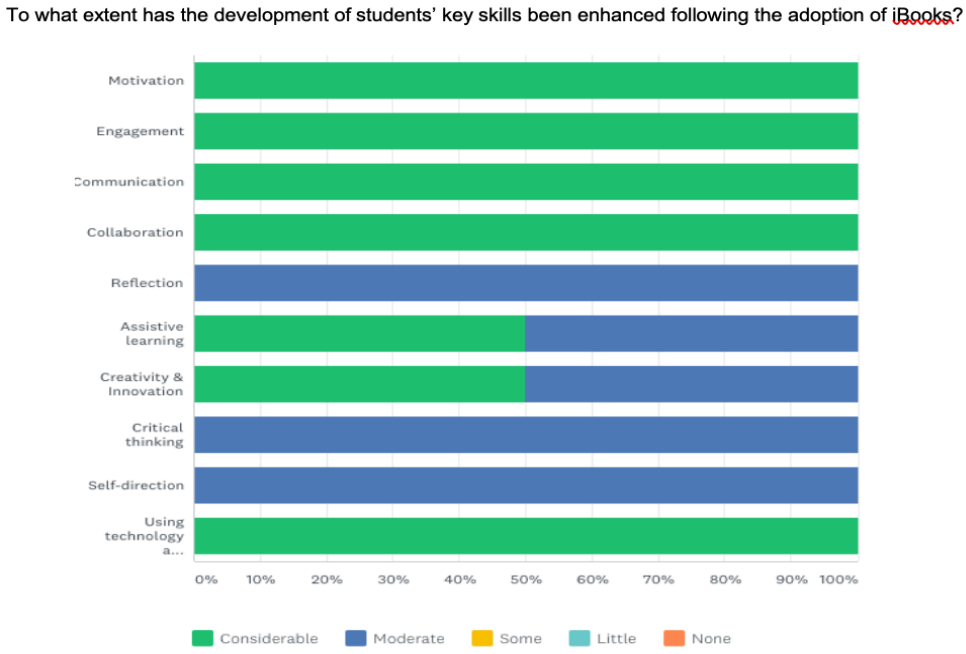


Figure 4-3: Case study 1 - Development of student key skills

4.3.2. Student survey data

Initially in CS1, there were a total of (n=46) responses from the student pre-test survey (Appendix D), but only (n=41) responded as part of the post-test survey. Unfortunately, a small number of students did not complete the post-test as they were unavailable to do so for various reasons. As such, a number of pre and post-test matching students from Class A (n=17) and Class B (n=18) were identified for analysis. In both instances' students were matched by name. Similar to the teacher survey, the researcher developed a series of Likert scale questionnaire items using the following format: 1. Very confident 2. Confident 3. Neutral 4. Not confident and 5. Not very confident. Adopting the mean value of specific combined answers, the researcher was in a position to calculate any difference and compare pre and post-test values to discover any statistical significance and effect size from within the data collected. For missing values, the researcher adopted the default value when using the paired samples t-test. Whereby, a case with a missing value for any variable specified on PAIRS is excluded from any paired-samples test.

4.3.2.1. Motivation

Q: Using the iBook improved my motivation to learn

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	39	2.2051	0.89382	39	0	-.74359	0.73	.001
Post Test	39	2.9487	1.12270	39	0			

Table 4-7: Case study 1 - Pre & Post-test Motivation

The researcher measured confidence levels of students (n=39) in relation to Motivation. The findings reveal pre-test data was associated with a confidence level (Mean(M) = 2.2051, Standard Deviation (SD) = .83982). By comparison, the post-test group illustrate strong evidence of increased Motivation, with a numerically larger (M = 2.9487, SD = 1.12270). The independent samples t-test was associated with a statistically significant effect, t (38) = -3.777, p = .001 (two-tailed). With the post mean test numerically larger, Cohens' *d* was also estimated at 0.73, which is deemed a medium effect based on Cohen (1992) guidelines. In this instance we can see a significant increase (-.74359) in confidence levels as a result of the intervention.

4.3.2.2. Engagement

Q: How confident are you to….

- *Use idea creation techniques such as brainstorming?*
- *Generate your own ideas about how to solve a problem or answer a question?*
- *Test out different ideas and work to improve them?*
- *Invent a solution to difficult problems?*

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	39	2.1474	0.66816	39	0	-.03205	0.04	.767
Post Test	39	2.1795	0.71008	39	7			

Table 4-8: Case study 1 - Pre & Post-test Engagement

Similar findings in relation to confidence levels in student Engagement also report an increase in the scores from Pre-test (Mean(M) = 2.1474, Standard Deviation (SD) = .66816) to the Post-test (M = 2.1795, SD = .71008), t (38) = .298, p < .767 (two-tailed). Moreover, with the p value >0.05 we can further conclude in this instance, that there is no statistically significant difference between the pre and post data conditions. Lastly, Cohens' *d* was estimated at 0.04 (no effect) based on Cohen's guidelines.

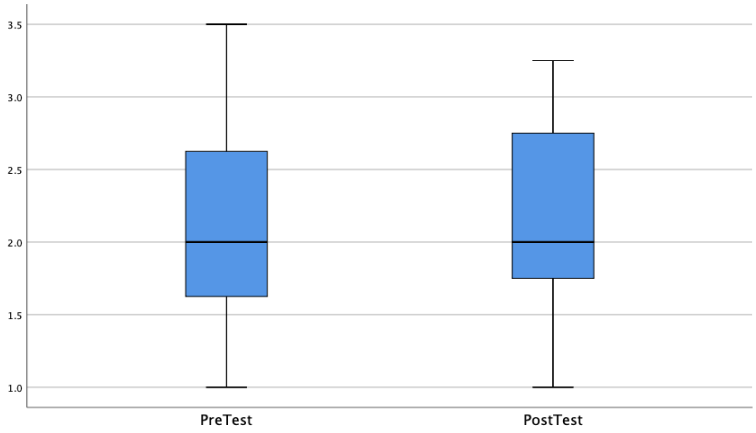


Figure 4-4: Distribution of scores – pre and post-test Engagement

4.3.2.3. Collaboration

Q: How confident are you to….

- *Work in pairs or small groups to complete a task together?*
- *Work with other students to set goals and create a plan for your team?*
- *Create joint products using contributions from each student?*
- *Work as a team to use feedback on group tasks ?*
- *Give feedback to peers or assess other students' work*

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	39	2.0115	0.62592	39	3	0.037	0.06	.68
Post Test	39	1.9744	0.64266	39	0			

Table 4-9: Case study 1 - Pre & Post-test Collaboration

In contrast, confidence levels related to Collaboration indicate a decrease in the scores from Pre-test (Mean (M) = 2.0115, Standard Deviation (SD) = .62592 to the Post-test (M = 1.9744, SD = .64266), t (38) = .416. Cohens' *d* was estimated at 0.058486 (No effect

size). This finding illustrates no statistically significant difference in student's confidence levels in relation to collaboration, (p = .06).

4.3.2.4. Communication

Q: How confident are you to….

- *Present your group work to the class, teacher or others?*
- *Communicate your ideas using media other than a written paper (e.g., posters, video, blogs, etc.)*
- *Prepare and deliver an oral presentation to the teacher or others?*
- *Answer questions in front of an audience?*

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	39	2.5385	0.94510	39	1	0.43590	0.45	.002
Post Test	39	2.1026	0.99035	39	6			

Table 4-10: Case study 1 - Pre & Post-test Communication

Students confidence in relation to communication also reveal a decrease in levels from Pre-test (Mean(M) = 2.5385, Standard Deviation (SD) = .94510 to the Post-test (M = 2.1026, SD = .99035), t (38) = 3.330, p < .002 (two-tailed). Cohens' *d* was estimated at 0.450315 suggesting a small effect size. In this instance the independent samples t-test was associated with a statistically significant effect.

4.3.2.5. Technology

How confident are you to….

- *Use technology to work in a team (e.g., shared workspaces, email exchanges, giving and receiving feedback, etc.)?*
- *Use technology to talk with experts or members of communities?*
- *Use technology to keep track of your work on assignments?*
- *Use technology to help to share information (e.g., multi---media presentations using sound or video, presentation software, blogs, podcasts, etc.)?*
- *Use technology to analyse information (e.g., databases, spreadsheets, graphic programs, etc.)?*

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	39	1.9897	0.64228	39	0	0.23077	0.38	.029
Post Test	39	1.7590	0.55475	39	0			

Table 4-11: Case study 1 - Pre & Post-test Technology

Whilst confirming student confidence levels in relation to Technology, the evidence reflects a decrease in the scores from Pre-test (Mean(M) = 1.9897, Standard Deviation (SD) = .64228) to the Post-test (M = 1.7590, SD = .55475), t (38) = 2.264. We can also conclude there is a statistically significant difference between the pre and post data conditions as a result of the intervention (p = 0.29). Finally, the effect size, Cohen's *d* was calculated and recorded as 0.38 (small effect size).

4.3.2.6. Reflection

How confident are you to….

- *Try to solve problems or answer questions that have no single correct solution or answer?*
- *Judge how good and useful online resources are?*
- *Compare information from different sources before completing a task or assignment?*
- *Draw your own ideas based on analysis of numbers, facts, or relevant information?*
- *Summarise or create your own interpretation of what you have read or been taught?*
- *Analyze different arguments, perspectives or solutions to a problem?*
- *Use evidence to develop arguments?*
- *Structure data for use in written products or oral presentations (e.g., creating charts, tables or graphs)?*
- *Decide how you will present your work?*

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	39	2.0573	0.66664	39	1	0.03704	0.06	.717
Post Test	39	2.0203	0.53650	39	1			

Table 4-12: Case study 1 - Pre & Post-test Reflection

Lastly, findings related to Reflection provide evidence of a decrease in the scores from Pre-test (M = 2.0573, SD = .66664) to the Post-test (Mean(M) = 2.0203, Standard Deviation (SD) = .53650), t (38) = .365. With the p value of .717 and a Cohen *d* calculated at 0.061149 (no effect), we can further conclude in this instance, that there is no statistically significant difference between the pre and post data conditions (p = .717).

4.3.3. Overview of results

Case study 1		Statistically significant	Mean value	Effect*
	Motivation	Yes	Increase	Medium
	Engagement	No	Increase	None
	Collaboration	No	Decrease	None
	Communication	Yes	Decrease	Small
	Technology	Yes	Decrease	Small
	Reflection	No	Decrease	None

Table 4-13: Case study 1 - Quantitative analysis summary

*The effect size affords us the opportunity to understand the magnitude of differences found, whereas the statistical significance examines whether our findings are more likely to be due to chance.

4.4. Qualitative Analysis – Interviews

4.4.1. Teachers Learning Activities

The following section will report on the qualitative findings from the semi-structured interviews with teachers and from focus groups with students. It is the researcher's intention to prioritise and highlight the themes from the data analysis through a thematic narrative. The narrative will be illustrated by excerpts selected from the raw data, comprising direct quotations from both teachers and students. To investigate if mobile devices such as the iPad and iBooks Author can address the aims of the Junior Cycle key skills, both teachers within Case Study 1 were interviewed using semi-structured interviews following completion of each of the three learning units they had developed

for their students. The following section considers the interview data generated in order to expand on the quantitative analysis detailed earlier.

4.4.1.1. Task 1: Judaism – Forgiveness / Parables and forgiveness within Christianity

Within Task 1, Teacher A requested his first year students to explore Judaism as a world religion. Initially the students focused on researching relevant text, but following scaffolding from Teacher A, students began collating relevant video and picture content. Whilst reflecting the theme of engagement, Teacher A suggests,

> *'…to be honest, I thought they were very engaged, from going around the classroom. I felt they were very engaged in it, it was very active'.*

Teacher A reaffirms the advantageous nature of the intervention, whereby students enjoy the active work and subsequently

> '…*engage much more deeply than traditional chalk-and-talk'*.

A number of subthemes were also identified including a deeper understanding by students in relation to the content created alongside the ability to critically reflect. As Teacher A reveals,

> '…the students had a concrete understanding of the topic and have a very good ability to understand and evaluate the story they created. In addition to this, students had the ability to critically reflect on the work they created.'

In contrast whilst highlighting the theme of changing pedagogical practice, Teacher A describes the changing situation,

> *'…for me as the teacher, I really did nothing. I wandered around the class and offered advice and answered questions, so for me, it was very easy because I didn't have to plan anything.'*

Expanding on their role in the classroom, Teacher A further suggests

> *'…in a way, doing tasks like these, is very free in the classroom. There is a lot of noise, moving around and talking and its very busy for the teacher. I ended up taking a back step and I was almost an observer in the classroom rather than a*

facilitator, I wasn't even a facilitator, I was calling in on the groups and asking a couple of questions.'

The comments demonstrate a changing role as an educator, highlighted in the recurring theme of pedagogical practice, one in which Teacher A were initially unfamiliar with and unsure of. While underlining the theme of developing research skills, Teacher A described the obstacles that many working groups encountered with regard to their skills and subsequent communication with each other. However, the teacher ultimately believes, these initial obstacles allowed them over a period of time to become more creative in both their research and furthermore as a group. Teacher A further suggests, a task like this leads the students to a sense of achievement and responsibility –

'…I think it gives them a sense of responsibility, there is a responsibility there, I think especially in this day and age – accountability and all that – it's really important that students here are aware that they can take responsibility of their own learning. And I think they have all experienced that.'

This sense of ownership and responsibility, reflected in the recurring sub-theme of ownership, was also evident and reflected in observations and comments by his school colleague Teacher B. In contrast, Teacher B had asked her 2nd year students to focus on the topic of parables and forgiveness within Christianity. Primarily the students were tasked with developing video content to explain the concept of forgiveness in relation to the parable of the Prodigal son, which they could embed within an iBook. Students were required to write their own short play, act it out and record it using their iPads, whilst demonstrating that they had the key facets of that particular story. The emphasis of the task focused around the area of forgiveness. Reflecting earlier comments of her colleague, Teacher B describes how,

'…immediately, from the very beginning I told them what they had to do and that they had ownership with a level of control. They were delighted with that and they had loads of ideas, they didn't need much direction, they kind of went with it.'

'…I could tell that the noise level was from their engagement, it wasn't about chatting about the weekend or whatever. They were talking about miracles and parables!'

The observations from Teacher B solidify the previous highlighted themes of both engagement and ownership. As Teacher B further confirms,

> '…students took to this new role very well and seemed to enjoy getting to create their own learning.'

In this instance, the feedback clearly indicates areas of critical reflection and responsibility of their own learning as very positive advantages arising from the intervention.

When viewing the different content from the individual groups it became quickly apparent for Teacher B, how easy it was to visualise the students learning experience, as she suggests,

> *'…it was very clear that you could really assess where they got the learning from, what they had created, so it was easy as a teacher to see they understood what you tried to get across. They really enjoyed it, they had fun and that was all part of the process.'*

However, although the task was relatively successful, Teacher B noted that some of the completed content was not as anticipated, due principally to the task having a less structured approach, which afforded the students more freedom and flexibility. Teacher B suggests in this case, the necessity for prompting and sign posting along the way, to support students with a unique opportunity to develop and create content. As such, Teacher B made a conscious note to ensure that the forthcoming Task 2 would include a more structured element to its design, with clearly defined learning outcomes. The levels of motivation and engagement experienced in the classroom at the time were as Teacher B suggests

> *'…really high. I think motivation is a big part of teaching. If you can get the students and motivate them, it makes your job quite easy as a teacher.'*

The data reveals the emphasis both teachers put on both engagement and motivation as keys areas to successful learning outcomes. In both cases the qualitative analysis reflects the survey responses from students. Limited resources within the school was a key theme first raised by Teacher B, as she noted, it was the one issue that would potentially hold students back. Although the task itself was quite complex and

challenging, overall she believed all of the groups involved were very successful with what they had achieved. She further noted that working in groups of 4/5 afforded each student the ability to improve their social and leadership skills.

As Teacher B suggests,

> *'…I suppose you get to know them in a different light a little, but because you get to see them interacting with each other, with different groups, you can see some of them taking on leadership roles. Some people love it and take it on, but some people are less so, you see different perspectives.'*

As a consequence of the task, this interaction with their peers highlights the theme of changing classroom dynamics.

4.4.1.2. Task 2: Mezuzah / Kingdom of God

Continuing with the motif of Judaism, Teacher A requested students complete a research task related to the religious object Mezuzah. First impressions by Teacher A, reflected the common themes of student collaboration, increased confidence in research skills and communication as a consequence of their own pedagogical approach in this instance,

> *'…personally I prefer to leave it open and give them the scope to discover, to really discover think about what they have found and what they are finding and how they put shape on it'.*

The comments are not dissimilar to those observations noted earlier by his colleague Teacher B in Task 1. When students had combined the material that they had created a subsequent discussion developed between both Teacher A and students on how best to present the relevant material. Following some initial scaffolding the students agreed to adopt a format of keynote presentations and picture galleries for this artefact and embed these within an interactive iBook.

Whilst reflecting on the theme of changing classroom dynamics, Teacher A believed the class had developed into a more relaxed atmosphere for both teacher and student alike, as Teacher A confirms,

'…I'm more comfortable now, with leading the project whereas before I was running around, the first time I was probably a bit more getting involved'. Teacher A continues, 'I think the atmosphere in the class is a bit more relaxed, not relaxed in a lazy way but just relaxed in a calm kind off happy way. People know what they have to do, there is greater focus but they are also enjoying it'.

The teachers comments further indicate his adoption of a more settled, clearly defined and focused pedagogical approach within the classroom, from that adopted in Task 1.

A total of 5 groups were involved which Teacher B believes made the task more manageable, compared to the previous Task 1. Each group had their own specific section and they had to show how their topic, like other groups, would feed into the main overall concept of the Kingdom of God. On this occasion, Teacher B offered more of a free reign in Task 2, affording students the ability to decide how they would amalgamate the content from various sources. These included, Apple keynote presentations and the use of Bookry (an application highlighted by the researcher during the CPD sessions) to embed various puzzles and the ability to add word search functionality). Teacher B was subsequently very pleased with how the students had used a wide variety of strategies and revision type tools within their artefact,

'…I thought that giving them a bit more free reign worked well because they were able to show their creativity a little bit more because I hadn't set the assignment as they got to create it themselves. So, they talked it out and discussed it and were using all the different apps they would like, and were able to put in and compromise with different members of their group. I suppose it required a lot of teamwork in that way.'

These comments highlight the key themes of creativity, collaboration and research skills. In highlighting the theme of technology and collaboration, Teacher B describes how her students have adopted iBooks Author and iPads to their advantage and furthermore the subsequent sharing of this knowledge with their peers,

'…they just really enjoyed it! You could just tell. They were so eager, one of them had cracked how to use the Bookry apps. They were all really excited about coding it and getting it in and making different things and showing each other it. It developed a good enthusiasm as well…'

Confidence levels had also significantly increased in the classroom,

> *'…they think they are flying! they are really enthusiastic about it', leading to a broad increase in levels of creativity in the class, '…more than happy I'd say, they're ecstatic!'.*

As a consequence of a change in pedagogical practice, students were afforded that extra 'free reign' for this particular task, and by adding a little bit of creativity, as she concludes

> *'…it ignites their 'fire' should we say. It's like a recipe; all those things work together very well and that's what we have now. It's how everything fits together that's important.'*

Finally, reflecting the subtheme of reflection and the overarching theme of learning, students were afforded the opportunity to reflect upon their artefact and those of other groups. Whilst viewing different approaches Teacher B confirms how students upon completion of Task 2 were able to critique other group projects, learn from these and ultimately see what helps their learning.

4.4.1.3. Task 3: Corrymeela Community

The task at hand focused around the Corrymeela community and how it promotes ecumenism and tolerance. On this occasion, the third and final task afforded the students the opportunity to amalgamate and build upon the skills they had previously acquired to develop an interactive artefact. Both teachers once again were very happy with the overall outcomes of Task 3. Subsequently, discussions between the researcher and each teacher moved on towards their overall thoughts on the intervention and any perceived impacts for both the teachers and their students. As is clear in the following excerpt from Teacher A, in relation to an aspect of social learning and underlying themes of continued engagement and motivation,

> *'…you could see it as they were getting more engaged, that they were bouncing ideas off each other, very effectively'.*

Participant responses clearly indicate high levels of engagement and collaboration within the classroom,

> '…motivation was excellent, they loved it, they just loved it.'

Teacher A further suggests

> *'…you can really tell from their engagement. They were super engaged in these activities and learning projects. I think they took much more ownership of their learning. I think they know the material better.'*

In this instance Teacher A's narrative illuminates the key themes of engagement, collaboration, motivation and the students sense of ownership and responsibility for their own learning. Furthermore, the comments also highlight the advantages to adopting a more student-centred approach with the potential to facilitate another sub-theme of deeper learning. In attaching themselves to this narrative, Teacher B was to further describe the intervention as 'a unique learning experience' whereby she was quite taken aback by how quickly her own students had firstly engaged with iBooks Author to develop interactive iBooks, secondly become so creative and ultimately become so motivated in response to this approach.

In reflecting the key themes of creativity and motivation, Teacher B was to further illustrate her position, by stating

> *'…they took such a personal interest because they had to create something and you could see the enjoyment. They really, really got into it. So ultimately, that's what you are trying to achieve all the time! They were very, very motivated, and it came from themselves, it didn't come from me.'*

Teacher B's responses indicate the level of students personal interest towards an implementation of this type of project-based learning approach. Furthermore, her comments provide one such example of the level of engagement within the class whereby

> *'…they forget now where they are. The bell would ring for lunch and they would actually nearly forget, like it was their lunchtime. They were actually so into it.'*

Teacher B's narrative echo those of here colleagues, confirming the strong engagement from students and genuine success of the intervention within their school.

In reflecting the theme of changing pedagogical practice, Teacher A concluded that as a consequence of the intervention,

'…I think now that they have seen, now that they have done the very active kind of a class, the chalk and talk is now the poor relative. Not that pedagogically there is anything wrong with a mix, but I think they were a bit disappointed when I walked in and said - Ok we are going to sit there now and listen'.

For Teacher B one of the key elements to the success of the intervention was its initial CPD sessions which afforded the attendees a very good grounding with the application and its potential. Furthermore, this grounding facilitated a key sub-theme of mentoring to other group members. Armed with the necessary skills and resources, the adoption of a more student centred approach to learning, develops the students creative skills and levels of critical thinking, as envisaged in the Junior Cycle key skills. As Teacher B elaborates,

'…their minds were constantly thinking of how to progress and think of how to make it better… that doesn't usually happen when teaching in a more didactic way. They are not thinking of how to improve when taking stuff down from the board.'

Both teachers agreed that the key themes of engagement, motivation and creativity were foremost in their thoughts of the overall intervention. From a teaching perspective, both educators confirmed that the approach has afforded students the opportunity to '…take real ownership' of their learning. This underlying theme has subsequently afforded the teachers the fortuity to see their class '…in a different light' whilst viewing students in a different perspective, maybe that wouldn't have come to your attention otherwise'.

4.4.2. Student Focus groups

The researcher met with two focus groups from Case study 1 following completion of all three tasks in May 2019. Each of the groups contained (n=6) students. In both cases, what resounded with the researcher most was how eager each group were to divulge their overall feelings on the intervention. Firstly, Focus group 1, aligned to Teacher A, were asked to describe their initial thoughts. Student 5 suggests

'…it was like a fun way of learning, cause you got to work in a group and put together a presentation, but you were learning at the same time.'

However, this first impression by students was quickly followed up with their contrasting experience of ICT issues, related to resources (lack of), password management and timing (to complete each task). While each of the focus group members unanimously agreed that the overall intervention was a 'fun' way to learn, they also described the opportunity to present their work as advantageous which included instant feedback from their teacher and peers.

While Teacher A believed having a smaller number of groups was more manageable, the students contradicted this opinion suggesting the group size was too large. Student five discusses the general opinion

> *'…in our group there was a lot of us, hard to keep track, it was hard to put it all together because we had so much stuff'. Student 2 further suggests, '…with so many people in the groups and everybody talking it can be very distracting'.*

The group numbers also afforded the opportunity for some participants to potentially take a more 'back seat' role, as student 6 describes,

> *'…because we were in such a big group some people might not have been doing as much as everyone else'.*

When asked to suggest a compromise, student 5 advised,

> *'…I'd say like maybe have three in a group. It makes more pressure on you to get things done but it makes you work harder and it's not all confusion.'*

When asked to describe any change in classroom dynamics as a consequence on the intervention student 3 suggests,

> *'…before this, it was kind of boring. In the classroom we would just loose concentration'.*

In contrast, whilst completing each task within the intervention,

> *'…we were always on task'.*

Echoing the comments of both teachers, student 2 describes their experience as a mentor, walking around the room guiding other groups,

'…it felt it was more responsibility, good'.

Focus group B aligned to Teacher B in similar eager fashion to Focus group A, described the intervention as '…fun!'. When asked to expand on their content creation, student 4 commented,

> *'…we edited them on our iPads using iMovie, to put music as a background, text on the video and clip bits'.*

When asked if creating the content afforded the students any advantages, student 2 stated,

> *'…it was a lot more fun than just out of a book and it was a lot easier to learn'. Student 4 expands on this suggesting, '…when you are just going to a topic and it's like a story you can do an exercise with your class, make a video, the class will understand more and have fun with it'.*

Focus group B were also keen to discuss how they had extended their embedded content with the introduction of quizzes, definitions and games within their interactive iBooks. The researcher subsequently touched upon group dynamics, in which the focus group described the process were group members would democratically vote on what was included. Following this, the researcher questioned the classroom dynamics as a whole. When asked if the relationship with their teacher had improved, they all agreed. Whilst they agree that they have made new friends as part of a group, they also believe that they have gotten to know their teacher much better too.

4.5. Summary

Initial survey analysis from the teachers suggest that they both uniformly agree on the importance and potential of a more student-centred approach to learning, highlighting the central impact on student motivation and engagement as a consequence of the intervention. The quantitative analysis derived from both student classes provide statistical significance in relation to a number of key areas of particular focus, including, Communication, Motivation and Technology levels. Furthermore, the data illustrates a marked increase in confidence levels in both Motivation and Engagement, as reflected in feedback from both teachers and students alike. In contrast, and contrary to expectations, the results reveal a minimal decrease in confidence levels in Collaboration, Communication and Reflection. While a small decrease in relation to the use of the technology is likely as a consequence of the ICT issues experienced and limited

resources available, the remaining negative results must be interpreted with caution as they do not reflect both teacher and focus group feedback.

There were a number of broad themes that have emerged from the qualitative data analysis. The first highlighted the high levels of student engagement throughout the process of completing the relevant learning activities developed by each teacher. The second was related to student motivation, which in this instance had shown a marked increase as a consequence of the approach. In both instances the increases were reflected in both teacher and student interview feedback. The third was a change in pedagogical practice for each teacher. While initially skeptical or uncomfortable with the approach devised as part of the intervention, both teachers have become aware of the affordances and advantages of this type of approach to teaching and learning. The fourth theme included the teacher's perceptions on how students had successfully taken ownership and responsibility for their own learning, as reflected in both student and teacher comments. Finally, the fifth theme to emerge from the analysis was the perceived increase in creativity of students as a consequence of the intervention. To conclude, while quantitative analysis reveals a small increase in confidence levels in a number of key-skills, the qualitative data in contrast arguably confirms the ability of digital mobile devices, such as the iPad, alongside content development apps like iBooks Author, to both potentially motivate and ultimately engage students in teaching and learning. In light of these tasks, both teachers from CS1 have confirmed that from September 2019 they will formally adopt this learning approach with new students.

4.6. Case Study 2 – Data Analysis Findings

4.6.1. Background

Case Study 2 post-primary school is a private Catholic all-girls secondary school located in the East of the Republic of Ireland. There are currently 720 students enrolled in the school. In 2016/2017 the school took part in a successful iPad pilot for teachers. In November 2018, a female teacher from the school agreed to take part in the researchers study along with her first year Science students (n=22). Initially, the researcher met in mid-November 2018 with the School Principal, Teacher C and (n=6) transition year students, who would act as mentors to the 1st year students in how to use the Mac OS desktop and iBooks Author, eBook development application.

Similar to Case Study 1, the teacher and students had access to only one Mac desktop in which to develop interactive iBooks using iBooks Author. Once again the students would create and collect various resources via their individual school iPads and transfer this material to the desktop via Airdrop. Following CPD with the students and Teacher C, everyone was formally asked to complete a pre-test online survey. Between January and May of 2019, Teacher C developed three learning tasks for her students to complete as part of the intervention. Following the completion of each task the researcher arranged to meet with Teacher C, discuss her thoughts on the process and tasks and highlight any subsequent observations on students' performance.

Reflecting the process adopted in Case Study 1, the researcher utilised both pre and post-test online surveys to generate quantitative data. Following similar steps in Case Study 1, the researcher firstly assessed if the quantitative data was normally distributed and subsequently employed a Paired-sample t-test and finally calculated the Cohen's *d* effect size of pre and post data. Qualitative data in the form of interviews with Teacher C and a focus group interview with students from the class focus group (n=6) was generated so as to expand on the initial survey data. In this instance, a total of three interviews with teachers were conducted and one with the focus group, recorded and transcribed verbatim. The transcriptions from each interview were imported into NVivo for analysis.

4.7. Quantitative Analysis

4.7.1. Teacher survey data

The following section considers the analysis of Teacher C questionnaire responses pre and post intervention. In November 2018 Teacher C from Case Study 2 completed an online pre-test survey prior to the intervention. The teacher confirmed that iPads had previously been used within the classroom as a research tool and for assessment purposes. Furthermore, she considered herself to have moderate experience using iBooks Author prior to the intervention and believed the software to be somewhat effective from her experience of developing an iBook version of the school prospectus with Transition Year students. When asked prior to the intervention as to how interested she believed her 2nd year students would find using the application, she believed they would find it to be somewhat interesting and slightly motivating. Teacher C had never used iBooks within her 2nd Year class prior to the intervention. Confirming in post-test analysis that the adoption of iBooks by her students was effective, Teacher C further concluded that interactive elements such as embedded videos and incorporation of review quizzes were of most benefit within the developed artifacts.

When asked to rank resources in terms of their usefulness in her teaching, Teacher C choose both PowerPoint and iBooks to be equally as most useful (100%), compared to textbooks and search engines. Whilst answering Likert scale questionnaire items Teacher C firstly gave a neutral response to her reply in relation to iBooks as an invaluable instructional tool. Furthermore, Teacher C gave a similar response to the question, if using the iBook had enhanced her effectiveness in teaching. However, she agreed that the iBook improved her students understanding of the course whilst also successfully improving their motivation. When asked as to what extent the development of student key skills had been enhanced following the adoption of the iBooks, Teacher C's response was unanimous. Motivation, Reflection, Assistive Learning and Critical thinking, as highlighted below were defined as the key enhancements as a consequence of the intervention.

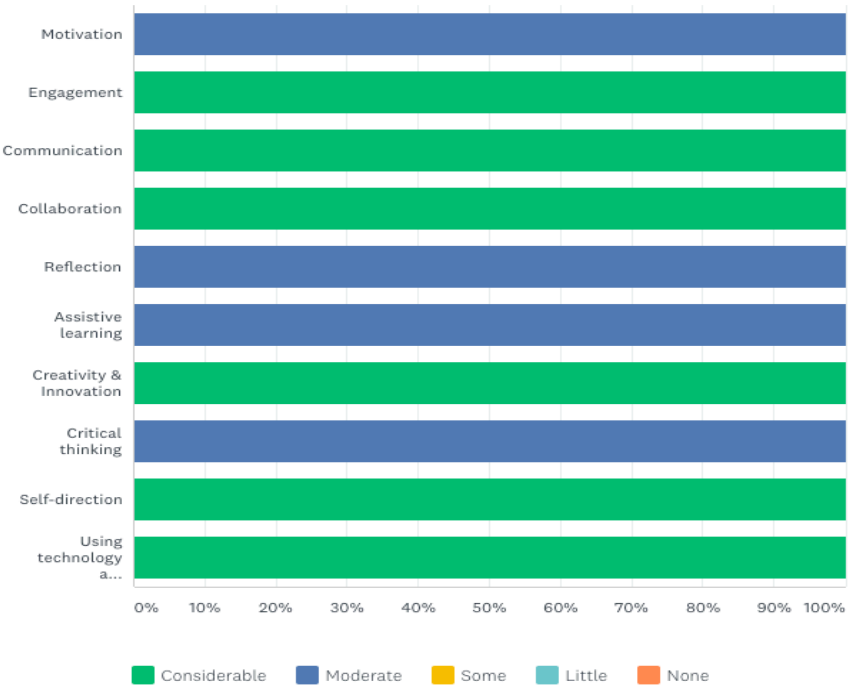


Figure 4-5: Case study 2 - Development of student key skills

4.7.2. Student survey data

The following section considers the analysis of student questionnaire responses pre and post intervention. A series of paired-samples t-tests were carried out to compare means in relation to confidence levels in motivation, engagement, collaboration, communication, reflection and technology. Results from these tests reveal increased levels across all of the tests, bar communication.

4.7.2.1. Class 3 (Teacher C) – Motivation

In this instance the researcher measured confidence levels in relation to Motivation (using iBooks Author), a calculated mean, from responses to online pre and post-test questions. Following initial normality testing, the pre-test data was associated with a confidence level (Mean (M) = 2.7778, Standard Deviation (SD) = .80845). By comparison, the post-test group was associated with a numerically larger (M = 3.8333, SD = .61835). The independent samples t-test was associated with a statistically significant effect, t (117) = -4.242, p = .001 (two-tailed). Whilst the post mean test was numerically larger, Cohens' *d* was also estimated at 1.466575 (large effect size). In this instance we can view an increase (-1.05556) in confidence levels as a result of the

intervention. The data presented below indicates that students in CS2 are more intrinsically motivated to learn as a consequence of the intervention.

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	18	2.7778	0.80845	18	0	-1.05556	1.46	.001
Post Test	18	3.8333	0.61835	18	0			

Table 4-14: Case study 2 - Pre & Post-test Motivation

4.7.2.2. Class 3 (Teacher C) – Engagement

In relation to Engagement, the data revealed that students have a higher mean from initial pre-testing (Mean (M) = 2.2125, Standard Deviation (SD) = .79586) in comparison to a numerically larger post-test scale (M = 2.4667, SD = .54438). Cohens' *d* was also estimated at 0.372829, which is deemed a small effect size based on Cohen (1992) guidelines. In this instance we can view an increase (-.25417) in confidence levels as a result of the intervention. A clear benefit of the intervention in relation to engagement is evident in this positive result indicated below.

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	20	2.2125	0.79586	20	0	-.25417	0.37	.111
Post Test	20	2.4667	0.54438	20	2			

Table 4-15: Case study 2 - Pre & Post-test Engagement

4.7.2.3. Class 3 (Teacher C) – Collaboration

The paired-sampled t test revealed that, for CS2 students, they are significantly collaborating more (M = 2.3100, SD = .69729) than in pre-test findings (Mean (M) = 1.8900, Standard Deviation (SD) = .48330). With the post mean was numerically larger, Cohens' *d* was also estimated at 0.70011 (Medium effect size). The intervention has, as the data suggests, encouraged students to collaborate more, as the increase in confidence levels reveal below (-.42000).

School	N	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	20	1.8900	0.48330	20	0	-.42000	0.70	.042
Post Test	20	2.3100	0.69729	20	1			

Table 4-16: Case study 2 - Pre & Post-test Collaboration

4.7.2.4. Class 3 (Teacher C) - Communication

The paired sample t-test unfortunately revealed no change in relation to means on communication (M) = 2.3750, Standard Deviation (SD) = .82118). Whilst not statistically significant (p = 1.000) and with a Cohen's d effect size = 0, as depicted below, the results were surprisingly unexpected, as previous comments from the teacher described 'communication' as a considerable key enhancement within the intervention.

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	20	2.3750	0.66639	20	0	.00000	0	1.000
Post Test	20	2.3750	0.82118	20	0			

Table 4-17: Case study 2 - Pre & Post-test Communication

4.7.2.5. Class 3 (Teacher C) – Reflection

Pre-test findings of the paired sample t-test in relation to reflection, revealed a confidence level (Mean (M) = 2.2164, Standard Deviation (SD) = .51116) in comparison to a higher post-test mean value (M = 2.3867, SD = .51195). With a Cohens' *d* estimated at 0.33, indicating a small effect size, the results further depict an increase (-.17032) in confidence levels as a result of the intervention, as detailed below. The findings in this instance echo earlier comments from the teacher, when referencing reflection as a key enhancement within the intervention.

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	19	2.2164	0.51116	19	0	-.17032	0.33	.247
Post Test	19	2.3867	0.51195	19	1			

Table 4-18: Case study 2 - Pre & Post-test Reflection

4.7.2.6. Class 3 (Teacher C) – Technology

Looking at the paired t-test in relation to technology, a comparison of the results reveal an increase in student confidence levels (-.10263). Whilst not statistically significant, the pre-test (Mean (M) = 2.1579, Standard Deviation (SD) = .9097) and post-test value (M = 2.2605, SD = .63477) suggest students became more comfortable in this instance as a result of the intervention. This result confirms earlier comments by the teacher in CS2.

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	19	2.1579	0.59097	19	0	-.10263	0.16	.550
Post Test	19	2.2605	0.63477	19	1			

Table 4-19: Case study 2 - Pre & Post-test Technology

4.7.3. Overview of results

Case study 2		Statistically significant	Mean value	Effect*
	Motivation	Yes	Increase	Large
	Engagement	No	Increase	Small
	Collaboration	Yes	Increase	Medium
	Communication	No	Same	None
	Reflection	No	Increase	Small
	Technology	No	Increase	None

Table 4-20: Case study 2 - Quantitative analysis summary

*The effect size affords us the opportunity to understand the magnitude of differences found, whereas the statistical significance examines whether our findings are more likely to be due to chance.

4.8. Qualitative Analysis – Interviews

The following section considers the analysis of Teacher C's responses to interview questions following the completion of each learning task/activity alongside student's responses from within a focus group meeting. In pinpointing, examining and recording patterns of meaning from the qualitative datasets, the adoption of a thematic analytical approach provided the researcher with a series of codes and the opportunity to identify a series of key recurrent themes.

4.8.1. Teachers Learning Activities

4.8.1.1. Task 1: Human health

On the topic on human health, Science Teacher C discussed inherited factors and genes and genetics with her students. Subsequently, she requested that each group choose one specific inherited condition, research this topic and present current literature and thinking within this domain. Whilst detailing causes and symptoms of the condition, students were further requested to clarify any progress scientists have made to date in treating the chosen condition. Teacher C believed that this learning task would meet specific key-skills to include technology, communication and research. The content gathered and created by each group would be combined to take the form of an interactive iBook using iBooks Author. Whilst highlighting the theme of engagement, Teacher C explains,

> *'…they have been very engaged. Anytime we use digital technology, it's like, the iPad trolley is the equivalent of when the teacher used to bring in the TV with the video player when I was in school.'*

Expanding upon this further, Teacher C suggests

> *'…I think that they had a bit of control over what they were researching as well, so having the digital technology engages them anyway. But this new kind of software (iBooks Author) they hadn't seen before. They were even more engaged.'*

Group sizes for Task 1 were relatively small as the students (n=2) were previously used to working with a lab partner only. While Teacher C did breakdown the task activities, students decided amongst themselves as to who would complete the various required actions, such as collecting images, researching and creating video content and text via Google Docs. The main concerns however for Teacher C became quickly evident

reflecting themes of lack of resources and technology issues. All of the class groups had access to only one Mac desktop in which to develop an iBook. Unfortunately, this did slow the process down quite significantly. A number of other technology issues were also highlighted, including the converting/porting of Google Doc text into the IBA application alongside access issues connecting the Mac desktop to students Google Drives. However, Teacher C suggested that these initial IT issues were also part of a learning process for the groups, as they successfully came to terms with a relatively new operating system (Mac OSX) and also specific features within iBooks Author application.

Teacher C confirmed that the current Junior Cycle curriculum relies heavily upon student research in the Science domain. Prior to the intervention, students would traditionally be tasked with completing a poster related to a specific subject matter. Teacher C suggested that the alternative development of amalgamated group content into a class interactive iBook, presented a very unique but challenging opportunity for her students. While the posters would simply gather dust at home, this new interactive iBook artefact she believed, was a reusable learning object (RLO), researched, compiled and developed by students, for students,

> *'…if everyone puts their thing into the one book, they get the benefit from the whole class research.'*

The researcher believes this idea maps perfectly to the identified sub theme of ownership. Following the initial increased level of engagement, Teacher C further confirmed an increase in other areas as a consequence of the task, including motivation and communication,

> *'…yes, increased definitely.'*

Collaboration and creativity were also touched upon as improved. In relation to her pedagogical approach in the classroom, Teacher C confirms

> *'…I suppose it kind of forces you to move away from the teaching at the board 'chalk and talk'.*

Discussing this change in approach while also reflecting the subtheme of mentoring, Teacher C further explains

'…yes, definitely. I was almost feeling guilty yesterday because I have them for a double, and I actually did have a lot to do then, the way I had set it up was that when a group of two was finished, they stayed on the computer and taught the next two, so I didn't even have to show them how to use the iBooks Author.'

Whilst highlighting the key themes of trust and ownership when replying to the question of changing dynamics within her classroom, Teacher C confirms,

'…I haven't thought about it. I suppose it has kind of been brought in. I have to trust them a lot more I think because …in terms of just managing classroom discipline you have much more control over it in a 'chalk and talk' situation. Whereas, when they have iPads and the whole internet to look at, they get a chance to chat with each other. It could go completely 'off the rails', looking up dodgy things and talking about things that are not 'on task'. I suppose I have had to trust them a lot more, than I normally would.'

Teacher C further suggests, that as a consequence of researching the task material whilst using their iPad, this has afforded students a unique opportunity to assimilate the material they have researched and created, more so than the traditional note taking method within a 'chalk and talk' class,

'…I think they will remember it because they had taken more control of it.'

As Teacher C was to further suggest, this type of learning approach lends itself perfectly with a key theme of content creation. When discussing the nature of the impending Task 2, the teacher suggested a change of focus, moving towards this type of approach, which she believes lends itself very well to both class activities and experiments. Even though a number of Transition year students who attended the initial CPD session presented by the researcher, were on hand to mentor Teacher C's students, they were not called upon as frequently as first anticipated due to the high level of IT competency demonstrated in the classroom. In this instance, Teacher C concluded that Task 1 was 'very beneficial' for students.

4.8.1.2. Task 2: Chemical reactions

Due to the afforded flexibility within the Junior Cycle Science curriculum, Teacher C arranged for her students to take a more creative role and develop some of their own

experiments whilst capturing these in an iBook format as part of Task 2. However, as the Science curriculum is not as explicit as previous iterations, there are both positive and negative connotations for teachers. For example, in Teacher C's case, one such learning outcome suggests 'students need to understand energy changes in a chemical reaction'. As such Teacher C gave her students a number of chemicals, in which each chemical would have four different reactions'. The intention in this instance was for students to measure each reactions' result while capturing this experiment in picture/video format, along with collating the relevant research material. Teacher C was keen to explore how successful this task would be, while also thinking long term in the context of her transition year students adopting this type of 'content creation' approach within the Science Department at a later date.

The aim of Task 2 was to encourage students to create and develop a reusable learning object. Teacher C admitted moving away from the traditional text books,

> *'…the new Junior Cycle has kind of forced that a bit'.*

Adopting the approach of students as content creators to develop curriculum material, for Teacher C is a very practical path to follow, in relation to the Science curriculum. While embedding the experiments in an iBook format has encouraged her students to think more deeply on '…how would I teach this experiment?' Thus, Teacher C believes affording students the ability to become much more, as the emerging subtheme suggests, become responsible for their own learning.

Levels of engagement, motivation and creativity were explored in discussions with Teacher C. In each case she noted continued success in these areas,

> *'…very motivated. This class are generally very motivated compared to the National average. They would be quite a motivated class anyway and technology definitely increase that as well.'*

While working in pairs, with one student performing the experiment and the second recording the event, Teacher C admits,

> *'…it did actually increase the engagement'.*

In describing levels of activity as very good, Teacher C however, further noted that this could have increased significantly, if it were not for the low level of resources available to students,

'…with that limitation it does limit their creativity',

as reflected in the theme of Technology.

However, Teacher C witnessed the students exploring and trying out different methods and widgets to present their material. When students discovered a new method or idea, they were subsequently keen to share this knowledge with their peers,

'…they will teach each other, '…look guys you can put this in'…and I'll be there trying to say, 'Can anybody tell me what you are doing?' I'm the last to know! That's only because they are mad keen to let each other know as to what's happening. They very quickly disseminate the information to each other'

During the researchers second interview with Teacher C, the Deputy Principal joined the conversation as she was keen to explore how the intervention was progressing within the school. At this point the Deputy Principal suggested that if the intervention was a success, that the school would be keen to explore and expand this approach with other classes in September 2019.

Describing her pedagogical approach within Task 2, Teacher C suggests

'…I think as you have said, I have gone to more of a kind of guiding than direct instruction'.

In conclusion, Teacher C whilst acknowledging the theme of changing pedagogical approach, also believes, that the most beneficial aspect of this particular task is such that students will now have a permanent record of their own work (RLO), which they can access at any time.

4.8.1.3. Task 3: Chemical bonding

For Task 3 the subject matter switched to Sciences ionic and covalent chemical bonding. In this instance Teacher C requested students build upon their earlier Task 1 and 2

creations and to add relevant iBooks Author widgets to explain the bonding process through various formats. Subsequently, students decided to add various multi-media effects and quizzes to their final artifact. Teacher C noted that all her female students spent quite a lot of time on the aesthetics of the completed artifact. With limited time and resources, Teacher C noted

> *'…time, yes, I think time was the main limiting factor, yes. They actually care so much about the task, they want it to look perfect, and especially once they know it's going to be presented to the class. They want it to be the best-looking piece of work they can present and that obviously requires time and they can be quite slow'.*

While Task 3 highlighted themes of time management and resources, Teacher C did however compliment as to the quality of the work of her students,

> *'…it was really good. Great work.'*

When asked if she had noticed any significant difference in students' approach between Task 1 and Task 3, Teacher C comments,

> *'…they are working better, yes and like they are even more familiar with the hardware and software app and everything. They have definitely become more confident and quicker with it.' When describing her own changing role from the initial Task 1 to Task 3, Teacher C comments '…I wasn't as much hands on as in Task 1 and it was more of a Time Manager, Project Manager'.*

When pressed further on this change, Teacher C elaborates by suggesting

> *'…no, it's good. Like when we (teachers) go to training and when we have inspections, they are looking for the role of the teacher to be less like teacher taught, they love that in an inspection!'.*

When asked how she perceives students overall thoughts on the intervention and using iBooks Author in particular, she confirms how in theory the students believed it was great, but a few steps did obstruct some students while developing their iBook (i.e.: Saving their book and publishing to their iPads).

When questioned on her thoughts related to technology use as a method of instruction, Teacher C highlighted its potential as a distraction. While the school has to some extent

limited the functionality of student iPads, however once accessibility is less restrictive, Teacher C suggests that the students will and have in the past, taken advantage of the situation. Underlying this subtheme of distraction Teacher C explains

> *'…if there is a chance for them to go onto a different website or start taking photos with the iPad camera, they will! So sometimes getting them to stay on task can be an issue'.*

With less restrictions applied and ensuring that the students were on task, Teacher C describes the output created

> *'…yes, it was actually good. Yes, yes, and even showing it to colleagues they were very impressed with it as it was of a good standard.'*

When further pressed on whether this type of learning approach and application meets any of the Junior Cycle key skills, Teacher C confirms,

> *'…oh definitely. Cause I was filling in the key skills, like for the Junior Cycle key skills I would say it covers about ½ of them. You asked me to fill in about 4 of them on the template, there was about 20 of them that I filled in. It covers so many of them, yes.'*

The researcher subsequently focused on Teacher C's thoughts on adopting a more student centred approach to learning. When asked to discuss the pros and cons, Teacher C clarifies the pros as

> *'…reduces the amount of Teacher talk time. They remember the material better. They are creating the material, think about it more. They are teaching it to each other, which means they will remember it better, rather than me just teaching it to them.'*

In contrast the cons are described as

> *'…while my work during the class time is less, it probably requires a little bit more thinking for class in how you are going to structure the groups, even how you are physically going to place them in the room and ensuring the apps we don't actually want them to be using are switched off, and those we do need are switched on…so there is a little bit more planning involved but during the lesson my work is less involved.'*

In conclusion, the researcher asked Teacher C for her opinion on iBooks Author and its ability as an instrument and pedagogical tool, to improve students learning. She responded by suggesting,

> *'…yes, when I get them to make the book, I get them to present to each other, and I think getting students to teach theory to each other is a real good way of getting them to learn it and to remember it better.'*

For the most part, videos and quizzes were the most popular widgets that students incorporated within their task artefacts.

4.8.2. Student Focus Group

For Case study 2 the researcher met with a focus group comprising a selection of Teacher C's students (n=6). The researcher was particularly interested in the feedback attained from this particular case, due to its unique status as a Private school. After formal introductions the researcher began the semi-structured interview by inviting the students to discuss what they had created and their initial thoughts when starting out with Task 1.

Two divergent and often conflicting discourses emerged. While previous comments from Teacher C suggested very positive outcomes to the intervention, students within the focus group offered very contrasting feedback. Firstly, students within the focus group were asked to describe their experience of Task 1. Whilst reflecting the theme of technology issues, Student 1 describes,

> *'…when everybody took out their iPad, like the first time, it was very relaxing, and it took a lot longer than it should have taken. And then making the book on the Mac desktop, I was actually gonna cry! It was so frustrating'.*

This first impression was reflected by similar comments from the remaining Focus group members. As Student 1 was to further explain,

> *'…it was like when you added a picture on the page, it kept on messing up. I mean a lot of our stuff got deleted, it was so bad! And afterwards it's like 'Yeah I've made this iBook', like I've learnt some stuff, but I could have just looked this up. I feel I just wasted my time'.*

In reflecting this theme and that of limited resources, and with so many groups vying to use the Mac desktop to import and develop their artefacts, frustration became very apparent. When asked to consider if the process became more effective, efficient and less frustrating as they completed further tasks, Student 3 was to further clarify,

> *'…the first time we did it definitely took a long time to do it, but the last time (Task 3) we did it quicker'.*

A related recurrent theme of time management was highlighted by Student 2 who describes how

> *'…some people are naturally slower at typing than others. It was just taking longer a lot longer. There were cool things as well that you could do. If you were doing a presentation it would be cool, because you could have quizzes and everything, but in general I think writing it down on a piece of paper, you get it in about 5 mins. But like if you are using the iPad it could take a few classes to do it'.*

Additional comments suggest positive affordances of the application and devices

> *'...it was like a lot of freedom there. I feel if you didn't have that like was one of the positive aspects of it, you could put in a quiz or pictures or videos''.*

While all of the focus group members agreed that the application was an excellent tool to develop and present content, their main concern however was that they believed they could mirror this process in a quicker fashion if completed by hand. Student 3 comments

> *'…I just prefer to do it on paper. I don't think it's something you should be doing all the time. I think it's a lot more challenging than doing it on paper'.*

Student 4 was to highlight

> *'…we have so many other classes and subjects it would be easier on paper'.*

The researcher believes these comments are primarily linked to initial student frustrations with the application, lack of ICT resources and the intervention timing, as highlighted within their related themes. Following such comments, the researcher

believes it is questionable if the intervention had complete student 'buy in', due partially to the fact that group artefacts were not assessed by Teacher C.

Whilst reflecting previous comments by Teacher C and in the context of a reusable learning object adopted as a revision tool, Student 1 suggests that such an artefact could potentially become a distraction. As she explains

> *'…If I was revising, I would just use my phone or an iPad and then if I get any sort of notification it would just distract me so much. I feel I will just get reassessed because you can't use a screen before bed'.*

In conclusion, while students were quite vocal in relation to their initial frustration in the early days of the intervention, when asked if they had access to more Mac desktops, would this have made a significant difference? They all replied with a resounding 'Yes'.

4.9. Summary

The initial quantitative analysis from Teacher C's survey responses suggest students, as a consequence of the intervention, have an improved understanding of the course material complimented by higher levels of motivation. Whilst reaffirming Teacher C's comments, the student data clearly provides statistical significance in both Motivation and Collaboration whilst furthermore illustrating an increase in confidence levels across most of the key skills measured.

Interview data has further revealed a students' sense of ownership, trust and responsibility of their own learning during the intervention process. In contrast, analysis from the focus group meeting reveals some interesting and conflicting perspectives. While Teacher C's comments suggest an increase across a number of key-skills, student comments in contrast suggest the intervention tasks were initially both time-consuming and frustrating. Whilst furthermore advocating that the artefact and technology (iPad), per say, could potentially become a distraction. Teacher C confirmed that her role as teacher had significantly changed as a result of her adopting a more student-centred approach to learning. Furthermore, she confirmed that as a consequence of this intervention, her school in September 2019 would encompass a more student-centred approach to learning within a number of their classes. In conclusion, Case Study 2 has clearly demonstrated an increase in confidence levels across most key-skills as a consequence of the intervention.

4.10. Case Study 3 – Data Analysis Findings

4.10.1. Background

Case Study 3 post-primary school is a mixed co-educational, multi-denominational community school located in East of the Republic of Ireland. Currently the school has over 1000 students enrolled. In early November 2018, the researcher met with two female Science teachers (Teacher D and E) who agreed to take part in the research study. Teacher D's class were comprised of 2nd year students (n=20), while Teacher E's class were 1st year students (n=22). Teacher D was relatively new to teaching and Teacher E was a senior teacher. In total (n=20) students from Teacher D 's class completed a pre-test survey, with a total of (n=16) completing the post-test survey. In Teacher E 's class a total of (n=22) students completed a pre-test survey, with a total of (n=20) completing the post-test survey. In both cases a number of students (n=6) were unable to complete the post-test due to various reasons.

By mid-November the researcher met with both teachers and (n=8) students, four from each class, who would act as mentors for some initial CPD on using the Mac OS desktop and iBooks Author application. In this instance, Teacher D's class had access to a Mac iBook laptop provided by the researcher for the duration of the intervention, while Teacher E's class had access to an older Mac OS desktop. As in the previous studies both classes would create and collect various resources via their individual school iPads and transfer this material to the Mac OS desktop via Airdrop. In both instances, following the CPD, teachers and students were requested to complete a pre-test online survey. Following the completion of each of three tasks the researcher arranged to meet with both teachers, discuss their thoughts on the process and tasks and highlight any subsequent observations on students' performance.

Reflecting the process adopted in both Case Study 1 and 2, the researcher collected quantitative data from both pre and post-test online surveys. The researcher firstly accessed the normality of the quantitative data and subsequently employed a Paired-sample t-test and finally calculated the Cohen's *d* effect size of both pre and post data. Qualitative data was measured in the form of interviews with Teachers D and E. Subsequent interviews with both student focus groups from each class followed, a total of (n=10) students attended. The data collected was collated to expand on the initial survey data. In this instance, a total of six teacher interviews were conducted, recorded

and transcribed verbatim. As in previous studies, the transcriptions from each interview were imported into NVivo for analysis.

4.11. Quantitative Analysis

4.11.1. Teacher survey data

The following section considers the analysis of Teacher D & E questionnaire responses pre and post intervention. In November 2018 teachers Teacher D and E from Case Study 3 (CS3) completed an online pre-test survey prior to the intervention. Initial pre-test responses from both teachers indicated their awareness and support of varied technology adoption, which previously had been very effective. In both instances their students' had used iPads in the classrooms for research purposes, accessing interactive online applications and completion of online quizzes. Both teachers had used access to eBooks effectively in their classes, however, neither of the teachers had used or were familiar with using iBooks Author. With both teachers suggesting considerable interest in using the application to develop their own interactive content, Teacher D believed her student's would be very motivated using iBA, while Teacher E suggested her student's would find it moderately motivating.

The post-test analysis confirmed that both teachers believed the adoption of iBooks was somewhat effective. Both educators agreed that Pop-Overs, Embedded videos and Audio clips were the most helpful interactive elements within the artifacts created. Interestingly, both teachers ranked the iBook in equal standing as a textbook (100%), with both PowerPoint and Search engines featured lower in usefulness (50%). Teacher D strongly agreed that iBooks are an invaluable instructional tool, while her colleague responded a neutral response. A similar response by both was reflected in the answer to iBooks improving their students understanding of the course. However, both teachers agreed that as a consequence of the intervention, student's motivation in both instances had significantly improved. When asked to measure the development of student key-skills as a consequence of the intervention, Teacher D & E both agreed that Self-direction was considerably enhanced, with Teacher D further suggesting that her students' key-skills had been particularly enhanced in the key areas of engagement, creativity and using technology, as detailed below.

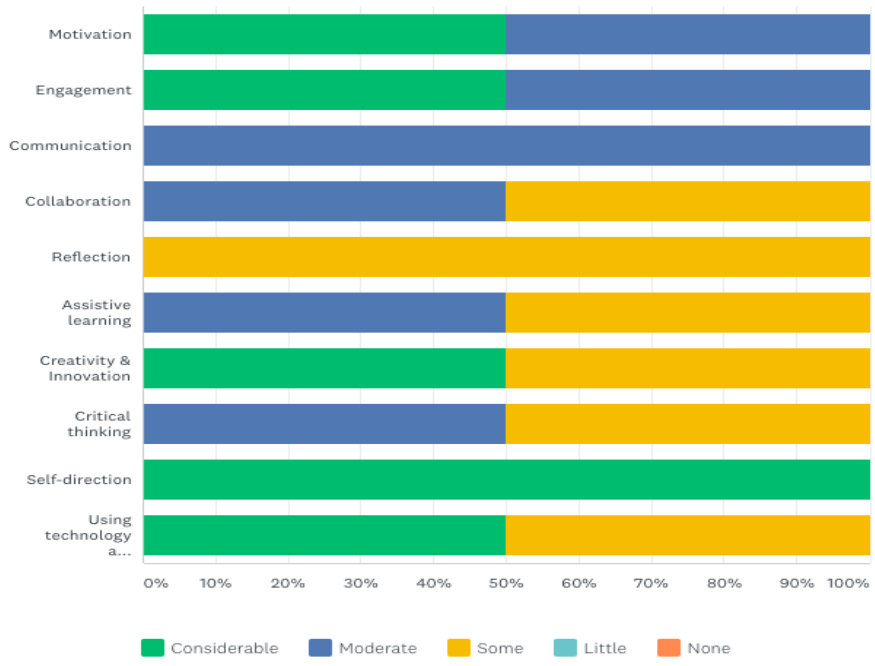


Figure 4-6: Case study 3 - Development of student key skills

4.11.2. Student survey data

The following section considers the analysis of student questionnaire responses pre and post intervention within CS3.

4.11.2.1. Motivation

Following initial normality testing, the paired sample t-test revealed a significant change with pre-test data associated with a confidence level (Mean (M) = 2.2647, Standard Deviation (SD) = 1.05339.). By comparison, the post-test group was associated with a numerically larger (M = 2.7647, SD = .88963), Cohens' *d* was also estimated at 0.512845 (Medium effect size). This statistically significant result clearly indicates increased student motivation as a result of the intervention (-.50000) and further reaffirm results provided by both teachers.

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	34	2.2647	1.05339	34	0	-.50000	0.51	.045
Post Test	34	2.7647	.88963	34	4			

Table 4-21: Case study 3 - Pre & Post-test Motivation

4.11.2.2. Engagement

In contrast, the paired sample t-test related to engagement, provided pre-test data associated with a confidence level (Mean (M) = 2.3401, Standard Deviation (SD) = .84674), in comparison to the post-test group was associated with a numerically smaller (M = 2.3378, SD = .67756). Whilst not statistically significant and with a Cohens' *d* estimated at 0.002999 (no effect size), the decrease (.00225) in confidence levels as a result of the intervention are somewhat surprising, particularly following the positive feedback attained from both teachers in relation to their perception of student engagement.

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	37	2.3401	.84674	37	1	.00225	0.00	.985
Post Test	37	2.3378	.67756	37	0			

Table 4-22: Case study 3 - Pre & Post-test Engagement

4.11.2.3. Collaboration

Pre-test data from the paired sample t-test was associated with a confidence level (Mean (M) = 1.9889, Standard Deviation (SD) = .67772), compared to a statistically significant and numerically larger post-test result (M = 2.2222, SD = .65164). Cohens' *d* was also estimated at 0.35 (small effect size), based on Cohen (1992) guidelines. In this instance we can view an increase (-.23333) in confidence levels as a result of the intervention, reaffirming earlier teacher data in relation to student collaboration within their classrooms, as depicted below.

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	36	1.9889	.67772	36	0	-.23333	0.35	.033
Post Test	36	2.2222	.65164	36	0			

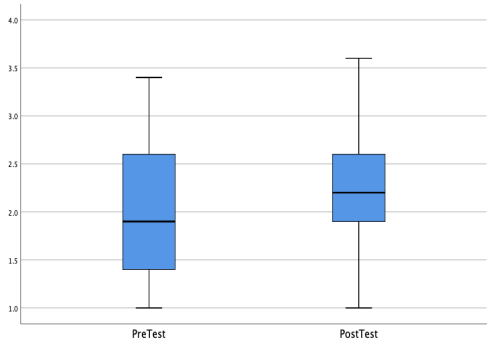


Table 4-23: Case study 3 - Pre & Post-test Collaboration

4.11.2.4. Communication

Confidence levels in relation to communication, whilst not statistically significant, improved from the initial pre-test value (Mean (M) = 2.4527, Standard Deviation (SD) = .95895) to a numerically larger post-test result (M = 2.4887, SD = .83891). With a Cohens' *d* test estimated at 0.03 (No effect size), we can view an increase (-.03604) in confidence levels as a result of the intervention.

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	37	2.4527	.95895	37	0	-.03604	0.03	.808
Post Test	37	2.4887	.83891	37	2			

Table 4-24: Case study 3 - Pre & Post-test Communication

4.11.2.5. Technology

With an initial pre-test result (Mean (M) = 2.2324, Standard Deviation (SD) = .72036) compared with a numerically smaller (M = 2.2216, SD = .63558), clearly indicates a loss in confidence, likely related to on-going ICT issues during the intervention. Whilst the paired sample t-test was not associated with a statistically significant effect, t (36) = .095, p = .925 (two-tailed), the post mean test was numerically smaller, with a Cohens' *d* estimated at 0.015899 (No effect size). In this instance we can view a decrease (.01081) in confidence levels as a result of the intervention.

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	37	2.2324	.72036	37	0	.01081	0.01	.925
Post Test	37	2.2216	.63558	37	1			

Table 4-25: Case study 3 - Pre & Post-test Technology

4.11.2.6. Reflection

Similar to evidence related to engagement and technology, the confidence levels for reflection reveal a lower result at pre-test (Mean (M) = 2.3500, Standard Deviation (SD) = .71986) compared with to a slightly numerically smaller post-test (M = 2.3367, SD = .64631) . Whilst not associated with a statistically significant effect, t (36) = .172, p = .864 (two-tailed), we can view a decrease (.01829) in confidence levels. Whilst reflecting feedback from both teachers in relation to limited development in reflection, this outcome could potentially be linked to ICT issues experienced during the intervention.

School	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	37	2.3550	.71986	37	1	.01829	0.02	.864
Post Test	37	2.3367	.64631	37	2			

Table 4-26: Case study 3 - Pre & Post-test Reflection

4.11.3. Overview of results

Case study 3		Statistically significant	Mean value	Effect*
	Motivation	Yes	Increase	Medium
	Engagement	No	Decrease	None
	Collaboration	Yes	Increase	Small
	Communication	No	Increase	None
	Technology	No	Decrease	None
	Reflection	No	Decrease	Small

Table 4-27: Case study 3 - Quantitative analysis summary

4.12. Qualitative Analysis – Interviews

4.12.1. Teachers learning activities

In this instance Teacher D requested her class of 2nd year students to describe the structure of the digestive system and its related functions. Students were requested to provide examples of diseases and disorders that affect the functioning of the digestive system, and to finally design and carry out a physical stimulation of the digestive system through an investigation. Teacher D believed that this learning task would meet specific key-skills including communication, collaboration and managing information and thinking:

- Communication - Interacting with other students through various processes such as dividing work up equally in the group for research/ video recording one another/ carrying out investigations.
- Working with Others – group work is essential in this task. Students will co-operate with one another and respect each-others work.
- Managing information & Thinking - students will learn specific ICT skills and how to use the iBook app correctly to compile information to be used during class.

The content gathered and created by each group would be combined to take the form of one interactive iBook using iBooks Author. A total of (n=6) groups took part in Task 1, one group of two and five groups of four students. Individual groups were given separate topics to cover.

In highlighting the key theme of Engagement, Teacher D commented,

> *'…I think maybe some more than others, because I gave some people a topic of these experiments and I want you to do the practical side of things. They were probably more engaged because they asked me if they could repeat the experiments and they did. They had already done it before but they wanted to do it again. I let them off and said ok here's your equipment and they sorted themselves out. Whereas others, if they were doing like the questions at the end, there was only so many questions, and by the time the laptop got around to them at the end they had four classes were they weren't actually on the laptop.'*

Limited engagement in this instance can potentially be connected to the unfortunate limited class resources available. Subsequently, the initial task furthermore highlighted key themes of Time Management and Research skills. When asked to clarify what worked particularly well during this task, Teacher D concluded

'…they were implementing their research, so that was really good and that they were being practical.'

In contrast, timing and organision of the task was at the forefront of Teacher D's mind,

'…I suppose the timing, like I always had to have, like we were doing exam papers and questions, there was like, I always made it very clear to them, if you are not doing this you need to be doing this. If you weren't doing something on the project you were answering questions. So, we had to be a bit more organised that way.'

With limited resources, both timing and organisation were key elements for Teacher D to a successful implementation of the intervention. Reflecting the theme of change in Pedagogical practice, Teacher D evaluated her changing role as a facilitator,

'…yes, I suppose I kind of, yes I did, it wasn't like me in the class it was all about them, kind of doing the work and doing the research. I could only go around and really help them with the ICT things, that's all I really did. I didn't help them in any form of content or anything like that, they did all that research themselves.'

When further questioned on adopting a more student-centred approach, Teacher D confirmed,

'…a lot of our classes are not really teacher led. I suppose with science its very much inquiry based. So, we would be doing a lot of practical work anyway, so there is less input from me. I would only spend 10-15 minutes actual teaching before they do the main activity and then go back to me.'

When asked to describe initial student feedback to Task 1, Teacher D replied by suggesting,

'…yeah, I actually think they enjoyed it, like the ones who made the videos, they were doing the videos and retaking them – 'let's do it again', they wanted to make sure that it was good. Like as I said some groups had like a more practical role, like maybe better topics than other groups, but like these ones who did the keywords, like they found this website about Acids and bases and put the link in

there. They made up these questions and then the answers, that was good for them.'

In relation to students confidence using the technology, Teacher D suggested that some students had struggled with using simple features that are different when using a Mac. These initial issues were however very quickly overcome, with students becoming more competent and quicker as they progressed with the task. In hindsight, she believed that extra knowledge at the beginning would, as she suggests, make it potentially easier and quicker. As a consequence of Task 1, Teacher D confirmed that she would be formally assessing her students on their completed work and presentation to their peers. Furthermore, she confirmed that the task would also act as a revision tool as this particular topic within Acids and Bases would be part of their impending exam.

In contrast, Teacher E requested her 1st year students in Task 1 to develop their own unique iBook to teach the following phenomena to their peers; The origins of the Universe, Black Holes, Stars, Planets, Galaxies and moons. While working in six groups of (n=4) students, Teacher E believes this task would afford her students will learn each of the defined Junior Cycle key skills. Teacher E defined her role in this task as ensuring that all students were fully on task. Upon completion, students would study the iBooks created and peer review other group artefacts. Following on, all of her students would be assessed using formative assessment and also a class test.

From the outset Teacher E had great expectations following the CPD session presented by the researcher just a few days earlier. She had confidence in her students, who, prior to the intervention were actively recording experiments using their mobile phones and iPads (for fun),

'…they would have been a class that would have used a lot of videos, did voice overs, commented on things they had seen on YouTube so I imagined this would have been right up their street or alley'.

As Teacher E further explains,

'…I gave them free reign, I didn't say it would have to be in this format or that, but I did say to them they were going to have two weeks to do the research'.

However, the result for Teacher E was as she describes, ‘somewhat disappointing’. Highlighting the themes of scaffolding and engagement, Teacher E describes how after two weeks she was presented with PowerPoint presentations and a few Kahoots (game based classroom response system). When asked why the content presented by students was in her words ‘basic’, Teacher E replied,

> *‘…I don’t know if they were being lazy. It’s probably the first time they have been given so much time. So, it could have been the topic.’*

When asked about their engagement during the task, Teacher E replied

> *‘I think when I set it originally going through creating a book I kind of ‘bigged it up’, that this book was going to be used in future classes to teach this topic and that was my hope and I had selected them because of the way they were very much into the inquiry based learning. They seemed to be really enthusiastic about it. They all wanted to go on the training (CPD). But I don’t know, when it actually came to it, if they were able to kind of pull it together or were they just writing down the first thing they happen to Google to be honest with you.’*

The researcher believes that in this particular instance, due to limited scaffolding/direction and subsequent low engagement, the students with ‘free reign’ had unfortunately decided upon adopting the easy option requiring little input.

Subsequently, while reflecting the theme of changing pedagogical practice and scaffolding, Teacher E was to admit,

> *‘…well, my teaching style with this project was really just to facilitate learning. I was just the facilitator. Going around checking everybody was on task and really just trying to encourage them to use the information that was out there. But I probably didn’t give as much direction as I would usually, like in the past had they have been doing a project, let’s say they had of been doing a project on diseases of the digestive system they would probably see a rubric of how it was going to be graded. So many marks for using a diagram, so many marks for including something, so maybe it wasn’t clear enough for them.’*

Once again the role as facilitator presents itself, reflecting the theme and comments of previous teachers. More importantly, for Teacher E, the lesson learned in this example was the need for scaffolding and direction of the students to ensure they were on task.

Initially deflated, Teacher E advised,

> *'…I'm not overly enthused with the product (iBA), I feel like it was a lot of time and they …..they just didn't use the widgets they had been shown to use and they didn't use the functionalities the could have.'*

The interview subsequently moved onto the challenges that some students faced as part of completing the task as highlighted in the recurrent theme of lack of resources . As detailed earlier, the Mac desktop available to the class was an older version which unfortunately did not afford the students the 'quick and effective' way of transferring materials between the desktop and their iPads and vice-versa using Airdrop (Bluetooth technology). Regrettably, students were rather forced to email materials to and from devices (with internal restrictions in place). The researcher subsequently offered to return to the classroom at a later date to discuss these issues with the teacher and students and to investigate a possible work-around in relation to current restrictions enforced. Teacher E pointed out to the researcher, that it was unfortunate that the desktop was not portable as she could have taken it home to 'work it out' for herself. In response to the initial offer, Teacher E confirmed,

> *'…I feel I need a another run through it myself!'.*

The researcher advised Teacher E not to get too disheartened by what had happened, Teacher E responded,

> *'…no, I'm not, it's just, the kids are flying through the work, it's not that its keeping me back or whatever, I'm worried that they are held back. I think I probably need to show them a few other ones (iBooks) from other places, we probably need to spend time on that.'*

Following the completion in class on the topic of Acids and Bases, the students from Teacher D's class were tasked with creating an iBook on said topic, highlighting key specific areas of interest. The students were firstly asked to develop a mind map for inclusion within the iBook. Each group were given different sections to complete. Whilst

developing this iBook, Teacher D envisaged students demonstrating their understanding of the task via the inclusion of video content and assessment questions. While students developed content, Teacher D spent time rotating with each group, to help with any data input issues and to answer any subsequent queries.

Students were afforded up to seven, one hour class periods to complete the task. Furthermore, Teacher D believed that the key skills the students would learn would include, Communication, Working with Others (Collaboration) and lastly Managing Information and Thinking.

For Task 2, Teacher E requested her students to highlight the digestive system, with each class group creating an individual interactive iBook. When questioned as to whether she could see the benefit of applying this type of project/task, Teacher E responded by highlighting the recurring themes of Time Management and Creativity,

> *'…I see the benefit of it, but I think you would probably have to start from September to run it and be chipping away at it. You probably would have a task, we had buy in at the start. But the fact that we couldn't get them to bring it home to show. The last time we were making a video, it was interesting to see if we just let them off, then they would go off and do a PowerPoint. Then after this, after creating a video, two students had created puppets to talk about the digestive system, they were fabulous.'*

Whilst highlighting the limited time-scale involved, Teacher E was to further discuss the theme of limited resources and its general impact,

> *'…I think that was the frustration when we kinda talked about it before we started, I was imagining the kids coming in …and I was coming down to the Principal and begging him to buy (a number of Mac Desktops). We Airdrop all the time, they are not use to emailing, they got frustrated. Their impression of this was that it was more time consuming'.*

However, in both cases Teacher D & E were generally happy with the progress of their students.

For Task 3, Teacher D's students were tasked to create an iBook on the structure of the classroom based assessments. In this particular instance the students were tasked with outlining the layout of how classroom based assessments work, provide tips and hints for drawing graphs and recording results, and finally design and carry out independent investigations. Unfortunately, once all of the groups had amalgamated their content into one specific iBook, it wasn't possible to share the completed work on everybody's iPad as intended due to the nature of the completed file sizes. In similar circumstances to her colleague Teacher E, both Teacher D and the students were disappointed and frustrated at being unable to share and distribute the completed content to their individual devices. This issue highlighted the theme of ICT issues, possibly due to a restrictive Wi-Fi infrastructure within the school but also related to capacity and linkage between the devices. Subsequently, discussions between the researcher and both teachers moved on towards their overall thoughts on the intervention and discussions around any perceived impacts for both the teachers and their students.

When asked if they could envisage benefits of adopting this type of approach to learning, Teacher D responded,

> *'…they really enjoyed their time in class, to create those things and really enjoyed going out to the hall and doing the videos, like they really did enjoy that. I kind of feel now that mine on the topic of Acids and Bases, like they know it! They know it!'.*

The comments reflect the theme of deeper learning attained by the students as a consequence of developing the artefact. Unfortunately, for Teacher D, she did miss a number of classes with her students due to Bank Holidays. This did have an impact on timing allocated to complete the various tasks. It was at this point that Teacher D suggested that this type of project and approach was she believed, very appropriate for a Transition Year group of students.

When questioned further as to if she believed iBooks Author was a purposeful learning tool, Teacher D replied in a positive manner. In highlighting a key theme of creativity, she believed,

> *'…it was very positive. It was great to see them doing like, they were very creative. They were using their imagination. They were going to do things in their own way in their own groups. Every group had something different to offer,*

whether it was going out to the hall and doing their video through experiments or whatever, like that process was really good.'

While commenting on the key theme of key-skills Teacher D clarified how the learning tasks developed had met some of the required skills,

'…yes, it did. Like it is a really really good idea, they are all busy they are all working together, they are all sharing things. They got all the information themselves'.

In light of some of the previous mentioned issues related to ICT, the teacher was asked to highlight her concerns in this area. Touching upon her overall thoughts on a more student-centred approach to learning, Teacher D reaffirmed earlier comments that her style was less on chalk and talk and more pro-active with student projects and investigations. Teacher D further advised that the culture of the Case Study 3 school,

'…is very different from most schools, it's the culture of the school. We have full free reign in the classroom'.

In conclusion, Teacher D while highlighting the recurring themes of time constraints due to minimal resources, suggests that she would be keen do repeat this type of approach again 'as an assessment'.

Reflecting earlier comments by her colleague, Teacher E was to note that

'…they definitely did enjoy it'.

Subsequently, when asked to clarify if she believed the tasks within the intervention met any of the key skills required by students, Teacher E responded,

'…yes. They were using their imaginations, being creative and all that'.

In responding to concerns with using technology within the class, she replied

'…no, like our students are using it in every class, they are using their iPads and are well able to show us how they do it! I think they were probably playing it safe

as well as doing things they were used to doing as we all do. If we were more familiar with it we could push them more to use it really effectively. I don't know how to use it.'

In conclusion Teacher E was very complimentary in relation to the intervention and its future possibilities,

'…for me sending them off to work…and for them to come back and produce the stuff they did produce with very little guidance it was amazing to see and for them as I said earlier using a puppet, someone videoing someone else and two lads had this torso and they had hearts made that were doing all the talking. They can be very creative in the right forum and this is definitely the forum for it. The unfortunate thing was getting what they had on their iPad onto the Mac desktop and then onto the book was the frustrating thing for me'.

However, what did strike a note with Teacher E was the ability of this type of approach and learning tool to engage students who typically would remain 'under the radar' within a classroom. As Teacher E describes,

'…and to be fair, you know what, the really weaker kids that I would have in here, really did very well. There is a couple of little kids I would have, who would be just under the radar. They wouldn't be scoring very high. The minute you said to them go off…and you could see….and I was standing here one day listening to this conversation and he could see I was listening to him, and we give out certs for kids and he would have got one of my certs, probably not get one anywhere else. With this he had the forum to show what he was good at, maybe not all the scientific knowledge correct but he was going to get it (a certificate) because he was making a good video and he was great. And when they were doing this he would have all the gear on him ready to go…he stood out to me as the one as I seen a different side to him completely'.

In highlighting key themes of deeper learning and research skills, Teacher D suggests,

'…students have a greater understanding of curriculum content and achieved learning intentions. Students have improved co-operation and research skills. Students have improved skills of managing their time and creative thinking. Students have improved ICT skills.'

As a result, the roles of both teachers had also subsequently changed,

> *'…I acted as a facilitator and there was very little teacher talk within the classroom. This gave the students more responsibility over their class time.'*

While both teachers agreed that this new approach has been advantageous for both them and their students, they do however suggest,

> *'…it is important to circulate the class and ensure to work with students who are unable to work independently and could be off task.'*

In both cases the key aspects that were highlighted as being of most benefit to the students, were in relation to key themes of enhanced creativity, independent learning and attainment of enhanced research skills. As a consequence of the researchers intervention, the Case Study 3 school are optimistic to develop upon their experiences with a new cohort of students in September 2019. However this is very dependent upon acquiring the necessary ICT framework and resources in place.

4.12.2. Focus Groups

The researcher met with individual class focus groups after they completed a post-test survey in relation to their thoughts on the intervention. For the most part each group had created interactive iBookk'ss as revision tools around content that would likely appear within a forthcoming exam. Describing the process Student 1 comments

> *'…for revision, it was easier to break down the notes, so that you could understand each note, put it in your own words.'*

In both instances group members decided amongst themselves as to who was responsible for which activity. Following the collation of various resources, a group decision was also made in relation to the format of their developed iBook.

In highlighting key themes of ICT issues and limited resources, feedback from both groups confirm the biggest issue was related to the transfer of materials to and from the Mac desktop via Airdrop, Student 3 suggests

'…I just think it was the time that it took. We thought we could Airdrop things but it was hard'.

To resolve this issue the students emailed content to each other and collected this via a browser on the mac desktop. However, when questioned on the experience, both groups were complimentary, Student 4 comments

'…different, it was good. It was a learning experience'.

Whilst discussing the creation of iBooks and the integration of various widgets, students endorsed the embedding of multi-media content and also in particular the Quiz widgets,

'…they were good. We thought it would actually be fun to do the quizzes as well at the end of each chapter.'

As commented earlier by both teachers, the student classes were experienced in an 'active' inquiry-based learning approach to learning, as Student 1 suggests when describing the intervention,

'…not a unique experience but a very positive one.'

Whilst highlighting the theme of collaboration, it was also evident from the responses that both groups had enjoyed the opportunity to work in a collaborative fashion with their peers. Whilst reflecting earlier comments by teachers in relation to the development of reusable learning objects, both focus groups were in agreement that the development of this type of artefact would

'…be good for this time of year, for revision, for exams. An easy revision guide.'

As one group member suggested,

'…when you were going back to revise it was easier, to learn them'.

4.13. Summary

The initial quantitative analysis from survey responses of both teachers, suggest that as a consequence of the intervention, their student's motivation has significantly improved

within the classroom. Whilst reaffirming these comments, the student data clearly provides statistical significance in both motivation and also collaboration whilst furthermore illustrating an increase in confidence levels in both alongside that of communication. This case study in particular has highlighted the key themes of time management, limited resources and related ICT issues. These issues have been reflected in both teacher and student interviews and furthermore in decreased confidence levels in engagement, technology and reflection. The contrasting interview data moreover suggests that students were creative and ultimately took ownership of their own learning as a consequence of the intervention. Furthermore, the teachers reaffirmed that their students were afforded a unique opportunity to collaborate and design their own unique lesson.

4.14. Cross Case analysis

4.14.1. Introduction

The following chapter identifies and reviews the commonalities and characteristics across each of the three case reports within the researchers' intervention. Following overall quantitative analysis of teacher survey data discussed earlier in this chapter, similar analysis of cross-case student data is presented. As detailed in the previous chapter, data was generated from student feedback using validated data instruments, both pre and post-test online surveys. Each case was explored and investigated for possible linkages between each of these previously discussed characteristic affordances of mobile learning (Motivation, Engagement, Communication, Collaboration, Reflection, Assistive learning) to the specific key skills in the context of the new Junior Cycle educational framework in Ireland. Following the adoption of a thematic analytical approach and as reflected in the presentation of individual case studies, seven key themes and eighteen relevant sub-themes emerged from the qualitative data derived from practitioner and focus group interviews across each of the case studies. These significant themes and related sub-themes provide a unique opportunity for the researcher to identify the commonalities and differences across the cases and fundamentally present an overall synthesis of the intervention.

4.14.2. Quantitative Results

In adopting a statistical analytical tool, such as SPSS, the researcher employed a Paired-sample t-test to analyse and compare the confidence levels in both pre and post-test survey responses from students. In each instance the effect size, Cohen's *d* (Cohen,

1992) was additionally calculated for each key-skill measured. One key commonality across all three cases, and the most important relevant finding to emerge from the data was a statistically significant increase in *Motivation* for all students who participated within the intervention.

Motivation	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	39	2.2051	0.89382	39	0	-0.74359	0.73***	0.001
Post Test	39	2.9487	1.1227	39	0			
Engagement	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	39	2.1474	0.66816	39	0	-0.03205	0.04*	0.767
Post Test	39	2.1795	0.71008	39	7			
Collaboration	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	39	2.0115	0.62592	39	3	0.037	0.06*	0.68
Post Test	39	1.9744	0.64266	39	0			
Communication	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	39	2.5385	0.9451	39	1	0.4359	0.45**	0.002
Post Test	39	2.1026	0.99035	39	6			
Technology	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	39	1.9897	0.64228	39	0	0.23077	0.38**	0.029
Post Test	39	1.759	0.55475	39	0			
Reflection	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	39	2.0573	0.66664	39	1	0.03704	0.06**	0.717
Post Test	39	2.0203	0.5365	39	1			

Table 4-28: Case Study 1 - Quantitative analysis overview

* No effect, ** Small effect, *** Medium effect, **** Large effect.

Motivation	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	18	2.7778	0.80845	18	0	-1.05556	1.46****	0.001
Post Test	18	3.8333	0.61835	18	0			
Engagement	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	20	2.2125	0.79586	20	0	-0.25417	0.37**	0.111
Post Test	20	2.4667	0.54438	20	2			
Collaboration	**N**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	20	1.89	0.4833	20	0	-0.42	0.7***	0.042
Post Test	20	2.31	0.69729	20	1			
Communication	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	20	2.375	0.66639	20	0	0	0*	1
Post Test	20	2.375	0.82118	20	0			
Reflection	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	19	2.2164	0.51116	19	0	-0.17032	0.33**	0.247
Post Test	19	2.3867	0.51195	19	1			
Technology	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	19	2.1579	0.59097	19	0	-0.10263	0.16*	0.55
Post Test	19	2.2605	0.63477	19	1			

Table 4-29: Case Study 2 - Quantitative analysis overview

* No effect, ** Small effect, *** Medium effect, **** Large effect.

Motivation	n	Mean	Std. Dev	Valid	Missing	Mean Difference	Cohen's d	p value
Pre Test	34	2.2647	1.05339	34	0	-0.5	0.51***	0.045
Post Test	34	2.7647	0.88963	34	4			
Engagement	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	37	2.3401	0.84674	37	1	0.00225	0*	0.985
Post Test	37	2.3378	0.67756	37	0			
Collaboration	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	36	1.9889	0.67772	36	0	-0.23333	0.35**	0.033
Post Test	36	2.2222	0.65164	36	0			
Communication	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	37	2.4527	0.95895	37	0	-0.03604	0.03*	0.808
Post Test	37	2.4887	0.83891	37	2			
Technology	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	37	2.2324	0.72036	37	0	0.01081	0.01*	0.925
Post Test	37	2.2216	0.63558	37	1			
Reflection	**n**	**Mean**	**Std. Dev**	**Valid**	**Missing**	**Mean Difference**	**Cohen's d**	**p value**
Pre Test	37	2.355	0.71986	37	1	0.01829	0.02**	0.864
Post Test	37	2.3367	0.64631	37	2			

Table 4-30: Case Study 3 - Quantitative analysis overview

* No effect, ** Small effect, *** Medium effect, **** Large effect

It is interesting to note from the above datasets, that while revealing a slight decrease in confidence levels in one occasion for each measurement across all three cases, the findings do not wholly reflect the very positive reflections attained from the majority of interviews with all key stakeholders within the intervention. It is difficult for the researcher to explain this inconsistency, but it potentially may be related to a number of factors. A possible explanation for these results may lie in interference of frustration with ICT issues/experience.

- ***Collaboration***
  In relation to Collaboration, whilst CS1 revealed a slight decrease (.03718) in students confidence levels in this area both CS2 and CS3 suggest a small to medium increase (-.42000, -.23333) respectively.
- ***Communication***
  Confidence levels in Communication while decreasing (.43590) in CS1, remained the same in CS2 with a slight increase (-.03604) in CS3.
- ***Engagement***
  Confidence levels in Engagement while increasing (-.03205, -.25417) respectively in CS1 and CS2, showed a slight decrease (.00225) in CS3.
- ***Technology***
  Confidence levels in Technology decreased (.23077, .01081) respectively in CS1 and CS3 while slightly increasing in CS2 (-.10263). In this instance the results were unfortunately expected due to the primary factors of limited resources and general on-going ICT issues related to network restrictions and document transfer between devices.
- ***Reflection***
  Confidence levels in Reflection reveal a decrease (.03704, .01829 respectively) in both CS1 and CS3 with a small effect size increase (-.17032) within CS2. Similar to comments related to technology, the findings in this instance were also expected due to its linkage with technology and subsequent unfortunate ICT issues, particularly in CS3.

Contrary to expectations, the study's overall findings provided statistical significance in only 7 out of 18 instances (38.8%). However, an increase in the mean value of confidence levels among students clearly indicate that 10 out of 18 (55.5%) had increased with either a small or medium effect size. In general the overall findings are contradictory in the key values related to instances of Collaboration, Communication and Engagement. Given the nature of the intervention, gains in these skills across all cases may reasonably have been expected. It is also very evident from the findings, that where ICT issues were reported, this ultimately may have had a profound effect upon the results from the dataset. Any contextual factors evident in the quantitative data, as a result of some conflicting findings, will be addressed in the discussion chapter.

4.14.3. Qualitative Themes/Results

The following section will report on the key themes attained from the researchers' analysis of interviews with teachers and students across all three case studies.

Core Themes & Sub themes	Case Study 1	Case Study 2	Case Study 3
Pedagogy			
Scaffolding	X	X	X
Role	X	X	X
Affordances/Key skills			
Collaboration	X	X	X*
Engagement	X	X	X*
Reflection	X	X	
Motivation	X	X	X
Communication	X	X	X
Time Management	X	X	X
Class Dynamics	X	X	X
Creativity			
Content creators	X	X*	X
Fun	X		X
Opportunity to shine	X		X
Learning			

Ownership/Responsibility/Trust	X	X	X
Deeper learning	X		X
Research skills	X	X	X
Student-student	X	X	X
Mentoring	X	X	X
Technology			
Resources	X	X	X
ICT issues/Framework	X	X	X
Distraction		X	

X* - Limited due to ICT issues

X** - Only one student acted as mentor

Table 4-31: Cross case analysis - Core themes & subthemes

4.14.4. Pedagogy

Each of the three case studies reported a fundamental value of a change of teaching practice as a consequence of the intervention. Under the umbrella theme of '*pedagogy'* three central sub-themes across all of the studies were formulated, they include: '*Role*', '*Student-centred approach*' and '*scaffolding*'. Against this backdrop each of the case study teachers reported a changing role to that of a 'facilitator' following completion of each learning activity as part of the overall intervention. The evidence suggests that a number of teachers initially struggled within this new role and its level of required input. Consequently, teachers described their role as becoming more of a 'project manager' or even in some cases as simply adopting the role of an 'observer'. Nevertheless, teachers highlighted the need to ensure that they were available to answer any questions, to help guide their students and ultimately ensure that everyone in the class was 'on task'. When interviewed on this subject, all five teachers replied positively to this new adopted role. In facilitating a student's ability to build upon the prior knowledge received from their teacher, the connected theme of scaffolding was highlighted across each study as both a necessity and a clear benefit to the students. By adopting a variety of techniques to facilitate a stronger understanding of a specific topic, each of the case study teachers ultimately afforded their students a greater independence and responsibility in the own learning process. As discussed previously, the role of facilitator has a certain measure

of responsibility associated with it. This responsibility includes effective support when required, until it is gradually removed, ultimately shifting the responsibility of learning from the teacher to the student. Collective thoughts and comments from all five teachers across the three case studies reveal a very positive attitude towards adoption of this pedagogical approach, as it

> *'…reduces the amount of Teacher talk time. They remember the material better. They are creating the material, think about it more, they are teaching it to each other, which means they will remember it better, rather than me just teaching it to them'.*

However, whilst favourable to the approach, the teachers were keenly aware of the potential disadvantages including the investment of time. The approach for the teachers was advantageous but it required, as they suggest, more thinking, planning and structure on the educators behalf. For some students within the intervention, this type of student centred approach was not uncommon (CS3), particularly in the area of science. As both Teacher D and her colleague Teacher E from CS3 was to confirm, with the traditional 'chalk and talk' approach, the Junior Cycle Framework currently adopted does not lend itself to that particular approach, rather as she suggests,

> *'…the culture here is very different from most schools, it's the culture of the school. We have full free reign in the classroom.'*

While some case studies did formally assess the content created by their students (CS1), those who did not (CS2 and CS3), when asked, confirmed that they would certainly want to employ assessment, in this type of scenario in the future.

4.14.5. Affordances/Key skills

A key theme of Affordance/Key skills was an overarching descriptive theme representing the six sub-themed affordances of tablet pcs, previously linked to key-skill elements of the Junior Cycle Framework. Aligned to the key-skill of '*Working with Others'*, the sub-theme of '*collaboration*' is in relation to students developing good relationships (with peers), learning with others and working with others using digital technology. References by the majority of teachers and students emphasised this particular sub-theme as a very positive aspect of the intervention. Feedback from CS1 focus group highlighted the 'fun' aspect to the intervention, with both teachers furthermore in agreement on its affordance

in developing social skills, leadership and teamwork. Moreover, comments from both teachers and students strongly indicate a positive reaction to the element of collaboration.

While mapped to the key-skill of '*Being Creative'*, student's immediate '*engagement*' was reported very 'active', as Teacher B describes within CS1,

> *'…immediately, from the very beginning when I told them what they had to do and that they had ownership with a level of control. They were delighted with that and they had loads of ideas, they didn't need much direction, they kind of went with it.'*

These findings support and compliment results from the questionnaires, reaffirming technology as one of the most effective tools to engaging students to their fullest potential. Whilst afforded an opportunity to produce their own content and subsequently develop an interactive iBook, the intervention had clearly connected with students. Reflecting a similar scenario from Case Study 1, Teacher C's feedback in CS2 suggest that her students also became instantly engaged in this project based learning activity, in adopting a new technology (iBooks Author). Whilst enabling interactive engagement through digital technology, the introduction of the iBooks Author application further afforded students a unique opportunity, to becoming creators of digital content. Acting as a stimulus to their learning, Task 1 had conclusively captured a 'buy in' and subsequent engagement from students across all three case studies.

Reflection was aligned to the key-skill of '*Managing Information and Thinking'*. Within this element students are guided to search and discover information from various sources, whilst developing their skills in judging and discriminating between various types and sources of information. Ultimately, this key-skill will afford students the ability to develop their higher-order thinking skills and problem-solving techniques. A key component in learning, self-reflection affords students an opportunity to access themselves and take increasing responsibility for their own learning. Following the completion of each individual learning activity (task) developed by their teachers, students could present their developed content to their teachers and peers. In some instances, students were assessed in groups. Reflection opportunities did take place within CS1 and CS2. It is evident that reflection was limited within CS3 due to ongoing ICT issues.

Mapped to the key-skill of '*Managing Myself*', whereby students have the opportunity to develop their personal goals and plans, developing strategies and taking action, '*motivation*' is the guide to a student's incentive to learn and participate. In analysing data from the teacher and focus group interviews, knowledge on the considerable increase in student motivation is illuminated, as a consequence of the intervention particularly in CS1 & CS2,

> *'…It was really high, yes, I could see every group motivated with it. They were very very motivated, and it came from themselves, didn't come from me'.*

Both teachers within CS3 were not particularly vocal via interviews in relation to motivation. This is likely in relation to early ICT issues followed by issues with the transfer of content between devices. A common view amongst interviewees was that while most classes in general are motivated to learn, the introduction of technology provided unique opportunities and impetus to attain knowledge. Communication was mapped to the key-skill of '*Communicating'.* In this instance students are provided an opportunity to develop their communication skills and literacy skills, expressing opinions and via written and oral presentations. Both CS2 and CS3 studies highlighted face to face communication levels among students as potentially increasing during the intervention process, reflecting the findings from student questionnaires. The results differ from CS1 but are broadly consistent with general feedback from teachers.

4.14.6. Time Management

A recurrent theme and probably the most contentious concern in relation to the intervention, was the particularly prominent issue of time management. While initial contact, discussions and CPD sessions with each of the case study schools began between September and November 2018, each case study formally commenced implementing the intervention shortly after the Christmas Holidays in early January 2019 until May 2019. Moreover, a number of teachers did cite '*Time Management'* in relation to the timing of the intervention, their required input and also (in conversation) the focus on examination and the required time needed to ensure all relevant curriculum material had been covered. Reflecting upon the process of content creation, content transfer and amalgamation, focus group feedback from CS1 admits, *'…It took a long time to put together, upload it and put it together.'* This common reoccurring theme of Time Management can arguably be linked to existing school organisational factors and their available resources. Whilst working with only one Mac desktop with iBooks Author

installed, it was necessary for each individual case study school to timetable each of their individual class groups to access this one device. As Teacher E describes in CS3, for everything to work smoothly;

> *'…you would need to have no technical glitches. It's not like Primary school were you could dedicate a day to this, we have an hour or so. Then the next day, setting up...it's all time'.*

As her colleague Teacher D was to suggest, overall the main obstacle was the time constraints in completing and compiling all the relevant projects. As Teacher C from CS2 was to reiterate, time was, they suggest, the main limiting factor during the intervention. Feedback from teachers across all three cases were consistent in relation to time management.

4.14.7. Class Dynamics

The focus group interviews revealed how students felt more relaxed, were afforded the opportunity to get to know both their peers and teachers much better and in some cases afforded an opportunity to make new friends. Teachers reported in all cases that the dynamics had somewhat changed as a consequence of adopting a more 'active' learning approach.

> *'…I suppose you get to know them in a different light a little but because, you get to see them interacting with each other, with different groups, you can see some of them taking on leadership roles, some people love it and take it on, but some people are less so, you see different perspectives'.*

This change in dynamics was quite evident across all three cases, with a few teachers highlighting a need to 'trust' their students when adopting a more student-centred pedagogy. As discussed earlier, educators are keenly aware that trust is a key factor in the learning equation when students adopt a more 'active' collaborative role within the classroom. As Teacher C from CS2 suggests, while teachers arguably have more control of classroom discipline within a 'chalk and talk' scenario, the move away from a teacher-cantered approach in parallel to the introduction of technology can potentially go 'off the rails'. In contrast, a more student-cantered approach which includes positive relationships between educators and students based on trust, provides a mutual responsibility for learning. As each of the teachers across the studies concluded, a

positive classroom dynamic in this approach requires the appropriate teacher leadership and skills to ensure that students feel supported whilst attaining a sense of ownership and control over their own learning. As such, both teachers and students observed a positive change in class dynamics as a consequence of the intervention.

4.14.8. Creativity

The over-arching theme of creativity includes the relevant subthemes of '*content creation*' in parallel to the '*fun*' aspect to learning that can potentially afford students' 'under the radar' the opportunity to highlight their specific skillsets via this channel. Whilst linked to student engagement, comments by teachers across each case indicated very positive references to their students work. Teacher C in CS2 highlighted the approach of students' as content creators to develop curriculum material as a '*significant, practical and positive path to follow'*.

With teachers as promoters of active learning, a student-centred classroom advocates collaboration and creativity. In cultivating creativity in the classroom, students are afforded a unique opportunity to express their independent learning via collaboration and creativity. While the resources were very limited across each case, the perceived creative potential was very evident and positive.

- *'…it was like a lot of freedom there, I feel if you didn't have that like was one of the positive aspects of it, you could put in a quiz or pictures or videos.'*
- *'…I thought that giving them a bit more free-reign it worked well because they were able to show their creativity a little bit more because I hadn't set the assignment as they got to create it themselves'.*
- '…*for them to come back and produce the stuff they did produce with very little guidance it was amazing to see and for them as I said earlier using a puppet, someone videoing someone else and two lads had this torso and they had hearts made that were doing all the talking. They can be very creative in the right forum and this is definitely the forum for it'*.

In contrast, a number of negative comments particularly in relation to the connected themes of limited resources, ICT issues and time management were also evident. In highlighting the limited desktop availability and group numbers, teacher comments highlighted their own and student frustrations with the creative process within the intervention. Both argue that with limited access and group numbers, opportunities to evaluate and explore both the operating system and the iBA application did unfortunately provide a limitation to their creativity. However, as some teachers evidenced, some

students did explore a number of features they hoped to adapt within their tasks. While a student-cantered approach is about 'understanding' content, it makes learning both interesting and relevant and most importantly 'fun'. References to the 'fun' aspect of the intervention were strongly positive from the students. On each occasion an opening question to each group was in relation to what they actually thought of the whole intervention process. In each instance, the answer was a resounding '…fun, it was fun!'. When meeting with focus groups at each of the case study locations, it was further evident how enthusiastic the students were when describing their experiences of the intervention. For the teachers too it was very noticeable how students thoroughly enjoyed the freedom afforded to each group, with one teacher describing;

> *'…for me as their teacher I was able to see them in a different light. You can see different students in a different perspective maybe wouldn't have come to your attention otherwise.'*

As discussed previously, Teacher E from CS3, also highlighted the affordance of the intervention with the potential to engage students, traditionally 'under the radar'. Once again comments from CS3 reflect earlier commentary from teachers within CS1, as to how this type of intervention has afforded each case study teacher a unique insight into their student and their skillsets.

4.14.9. Learning

The strategic broad theme of learning encapsulates the recurring subthemes from the dataset of '*ownership/responsibility*' and '*trust*', '*deeper learning*', '*research skills*' and '*mentoring*'. In their accounts related to learning, both teachers from CS1 were in agreement on the transformation in ownership and responsibility afforded to students during completion of all three tasks.

- *'…they had ownership with a level of control'.*
- *'…It was probably the first time I got them to take real ownership of it (what they did).'*
- *'…I think they took much more ownership of their learning, I think they know the material better.'*
- *'…I have had to trust them a lot more, than I normally would.'*

This sense of ownership, control and responsibility, resonated with students across the cases and throughout the intervention, as reflected in comments by both students and

teachers alike. While embedding experiments in an iBook format has encouraged her students to think more deeply on '…how would I teach this experiment?' Teacher C from CS2, believes the overall approach affords students the ability to become much more responsible for their own learning, which again reflects a repeating theme of ownership and trust from the CS1. In adopting a more student-centred approach, the pedagogical approach is typically designed to be relevant, engaging and to make learning meaningful. Deeper learning provides students with the necessary skills, such as critical thinking, solving complex problems and communicating effectively. As a consequence of their role as 'content creators', the subtheme of deeper learning relates to their subsequent understanding of the developed material. As reflected by her colleagues, Teacher C comments..

- '…I think they will remember the material a bit more, better, in a kind of long-term way, because they went off and found it themselves'.

Complementing previous comments, students' in Focus Group 3 (CS3) further suggest,

> *'…When you were going back to revise them it was easier to learn them'. Their teacher was equally as positive in reaffirming, ' … they know it! They know it!'.*

In developing their research skills, students' acquire the necessary skillset to search, collect, analyse, interpret and evaluate relevant subject matter material. Across each case, teachers highlighted an increase in developing research skills by their students' whenever searching and filtering for relevant content. For example, in CS1, for Task 1, Teacher A decided not to deliver any background material related to the topic but rather afford students the opportunity to research the area. Initially the students' did not filter the gathered data for its relevance, however in follow up task 2 and 3 the practitioner remarked on its noticeable improvement. As Teacher A suggests,

> *'…I suppose their ability to discern how good a source is that was really challenged. They developed an awareness of it. So sometimes they did get the wrong end of the stick, but this is part of learning as well. So, I think it was valuable, the nature of this informal learning, this style is haphazard, it's not systematic because they are findings things as they find them'.*

As confirmed by his colleague Teacher B, without the necessary initial structure and scaffolding Task 1 could and did on this occasion provide some unintentional results. In contrast, Teacher C in CS2 scaffolded her students at Task 1, concluded, *'…I think that*

they had a bit of control over what they were researching as well'. Similarly, for CS3, Teacher D confirmed that her students' research skills were of good quality during the intervention. In sharing their knowledge and experiences, students' can connect with their peers, adopting an important role in student learning and development within the classroom. Furthermore, with the introduction of new technology as part of the intervention, the mentors played a significant key role in raising awareness, advice and guidance to their peers. Teachers across the studies were strongly positive in relation to student mentoring, particularly within CS1 and CS2. Focus group members in CS3 highlighted the practice taking place in later stages of the intervention. Both Teacher D and E shared a resource within the school to help mentor their groups. In CS1, Teacher E acclaimed,

> *'…they just taught each other how to use iBooks Author, so that was brilliant, how like one would show the other was really really amazing.'*

This sharing of knowledge and mentoring of their peers in CS2, also reflects the earlier complimentary findings from Teacher B in CS1. As Teacher C comments,

> *'…they teach each other. Even, it doesn't have to be 1 skilled student group, even if you had 1 or 2 in a class of 20, they very quickly disseminate the information to each other.'*

4.14.10. Technology

Whilst the introduction of technology within a classroom has compelling benefits, potentially providing improved engagement, knowledge retention, individual learning and encourage collaboration, its successful adoption is dependent upon a number of key factors, as described earlier. Unfortunately, the limited resources across the overall study became equally as contentious as the issue related to '*Time Management*'. In each case, access to limited resources and access to specific functionality and services was of major concern to all of the teachers and frustration for students. With only one Mac desktop available in each case study to develop the relevant interactive iBooks, the limitation became a formidable issue that lead to a lot of frustration for both teachers and students. As Teacher B from CS1 concludes,

- *'…the main one for me is still the fact that they have to go to the desktop to get it into the iBook. That's the vain of my life! That part is hardship everything else is fine, there is actually no other'.*

- *'…we Airdrop all the time, they are not use to emailing, they got frustrated. Their impression of this was that it was more time consuming'.*
- *'…we couldn't share the final iBook.'*
- *'…the unfortunate thing was getting what they had on their iPad onto the Mac desktop and then onto the book was the frustrating thing for me.'*
- *'…it took a lot longer than it should have taken. And then making the book on the Mac desktop, I was actually going to cry! It was so frustrating'.*
- *'…just getting every group to have gone through that process was time consuming'.*

A number of factors came into play within each case study. Firstly, the intervention required students to transfer their developed and accrued research to a MAC desktop. Traditionally this is achieved using Airdrop, a Bluetooth technology. Teacher D in CS3 was using an older desktop with outdated Airdrop connectivity. Secondly, students in all three case study schools have by default attained knowledge in how to use a Windows desktop device. In most cases this was also the situation for teachers too. All of the students across the studies had experience of using iPads but no relevant experience in using a Mac OS desktop. While initial CPD in this area was provided by the researcher, it was limited and was provisioned as a 'kick-start' for students. Thirdly, Wi-Fi and general network connectivity in schools is primarily restrictive, as highlighted earlier. Fourthly, while the iBooks Author application would be described as intuitive, students were initially frustrated with progress in the development process due primarily to a lack of experience. Therefore, in the beginning, each of the studies initially struggled with the complexity surrounding working with an unfamiliar operating system (MAC OSX) and application (iBooks Author). While CS3 additionally struggled with the lack of Airdrop support to transfer material, as well as restrictive Wi-fi connectivity in relation to file-sizes. Taken together, the interconnecting themes of technology and time management highlight prominent concerns, as illuminated by both teachers and students. Evidence derived from the collective interviews substantiate the negative findings from teacher and student questionnaire responses.

During interviews, each of the teachers were questioned if they believed the iPad device and interactive iBooks developed by students, would act as a possible distraction. On each occasion the teachers highlighted potential risks of distraction. As Teacher C from CS2 explains,

> *'…sometimes getting them to stay on task can be an issue. They take 'selfies' with the iPads, like this is their big thing…it's not particularly anything bold, you*

give out the iPads and you can see them all taking selfies. So we can centrally switch off the cameras on the iPad. So, they can get distracted a little sometimes.'

In total 5 focus groups were held following the intervention. In CS2's focus group, one student was particularly vocal in relation to the potential distraction in using an iPad and content therein. A number of other group members also acknowledged the distraction. It is difficult to explain their stance, but it might be related to a number of factors. In parallel to this stance the students in question also had issue with the devices (iPads connecting to the Mac desktop) per say, suggesting that it would have been quicker to achieve the necessary results using a pencil. While results from the online questionnaires for CS 2 highlight increased confidence in all but one of the key affordances, these comments may be the result of student frustration with the application, the limited resources available to the class and as a possible consequence of the intervention, its timing and also relevance to their end of term results. As noted earlier, the two divergent and conflicting discourses that have emerged between teacher and student comments in CS2, are perhaps a consequence of students own learning culture and expectations. As Teacher C did not formally assess her students as part of the intervention, the key focus for students in CS2, was not in relation to the intervention but rather on those marked assessments related to their formal end of term results. Ultimately, the combination of time, energy and frustration with on-going ICT issues and resources related to the on-going intervention, consolidated with student expectations, explains the conflicting discourses evident between the teacher and her students in CS2.

4.15. Conclusion

The overall results of this study have clearly exhibited an increase in confidence levels across all three cases in relation to '*Motivation*'. Furthermore, an increase in '*Engagement*', '*Collaboration*' and '*Communication*' is noted across a number of the studies. Any decrease in the remaining measurements are defined as having either no or small effect size. In contrast, reflections in both teacher and student interviews has presented evidence revealing distinct advantages in pedagogical practice, student key skills – motivation, engagement, collaboration, communication, technology and reflection, as a consequence of the intervention. It is interesting to further note that in all three cases of this study teachers indicated that the intervention had successfully introduced the concept of students as content creators. Furthermore, as a consequence, they suggest that the approach, with its development of interactive artefacts, has

successfully provided students with an opportunity to take ownership and responsibility for their own learning, a deeper understanding and retention of the subject matter and further developed their individual research skills. However, in contrast, a common view expressed across each case study by both teachers and students, has provided important insights into the negative impacts experienced during the intervention. These key impacts include the lack of adequate resources/experience, challenging ICT issues and time management. Whilst unfortunate, it is very likely that a number of these issues could potentially have played a dominant impact on findings, particularly in relation to '*Technology*' and '*Reflection*'. These negative aspects and the contradictory results between the quantitative and qualitative datasets, will be deliberated in detail within the following discussion chapter.

Chapter 5. Discussion

5.1. Introduction

This study set out to explore if mobile devices can contribute to the realisation of the aims of the new Junior Cycle Framework via an intervention facilitated by post-primary teachers across three unique case studies. The general theoretical literature related to the potential of mobile technologies to support teaching and learning continues to be in its infancy and under-examined.

The general theoretical literature in the context of digital tablet device adoption within teaching and learning is also inconclusive on several vital questions within the discourse. In both instances this lack of attention is somewhat significant, as a deeper understanding of the pedagogy employed and the additional alignment of 21st century skills in using the devices, can potentially provide extensive benefits in supporting teaching and learning.

This chapter provides a review of the research questions addressed within the study, followed by a discussion of the findings in light of the findings from online questionnaires and emerging themes from teacher and student interviews. Implications of the findings on current and future educational technology adoption are reviewed, along with recommendations for practice and research.

The main empirical findings are chapter specific and were summarised within the respective chapters; Case Study 1, Case Study 2, Case Study 3, and Cross Case summary. This section will synthesise the empirical findings to address the study's three research questions.

The purpose of this survey and multiple site case study methodology approach were twofold. Firstly, the overarching research question guiding this study within an Irish context was: An exploration of the utilisation of mobile devices and how they contribute to the realisation of the aims of the new Junior Cycle framework.

Secondly, the inquiry set out to address the following research questions:

- How can teachers take advantage of the affordances of mobile devices and in particular the iBook Author application in their instructional activities, so as to address the aims of the new Junior Cycle (*motivation, engagement, communication, collaboration, reflection and assistive learning*)?
- What pedagogies fully leverage using iBooks Author content on mobile devices for teaching & learning in the context of the new Junior Cycle framework?
- As a consequence of using iBooks Author with tablet PCs, in what ways have the dynamics changed between the teacher and student?

5.2. Summary of findings

A focus of the current research was firstly to provide through a multiple case study intervention, a deeper understanding of the pedagogy employed with the adoption of digital devices (such as tablet pc's). Furthermore, to discover if the additional alignment of 21st century skills when using such devices, can contribute to the realisation of the aims OF the Junior Cycle framework. Moreover, to explore any change in dynamics as a consequence of adopting iBooks Author in conjunction with tablet pcs. Firstly, the intervention did have a positive impact on pedagogical practice across all three schools. The data provided from questionnaire responses from teachers presents clear evidence of change in practice and is further confirmed by detailed interview data. The teachers confirmed a significant change of practice, to that of 'facilitator', due to their adoption of a more learner-centred approach within the intervention (Kovalchick & Dawson, 2004). Reflecting previous research, a number of the teachers were initially uncomfortable within this role. However, as the intervention progressed, the teachers became more 'at ease' within the adopted role, whilst observing the corresponding impact on student's motivation, and responsibility for learning. The evidence presented is consistent with previous research in highlighting how digital devices can transform learning in both a mutual and beneficial way for teachers and students (Burden et al., 2012a). As a consequence of the intervention, the teachers' views on the adoption of a more student-centred approach to learning were mainly positive.

Secondly, the data reveals an overarching statistically significant increase in student 'Motivation' across the three case studies in the intervention. For example, evidence has been presented via online questionnaire responses by both students and teachers and

confirmation derived from subsequent follow-up interview data. In this regard the data are consistent with previous research into tablet adoption and its potential to affect attainment and progress within teaching and learning (Clarke et al., 2013; Twining et al., 2005). Moreover, this evidence clearly illustrates a link between motivation as a characteristic affordance of mobile learning to the specific key skill of '*motivation*', within the Junior Cycle framework.

Thirdly, as a consequence of this shift to a more student-centred approach, the evidence from both questionnaires and interviews demonstrates students taking 'ownership' and subsequent 'responsibility' for their own learning (Baab et al., 2016; Gray et al., 2017). Moreover, evidence from both teachers and students confirms that the intervention, with the initial adoption of peer-mentoring, also provided an opportunity for students to become 'content creators' within a collaborative environment (Falloon, 2017). The evidence also clearly reflects similar findings in previous research which illustrates a shift away from direct instruction, as a consequence of a change in pedagogical practice in parallel with the affordances and capabilities of digital mobile devices (Thumlert et al., 2018). The researchers' resulting data also illuminates how from the teachers' perspectives, their students have attained a 'deeper' understanding of the curriculum (McCaffrey, 2011), whilst developing their research skills (Falloon, 2015). Conversely, the data has clearly identified a number of challenging issues within the intervention that reflect the literature in relation to the adoption of technology (Zhao et al., 2002). The data, particularly that derived from both teacher and student interviews, has identified challenging ICT issues, lack of resources and teacher and student experience of the operating systems, when adopting a more student-centred approach to learning (Schweisfurth, 2011). The evidence is also consistent with previous literature highlighting a specific need for relevant training, resources and pedagogical practice required for a successful technological program within education (Education, 2011; Galvin et al., 2010). The researchers' findings did present a common teacher view in relation to 'time-management'. These findings match those observed in earlier studies highlighting the time constraints in developing digital material and the required familiarisation with the technology (Cochrane, 2010; Lim, 2011; Melhuish & Falloon, 2010; Vrtis & Hansen, 2010). The findings also match those of a similar project (using Microsoft surface tablets) in Ireland in 2015 at Clare Galway College in partnership with Learnovate (Trinity College, Dublin) in relation to time-constraints in developing digital materials.

Lastly, an unexpected outcome was observed in relation to technology as a possible 'distraction' to teaching and learning (Butcher, 2016; Curry, Jackson, & Benchic, 2019; Marmarelli & Ringle, 2011). Some students within CS2 expressed the belief that, in their case, using an application like iBooks Author to develop interactive content for iPads, provided an opportunity for their peers to become distracted (Dobler, 2015). While some evidence within the literature does highlight the potential for this (Tay, 2016), most of related literature to date primarily focuses on ensuring that students are 'on task', particularly when using technology within the classroom.

5.3. Discussion of findings

The following is a discussion of the findings from all three case studies. The discussion has been divided into the relevant pertinent features identified and reflected as themes, raised by the adopted research questions. Each theme will be subsequently related to current literature within this domain.

5.4. Research Question 1 – Key skills / Affordances

How can teachers take advantage of the affordances of mobile devices and in particular the iBook Author application in their instructional activities, so as to address the aims of the new Junior Cycle (motivation, engagement, communication, collaboration, reflection and assistive learning)?

The researchers exploratory research aimed to examine the alignment of the intervention with the relevant key-skills to be acquired by students in the context of the Junior Cycle reform. Teachers within each study developed three learning activities related to specific curricular needs. After receiving each of the learning activities from their teachers, the students began to create relevant content with their iPads and subsequently collated this material to develop interactive iBooks using iBooks Author.

Data analysis of the findings provided key themes ('Key skills / Affordances') and relevant subthemes emanating from interview transcripts to address this specific research question.

Figure 5-1: RQ1 - Affordance/Key Skills

5.4.1. Motivation

In linking the key affordances of tablet pcs to the key skill elements within the Junior Cycle framework, motivation was mapped to the key skill of 'Managing Myself'. The core sub-elements within this key skill include:

- Knowing myself
- Making considered decisions
- Setting and achieving personal goals
- Being able to reflect on my own learning
- Using digital technology to manage myself and my learning

To address this specific research question, both staff and students were asked to complete a pre and test post online questionnaire in relation to their levels of motivation as part of the intervention. Firstly, the qualitative evidence revealed high levels of student motivation as described by both teachers and students alike, confirming an increased incentive to learn and participate. As reflected in early literature there is an immediate impact on student motivation once they begin to use mobile devices (Valstad, 2011). This is further supported by findings from Sachs and Bull (2012) who firmly believe that digital devices, such as an iPad, can have a positive effect on student motivation, these findings are also consistent with previous research by Twining et al. (2005). The researchers' study has highlighted the increased motivational factor, due firstly to the

combined introduction of technology (iPads) and their use in a collaborative project-based approach within the intervention.

Secondly, as reaffirmed by the researcher's follow-up analysis from teacher and focus group interviews, the findings reflect those of Karsenti and Fievez (2013) and Flewitt, Messer, and Kucirkova (2015) were students became 'considerably motivated' as a consequence of using tablet pcs. The focus group feedback in particular reflected that from earlier studies, when suggesting, '…it's a lot more motivating with the iPad in class' (Karsenti & Fievez, 2013, p. 28). Across all three case studies, there is evidence to suggest that the students were 'considerably motivated' as a consequence of the intervention. These findings are broadly in line with those of previous work in this field. Similarly, the evidence initially contributed from teacher and student questionnaire feedback provided a very positive indication of increased student motivation. As a consequence, the research findings contribute to clearly establishing and confirming a linkage between each of previously discussed characteristic affordances of mobile learning (tablet pcs), to the specific intended outcomes of the Junior Cycle. Student engagement and a high level of interest within a class are key components for active learning. As such, those students who are highly motivated make a similar effort to become highly engaged. As research indicates, there is a clear link from motivation to engagement as suggested by Clarke et al. (2013). Examining teacher and student perceptions in relation to how tablet pcs play a motivational role in student engagement with their school and studies, research by Clarke et al. (2013) highlighted the initial change in practice for students, in addition to the 'iPad factor'. This experience of change in combination with adopting the latest technology, provided renewed engagement by key stakeholders. The teachers within the study attributed the marked increase in student motivation to learn, with a change in curriculum alongside the development in student independence. Taking control of their own learning had ultimately prompted an increase in motivation, reflecting the researchers own experience across all three of the interventions case studies.

The findings from the study have provided evidence of a positive increase in student motivation due to adoption of the latest technology ('iPad factor'), where students are provided with the element of personal agency, particularly when the learning activities are presented on/with a digital device (Burden et al., 2012b).

5.4.2. Engagement

Engaging learners has been recognised as a key priority within education. The engagement of learners as such depends upon their meaningful and active involvement in the learning process. One of the fundamental affordances of iPad devices has been its potential to engage students within and beyond the classroom. The researcher mapped engagement to the key-skill element of 'Being Creative'. The core sub-elements within this key skill include:

- Imagining
- Exploring options and alternatives
- Implementing ideas and taking action
- Learning creatively
- Stimulating creativity using digital technology.

Improving engagement is one of the core challenges that education faces today, whilst encouraging students to think critically and creatively as they become immersed within a topic. In this instance students are expected to acquire the necessary skills to explore, implement ideas, imagine and most importantly stimulate creativity using digital technology. As such, each of the learning activities developed by teachers, provided students the opportunity to fully engage within the project as they developed their research and creative skills respectively. Increased levels of engagement as discovered by the researcher in this study, reflects earlier findings from within the literature. The recurring theme of engagement in all three case studies, as demonstrated by Teacher A in CS1, was reflected across all classes, particularly at the start of the intervention '…I felt they were very engaged in it, it was very active'. The initial statistical pre and post-test evidence from CS1 and CS2 demonstrated an increase in confidence levels related to engagement and was further reinforced from within subsequent interviews. An implication of this finding is the possibility that as a consequence of higher engagement, students will ultimately become more responsible for their own learning and moreover it will also potentially cultivate creativity within the classroom.

The exploration of related literature suggests high levels of interest and engagement with the adoption of iPads, Couse and Chen (2010), with such devices also providing non-traditional learners the opportunity to engage whilst removing any formality, (Oblinger, 2010). The findings of the researcher's current study are further consistent with early observations by Brown et al. (2014) who underscore the desire from students to adopt and use digital technology within the classroom. Similar findings of increased

engagement are also reflected in the thoughts of McCaffrey (2011, p. 2) who claims, '…mobile devices applied in the context of education will engage students, foster deep and meaningful learning, and result in today's kids reaching frontiers that generations before them could never hope to glimpse'.

This claim is further imitated in findings observed in later studies by Clarke et al. (2013), when reporting increased engagement when using the devices. Such claims are further confirmed in recent inquiries by Bikowski and Casal (2018) who express significant increase in engagement when students access customised interactive digital textbooks, as reflected in the researcher's own intervention. Whilst early perceptions of technology in education have indicated its 'novelty' factor, recent debates within the literature positively assert the diverse range of affordances of mobile devices, such as iPads. The findings observed in this study mirror those of previous research that have examined the affordances of tablet pcs and student engagement, thus addressing a key aim within the Junior cycle framework.

5.4.3. Collaboration

The researcher mapped collaboration to the key skill element of 'Working with others'. The core sub-elements within this key skill include:

- Developing good relationships and resolving conflict
- Co-operating
- Respecting difference
- Contributing to making the world a better place
- Learning with others
- Working with others through digital technology

The subsections of this unique element relate to dealing with conflict, co-operating and respecting differences, learning with others and working with others through digital technology are of equal importance. The initial statistical pre and post-test evidence from CS2 and CS3 demonstrated an increase in confidence levels and were further reinforced from within subsequent interviews. As discussed earlier, the findings indicate that the researchers' intervention provided an opportunity for students to express their independent learning through the medium of collaboration with their peers and subsequently cultivate creativity. The researchers findings substantiate early research by Fisher et al. (2013) highlighting the design and accessibility features of mobile

devices, such as the iPad, in relation to size, portability, versatility and tactile nature, as one of the main factors in enabling collaboration.

Evidence from within CS1 describe an example of the collaborative thinking process within the current study, whereby students deliberated the specific tasks and decided upon what apps to use while at the same time, when necessary, compromising with other group members on how best to complete the learning activity. As observed by the teachers, teamwork between student became an intricate part of the learning process.

Research has further claimed that mobile devices, such as the iPad afford teachers and their students a unique opportunity to enhance digital technology in communicating 1-2-1 or collaboratively (Falloon, 2015). One of the key findings of the current study is that students actively collaborated with their peers while using iPads to develop content, as defined by Jahnke and Kumar (2014) and Falloon (2015). The additional feedback from teacher interviews has further highlighted the interventions' potential contribution to student higher order thinking and collaborative development. As detailed, there is a growing body of evidence related to the collaborative affordance of iPad devices as a critical component within a classroom activity or project.

Similar to the earlier research by Fisher et al. (2013), the findings further suggest that when combined with Cloud based apps such as Dropbox, Google Docs (as in Study 2 (CS2)), this collaboration can potentially be extended well beyond the classroom walls. This finding is consistent with research in relation to extending collaboration via convergence of mobile computing with cloud based services (Stec et al., 2018). The findings from the case studies reaffirm conclusions from the literature and also suggest this affordance can potentially address a key aim of 'collaboration' within the Junior Cycle framework.

5.4.4. Communication

The core sub-elements within this key skill include:

- Listening and expressing myself
- Performing and presenting
- Discussing and debating
- Using language
- Using number
- Using digital technology to communicate

The ubiquitous nature of tablets devices such as the iPad can potentially play an important role in empowering learning and facilitate communication. The observations from the current researcher's study reflect those of Osmon (2011) when highlighting communication opportunities, as a particular affordance of tablet pcs and as of particular interest to teachers. As the present findings suggest, the teachers collectively agreed that their students were connecting much more with each other than they would traditionally do so within class. A number of channels of communication were evident including oral communications between group members alongside collaborative communications via Airdrop, as students shared relevant content within the classroom, between each other, with other groups and with their teacher. This result indicates that mobile digital devices have the potential to compliment teaching and learning, with students acquiring higher levels of communication skills (Gray et al., 2017). Tablet device attributes combined with the inclusion of engaging apps can provide unique communication opportunities while supporting collaboration within the classroom. However, the overall questionnaire and interview findings from within this study were contradictory, due primarily to a number of challenging ICT related issues.

Teachers and students described communication as potentially increasing during the intervention process, reflecting the findings from questionnaire responses related to CS2 and CS3. The findings presented are broadly consistent with those of Kagohara et al. (2013) and McNaughton and Light (2013) who highlight the significant communication affordance of devices such as the iPad, which could particularly empower those students with disabilities. Whilst the present findings are consistent with the early literature, the researcher however concurs with studies by Lindsay (2015) and Mouza and Barrett-Greenly (2015) who argue that the communication potential is firstly unrealised and secondly continues to be in its infancy. With this in mind, the conclusion drawn from the intervention findings indicate that this particular characteristic affordance can potentially facilitate the key skill element of 'Using digital technology to communicate'. However, this is only possible across all affordances including communication, once adequate resources and relevant training are in place for both teachers and students.

5.4.5. Reflection

Mapped to the key skill of 'Managing information and thinking', students acquire reflection as a key element in professional growth (Schön, 1983). The core sub-elements within this key skill include:

- Being curious
- Gathering, recording, organising and evaluating information
- Thinking creatively and critically
- Reflecting on and evaluating my learning
- Using digital technology to access, manage and share knowledge

As discussed previously, in this instance students are required gather, record, organise and evaluate information and data and subsequently reflect upon and evaluate their learning. Early research by Fleck and Fitzpatrick (2010), Hallnäs and Redström (2001) and Kori et al. (2014) has previously highlighted the affordance of mobile devices in facilitating reflection. These findings are consistent with recent research by Leinonen, Keune, Veermans, and Toikkanen (2016). Within the current study, survey responses from students in both CS1 and CS3 revealed a very small decrease in confidence levels in relation to reflection, with a slight increase for CS2. This finding was somewhat expected as a number of practitioners had previously during interviews highlighted concerns related to ICT issues, particularly in the case of CS3. Furthermore, as described in interviews with both practitioners and focus groups, in both instances of CS1 and CS2, reflection, while taking place, was quite limited due to time restrictions and it was not possible in some instances, to provide students with an opportunity to reflect with their peers. However, while reflection was limited, the findings do reflect those of Pegrum et al. (2013), whereupon both teachers and students agree that the devices can provide an opportunity to develop reflective skills.

Based upon the analysis of questionnaire and student interview feedback, it was clear that the vast majority of students perceived each of the learning activities to be both enjoyable and rewarding. In each of the case interviews, teachers reaffirmed the student feedback, whilst also suggesting that the intervention had also successfully addressed a number of the required Junior Cycle key skills. The findings from the case studies reflect previous literature and moreover suggest this affordance could potentially address a key aim of 'Managing information and thinking' within the Junior Cycle framework. However, in this instance, across all three case studies, evidence suggests minimal reflection due to both ongoing ICT issues and time restrictions within each school.

5.4.6. Assistive Learning

Unfortunately, as initially discussed, the researchers overall study did not provide any significant focus on the potential linkage between the affordances of tablet devices within the area of assistive learning. However the researcher believes this area holds potential for further work and inquiry.

5.4.7. Conclusion

In addressing this research question, evidence across all three cases clearly revealed high levels of student incentive to learn and participate within the intervention. The positive feedback from all participants demonstrates that students were 'considerably motivated'. Additionally, an increase in confidence levels in relation to engagement first suggested by students was later confirmed in teacher interviews. Teachers believed levels of collaboration during development of the artefacts by students had increased, however this was limited as a consequence of on-going ICT issues. Similarly with reflection, in the same manner, when the necessary affordances were available, reflection too was also limited. Evidence from participants confirm that levels of communication between students increased as the classes became very 'active', as they embraced the technology, engaged with the learning, and participated in developing their artefacts in a collaborative manner. As such, the researcher believes that the distinct affordances of mobile devices such as an iPad, can potentially address a number of aims promoted within the Junior Cycle Framework.

5.5. Research Question 2 – Pedagogy / Technology

What pedagogies fully leverage using iBooks Author content on mobile devices for teaching & learning in the context of the new Junior Cycle framework?

5.5.1. Pedagogical practice

Defined as the theory and practice of education, pedagogy encompasses the strategies adopted in order to teach, how content is developed, presented and delivered to achieve meaningful cognitive learning. The following section will discuss the changing role of the teacher and address the question of what pedagogies fully leverage using iBooks Author content on mobile devices for teaching & learning in the context of the new Junior Cycle framework. The findings of the current study will be compared to those in previous significant literature. Data analysis of the findings, provided key themes ('Pedagogy' & 'Technology') and relevant subthemes emanating from interview transcripts from both teacher and focus group interviews to address this specific research question. The early

findings by Cochrane (2010) identified no clear pedagogical theory for designing effective mobile learning. Cochrane furthermore identified other gaps including limited evaluation for mobile learning activities, determining the impact on learning and support for teachers and their students in mobile learning. While supporting this statement on pedagogical theory, Melhuish and Falloon (2010) further suggest such a pedagogical approach must maximise the potential of devices, such as the iPad in the context of teaching and learning. The findings from the researcher's case studies firstly reaffirm the conclusions of Melhuish and Falloon (2010) and provide evidence in the advantage of adopting a more learner-centred approach. With the literature further suggesting that the advantages outweigh the disadvantages in relation to tablet adoption Huber (2012), similar attitudes are elevated by Karsenti and Fievez (2013) describing iPads as having 'breath-taking cognitive potential'. Within the overarching theme of 'Pedagogy' a number of subthemes were defined from the current findings. These include the changing 'Role' of a teacher, the need for student 'Scaffolding' and the adoption of a more 'Student centered' approach to teaching and learning. This overarching theme of 'Pedagogy' and related subthemes are underpinned by class dynamics.

5.5.2. Role as facilitator

As Kovalchick and Dawson (2004, p. 194) suggest, the role of a teacher must switch to that of a facilitator in relation to curriculum-based integration of educational technologies. Although the literature has shown that teachers may initially become uncomfortable within this new adopted role, as reflected in the researchers own existing study, whilst students will adjust, become more responsible for their own learning and also become more motivated.

As more recently reaffirmed by Robertson (2017), this focus on student agency within education today, affords many adaptive schools the opportunity to provide the 'student voice' whilst positioning teachers firmly in the role as facilitators. The present findings reported across all three case studies are in agreement in relation to a positive change in practice as a consequence of the intervention.

This change reflects earlier studies by Twining et al. (2005) and Rikala et al. (2013), highlighting the opportunities provided by adopting digital tablet pcs in teaching and learning and the potential transformation in practice. This changing role from a 'sage on the stage' to that of a facilitator also echo's early educational drives for change (Fullan, 2013).

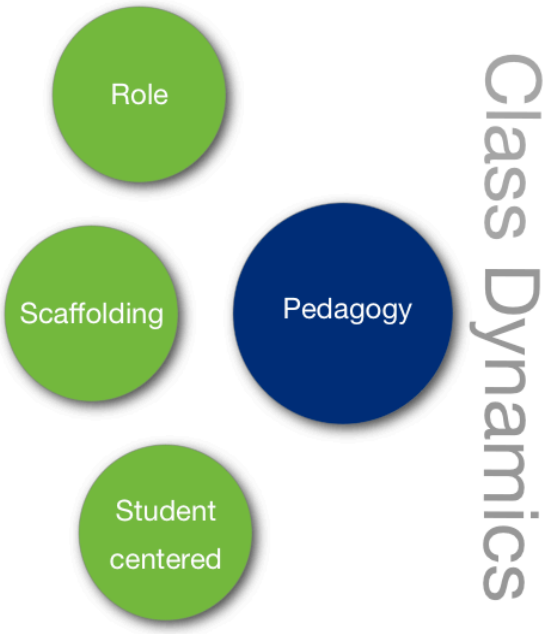


Figure 5-2: RQ2 – Pedagogy

In adopting more of a facilitator role, each of the teachers across the intervention relied upon a solid structure to afford students an opportunity to develop and create. In adopting the Junior Cycle key skills framework, teachers view themselves as facilitators of learning, moving away from the traditional pedagogy of direct transmission of content. As a consequence, teachers provide their students with more learner autonomy, transferring the responsibility of learning from the teacher to the student. Additionally, with digital technology positioned as potentially providing a significant role in the realisation of key skills, alongside their potential to enable learning experiences requiring communication, collaboration, problem solving and creativity skills amongst students; these affordances ultimately position the teacher as a 'facilitator of learning' while also meeting the need for 'innovative practices'. With the teacher as a designer of learning activities, the integration of motivational strategies within instruction affords learners the ability to achieve their academic goals.

As, a distinct consequence of the intervention, the findings indicate that students were actively participating more within group activities. As such, each of the learning activities developed by the teachers, facilitated 'active' project-based learning as promoted within the Bridge 21 model by Conneely et al. (2013), in relation to students gaining enhanced

research, observational and presentation skills. With its underlying theme of 'Peer Learning', the Bridge 21 learning model incorporates the following components:

- Team based learning – TBL can provide a positive impact on the progress of student learning, and the relationships with their peers and teachers.
- Technology mediated – Collaborative sharing of technology in provisioning Peer learning
- Project based – A structured approach to learning that involves challenging projects using technology supported by facilitators/mentors
- Cross-curricular – Project work across the curriculum

As findings from the intervention suggest, adopting a project based, technology mediated model across cross-curricular activities, adopting a Bridge 21 model, has provided a positive response from all participants within each of the case study schools. However, as the findings further highlight, this structure and change in practice necessitated the required sign posting to ensure students completed their required tasks.

5.5.3. Scaffolding

Best practice requires teachers to support their students with instructional assistance. This may come in the form of individual coaching, prompts, open-ended questions and discussion. Furthermore, to maintain student engagement, it is crucial that teachers consider the speed and rate of delivery of a lesson. The literature has clearly shown that instructional pacing '…is a robust alterable variable that, when systematically manipulated, can substantially affect student performance', (Tincani & De Mers, 2016, p. 817). While working in groups, the interventions' learning activities', developed by teachers, afforded students the ability to discuss and brainstorm with their peers when working collaboratively to develop interactive project content. The evidence from the researchers' study reflects the need for scaffolding students within a change of practice, in order to move them progressively towards a stronger understanding of specific topics. In developing the interventions unique learning activities', each of the teachers believe they provided the necessary scaffolding of students, clearly describing the activities purpose, the direction they must follow and the learning goals they were expected to achieve as a consequence. However, as the findings were to suggest, with this changing pedagogical approach there is a clear necessity to both prompt and provide sign-posting to students, to move responsibility of the learning away from the teacher and provide students an opportunity to take an active role in their own learning.

5.5.3.1. Student-centred approach to learning

A paradigm shift from the more traditional format of direct instruction, a student-centred approach typically offers interactive classes punctuated with engaging, learner-centred learning activities. Early literature in adopting such an active learning strategy, that shifts the focus of instruction from the teacher to the student at the centre of the learning process, describes an approach that is fraught with issues, Schweisfurth (2011). In the context of developing countries, the emerging evidence from 72 relevant articles related to Learner-centred education depict 'problems with the nature of reform and its implementation; barriers of material and human resources', (Schweisfurth, 2011, p. 1). However, while conflicting in its analysis, this research further highlights the lack of 'student voice' within this scenario. Linked to the overarching theme of 'Pedagogy', the findings of the current study are consistent with later research associated with the advantages of adopting a more student-centred approach to teaching and learning (Hallissy, Butler, et al., 2013). Moreover, in relation to the underlying theme in this instance of 'Class Dynamics', the research findings are consistent with findings from Barak et al. (2006), Henderson and Honan (2008) and Richardson (2010), suggesting that mobile devices provide students with a more personalised learning experience, whilst leaning towards a more meaningful interaction with their teacher. These findings reflect those echoed by Clarke and Abbott (2016) and Cochrane et al. (2010) who further emphasise a required addition to include a comprehensive pedagogy guiding their effective use. The data reported in the current study is aligned with the ideas of Hallissy, Gallagher, et al. (2013b), where schools must focus on key initiatives, such as Junior Cycle reform, when reconsidering a pedagogical approach using mobile devices. The current findings secondly indicate a positive significant change in practice coupled with the adoption of project-based group work as result of the intervention, across each case study. Collaborative group work has the potential to firstly motivate students, develop their key critical thinking skills and encourage active learning while potentially developing increased individual achievement and the enhancement of communication and development skills. While earlier studies highlight the advantages to the adoption of a more project-based approach Boaler (1997), recent findings by Pandey and Singh (2015) describe m-learning as lending itself to both collaborative and project-based learning, while supporting groups of students in their collective communication needs. Findings from teacher interviews within the current study, whilst reflecting the positive aspects within earlier literature, do suggest the need for continuing professional

development for teachers in relation to the various learning technologies available, to effectively engage and motivate their students.

In support of teacher feedback, findings provided from focus group interviews support this shift in teaching focus to a model that places greater responsibility and involvement on the students. In an Irish context, early research by Halbert (2005) has highlighted students disillusionment with the learning process with assessment practice, described as 'out of line' with best practice of high-performing educational systems in many other countries. Furthermore, with both teachers and students primarily focusing on learning for final external examinations, the need arose to empower schools with a framework encouraging schools to engage in a process of self-evaluation and reflection. With the reform of the Junior Cycle, teachers were provided with an opportunity to take more control and involvement in student assessment (NCCA, 2015). Moreover, with the introduction of technology within classrooms alongside the required transfer to students of 21st century skills in 'critical thinking', 'creativity' and 'collaboration', the affordances of mobile devices particularly highlight their potential to reposition assessment within a more student-centred model.

5.5.4. Assessment

As a process that both generates and gathers evidence of learning using various instruments and methods, educational assessment in particular provides detailed information on the learning progress of students. The combination and overlapping of both Formative (Quizzes, Classwork & Homework) and Summative (State assessments, End of Term examinations) assessment, complement each other to conclusively determine at a particular point as to what students know and potentially don't know. More recently, with the introduction of technology within classrooms there is an opportunity to develop innovative assessment design while adopting the SAMR model as a guide across disciplines, to further enhance student learning (Romrell et al., 2014).

In adopting a more 'learner-centred' approach to teaching and learning, Peer-assessment can also afford students a central role in the assessment process and feedback cycle. As such, providing an opportunity to engage students and develop their understanding of the assessment criteria. Findings from this study suggest that teachers within CS1 and CS3 had adopted a formative assessment approach to measure the

development, strengths and weaknesses of their students as they completed each of the learning activities. The findings reflect a move away from providing centralised examinations in re-positioning assessment. It further reflects how each study highlighted ensured that literacy and numeracy are key skills embedded in the learning within their classrooms. Recent literature suggests that both formative peer and self-assessment for learning is recognised and valued by teachers and their students, with Higgs et al. (2017, p. 5) declaring that '…unless we explicitly name our goals, and underpin our use of technology with principles of good assessment and feedback, the potential that technology offers for improved student learning may not be realised'. Whilst leveraging the potential affordances of new technology presents challenging issues for teachers, Sweeney et al. (2017, p. 13) further suggest '…by integrating taxonomies and frameworks, such as the transformation levels of SAMR and the teacher knowledge called for by TPACK, together with principles of good practice in assessment and feedback, we can inform pedagogical design and unlock the potential of TEA'. However, as recently discussed by Dalby and Swan (2019, p. 842) in relation to using iPads within formative assessment, '…the capacity of the software to provide formative feed- back and be adaptative to students' responses, greatly influences how significantly the iPad technology contributes to formative processes'.

5.5.5. Technology

In relation to the over-arching theme of 'technology', the key sub themes of particular interest were 'ICT issues', the element of 'distraction' and limited 'resources'. Early research by Lim (2011) while highlighting the ubiquitous nature of mobile devices alongside an appetite of users with mobile learning, suggest that technology requires accompanying effective guidance. As practitioners are keenly aware, technology plays a key role in enriching lessons due to its many affordances (Thompson, 2013a). The findings of the current study support Thompson's conclusions. However, a number of factors within the researcher's intervention played a significant impact to the overall findings. These included limited resources and subsequent technical and infrastructure issues related to ICT, and the potential 'distraction' factor related to the introduction of technology within a classroom.

Figure 5-3: RQ2 – Technology

Whilst the current study reflects the value of mobile technology as an educational tool and the significant role it can play in teaching and learning (Heinrich, 2012), it also highlights the various levels of limited technology experience and ICT support available across each of the case studies. One unanticipated finding was of students perception in relation to technology as a possible distraction. This finding, from a focus group interview in Study 2 (CS2), was unexpected and may reflect the current culture of many post-primary schools where the priority and focus is on high stake external assessments. As discussed by Dempsey (2016), policy makers in Ireland need to review how education can move away from the culture of standardisation to that of a more key skills based cultural approach. As confirmed by teachers and the literature, while they do recognise that distraction is an potential issue with the introduction of iPads, this they believe is inevitable with the introduction of any technology within a classroom (Henderson & Yeow, 2012).

The debate on adopting digital devices, such as tablet pcs in classrooms, is ongoing, as the multi-tasking capabilities of such devices provide a potential risk of distraction (Berkowitz et al., 2014; Chen, Teo, & Nguyen, 2019; Curry et al., 2019; Dobler, 2015; Gong & Wallace, 2012; Mango, 2015; Marmarelli & Ringle, 2011; Tay, 2016). As the

research confirms, digital distraction is typically a classroom management issue, the key for practitioners is to ensure that students are always 'on task'. However, distraction within the researcher's intervention was highlighted in the context of a particular schools culture in relation to assessment (CS2). Unfortunately, across all three studies within the intervention, each school was very limited in ICT resources, infrastructure and training, with each of these factors, impacting to varying degrees upon the completion of each of the learning activities. The researchers current findings support those of Anderson et al. (2018) who confirm that projects of a similar nature to the current intervention are fraught with high expectations linked to both time and resources.

5.5.6. Conclusion

The Junior Cycle promotes key areas of 'core learning', providing teachers an opportunity to embrace a change in practice, gaining an opportunity to focus their teaching and learning within a more learner-centred and inclusive manner when working with digital technology. The development of key skills has been driven by both an educational and industry drive for change, (Abbott, 2014; Butler et al., 2015; Fullan, 2013). In the context of the researchers study, feedback from teachers across each of the three cases concluded the need for clear guidance to ensure that they are on equal par (with their students) in relation to knowledge on digital technology, its adoption, its potential affordances and appropriate proven pedagogical strategies required to meet the teaching and learning needs of their students, aligned with the required Junior Cycle key skills. In addressing the research question, a number of key pedagogical strategies were highlighted as 'best fits' to a more 'learner-centred' approach adopted within the intervention. Findings from the literature have been consistently favourable to adopting approaches underpinned by the TPACK framework while requiring that continuing professional development is in place for teachers.

In the context of this study, the researcher advised the teachers to adopt the Bridge 21 model as part of the intervention to facilitate and foster creativity, collaboration and reflection, while mentoring the teachers to develop classroom learning activities related to their specific curricular needs. The evidence from each of the studies have provided positive feedback from all participants in relation to the developed learning activities and the opportunities these activities provided students in facilitating creativity, increased engagement, motivation, collaboration and reflection, moreover, affording students to develop as content creators, while gaining responsibility for their own learning.

The research findings from the intervention contribute to clearly establishing and confirming a defined changing role for teachers within their 'active' classrooms, as a consequence of the intervention. Teachers from across each study wanted to lead by example to their peers, whilst ensuring they attained the same level of literacy as their students. To actively embrace technology in a meaningful teaching and learning scenario, a defined pedagogical model is required, ensuring that teachers gain the vital and necessary 21st century technological skillsets. The current intervention highlighted the Bridge 21 model as a potential framework for teachers to improve skills in their professional practice while also affording students a unique and purposeful mix of technology and creativity. The three Post-Primary schools who actively engaged within the researcher's intervention have become beacon schools in how education is evolving within Ireland. Acting as exemplars to their peers, this cohort of teachers seek to become well versed in the methodologies and techniques within the interventions' adopted learner-centred approach.

Ongoing ICT issues and the availability of limited resources during the intervention provided some negative feedback across both surveys and interviews from participants. As a consequence, these issues are very likely to have impacted the overall findings. Furthermore, as noted in CS2, even with all the necessary technology and scaffolding in place, a number of negative comments from some students in a focus group highlighted their perceived non relevance of the intervention, due the researcher believes, to a school culture that prioritises assessment performance. As such, any standardisation of assessment (measurement of a students' ability compared to others of the same age) is firstly somewhat incompatible with a learner-centred, collaborate project based approach to teaching and learning as presented within the researchers intervention, as well as in any key skills based approach like the Junior Cycle Framework (Dempsey, 2016).

In conclusion, the findings within the researcher's intervention mirror the key characteristics required if teachers are to promote a more learner-centred and collaborative approach that facilitates digital technology adoption within their pedagogical practice. In some regards, the researchers own intervention has facilitated an insight into adoption of this approach and provided an opportunity whereby teachers can recreate the intervention within course design of their own.

5.6. Research Question 3 – Changing classroom dynamics

As a consequence of using iBooks Author with tablet pcs, in what ways have the dynamics changed between the teacher and student?

5.6.1. Classroom dynamics

As a consequence of using iBooks Author alongside iPads, the current study has provided a unique insight into changing classroom dynamics between teachers and students. As a result of the intervention the data analysis from the current study reflect those of early inquiries by Henderson and Honan (2008) and Richardson (2010). While the research in this area continues to be in its infancy, the current study endorses these earlier findings by confirming that the technology affords teachers the flexibility in provisioning a more personalised experience of teaching and learning for a teacher and their students. Research literature has defined the ubiquitous nature of digital mobile devices as having the potential to change the nature of teaching and learning (Johnson et al., 2013). Moreover, mobile tablet pcs, such as the iPad can, it suggests, additionally transform and redefine classroom relationships by moving the responsibility for learning from the teacher (facilitator) to the student (Burden et al., 2012b).

In fostering the debate on classroom dynamics, evidence from Van Maele and Van Houtte (2011) and Beauchamp and Hillier (2014) highlight the potential of tablet pcs' in enhancing classroom relationships. The existing study supports these findings in moving away from a teacher-centred model of instruction, to one where students can achieve their specific learning goals via meaningful and authentic learning. This paradigm shift, in contrast to earlier findings by Schweisfurth (2011), has provided an opportunity for learners to become much more responsible for their own learning and to subsequently enhance their learning through the adoption of digital devices and development of digital artefacts. As confirmed by Teacher A in CS1, when the students initially make a psychological investment in their own learning, they, '….take responsibility for their own learning, addressing those key-skills that are so important and the ability to work together with other groups, so important with coming into the workforce, college etc, research skills'.

This mutual and beneficial transformation as described by Burden et al. (2012a), does however provide initial challenges for teachers as they become co-facilitators to students who feel empowered to actively support their own teachers (Beauchamp & Hillier, 2014, p. 19). In making this shift, literature has emphasised how teachers experience

reservations as to their own competence and familiarity with the technology, as experienced by the teacher within CS2. As a consequence, teachers are initially uncertain as to the appropriate levels of scaffolding required for students, whilst highlighting the need for continuing professional development within their own roles (Johnston et al., 2015), as mirrored in the findings of the researcher's existing study.

5.6.2. Learning

A key theme of 'learning' developed from the analysis with relevant subthemes in the areas of 'Mentoring, 'Research Skills', 'Deeper learning' and 'Ownership/Responsibility'.

Figure 5-4: RQ3 – Learning

5.6.2.1. Mentoring

The researcher provided a number of mentoring workshops across each of the studies in relation to use of the iPads, Mac desktops and specifically on how to use and develop interactive content with Apples iBooks Author. Following initial mentoring of teachers, peer-mentoring support was developed for a number of enlisted students as mentors within each school class, who agreed to mentor other students during completion of each of the learning activities devised by individual teachers. Each peer-mentoring group

consisted of approx. 4-5 students. As the teachers within each study was to discover, students were proactively and successfully promoting digital fluency among their peers (Ostashewski & Reid, 2013).

In accordance with the present findings, previous literature has also demonstrated the 'domino effect' once students become aware of a new feature or function on an iPad, with subsequent ripples across the classroom (Goodwin, 2012), as evidenced by Teacher C from Study 2 (CS2), when describing how students became aware of a feature within the device or application, by the sharing of knowledge across individuals and groups by enthusiastic mentors. The existing findings from the researchers intervention further reflect those of Psiropoulos et al. (2016) suggesting that peer-mentoring (iBuddies) provides significant 'informal learning alliances'.

5.6.2.2. Research Skills

The present study mirrors those findings by Conneely et al. (2013), were in relation to students gaining enhanced research, observational and presentation skills, when they work collaboratively with their peers. As part of the Junior Cycle framework students are encouraged to develop their research skills. The intervention and learning tasks therein provided an appropriate opportunity for students to improve and develop in this area. Analysis of the data from the intervention reflect these key findings of Conneely et al. (2013).

5.6.2.3. Deeper Learning

The early research by Koole (2009, p. 38) has identified mobile learning as providing '…a deeper contextualization of learning'. The evidence from the current study are consistent with (Koole, 2009). As the focus group within Study 2 (CS2) describes,'…it was a lot more fun than just out of a book and it was a lot easier to learn'. This is further reflected in later research by (McCaffrey, 2011, p. 2) when describing the affordance of fostering deep and meaningful learning when using mobile devices. As the inquiry was to further suggest, students learn best whenever technologies, such as tablet pcs, are integrated into the curriculum to enhance the learning experience. This finding validates the ideas of Sachs and Bull (2012), who suggest that tablet pcs both enhance and provide a positive effect on student motivations to learn.

5.6.2.4. Ownership/Responsibility

Early literature has shown how the portability of digital mobile devices has the ability to change the nature of learning within a classroom whilst highlighting the movement in responsibility for learning as evident within the researchers own intervention, Burden et al. (2012b). This is further supported by findings from Hallissy, Butler, et al. (2013), who suggest that this active engagement additionally highlights the need to help students become critical thinkers whilst adopting their new role. As in the case of the researchers intervention, the findings suggests that autonomous learners within each study became more independent and responsible as reflected in feedback from all participants. As a consequence of adopting mobile digital devices, findings by Gray et al. (2017) highlight students acquiring increased confidence and ownership of the learning process. The evidence from the current study reaffirms this and earlier studies (Churchill, Fox, & King, 2012; Reed, 2013).

5.6.3. Creativity

As a core theme emerging from the analysis, creativity included key subthemes of students as 'Content Creators', 'Having Fun', and providing students with an 'Opportunity to Shine' within the classroom. The current findings firstly support previous research by Twining et al. (2005) whereby the versatility of iPad affordances can highlight the creative potential for students. The findings are also consistent with those of Hallissy, Gallagher, et al. (2013a), in provisioning to engage and connect students as life-long learners while meeting the needs of a 21st century society. In some instances the feedback from the current study also reflect those of students from an inquiry by Beauchamp and Hillier (2014), who feel empowered in their newly adopted role as '*content creators'* and masters of digital devices.

Figure 5-5: RQ3 – Creativity

As a consequence of a change in pedagogical practice combined with the affordances of digital tablet pcs, the literature has demonstrated how this consolidation can deepen the effectiveness of classrooms by supporting students creativity (Falloon, 2015; Lai & Hwang, 2014; Pandey & Singh, 2015). This move to a more student-centred digital content delivery is further supported in findings by Baab et al. (2016) in providing students the ability to develop relevant content and engage in meaningful lessons. The current study is also in agreement with strong convincing evidence by Falloon (2015) and Falloon (2017) in confirming apps such as iBooks Author contributing to higher order thinking, collaborative development and creativity within the adopted intervention. As concluded by the teachers, '…it is a really really good idea, they are all busy they are all working together, they are all sharing things'; ' they were using their imaginations, being creative. They can be very creative in the right forum and this is definitely the forum for it'. In accordance with the findings, previous research confirms that as a consequence of this change in pedagogical practice, students now find themselves formally positioned as content creators and knowledge makers. As such, the students within the intervention became responsible for their own learning, as reflected in previous research by Thumlert et al. (2018).

5.6.3.1. Content Creators

In a distinct shift to a more project based learning approach and as a consequence of the changing dynamics within the classroom, the evidence from the study indicate that students evolved in their role as 'content creators' whilst guided by their teachers, as reflected by Baab et al. (2016). The findings from the intervention, further echo those of Thumlert et al. (2018) in suggesting that as a consequence, students are now firmly positioned in the role as 'content creators' and 'knowledge makers'. From the teachers perspective, the content developed by students was of a 'very good standard', 'very creative' and consequently ensured that students understood the content much better than in a more traditional delivery method of teaching and learning. Across each of the case studies a consistent theme emerged of students feeling empowered in their new roles as 'content creators', while additionally describing the experience of the intervention as a 'fun' way of learning.

5.6.3.2. Fun/Opportunity to shine

Students within the focus groups, were vocal in their description of the 'fun' element in using tablet pcs as part of a project-based classroom activity. In reflecting the research of Beauchamp and Hillier (2014, p. 26), the study confirms how '…the multimodal capacity of the iPad increased their levels of engagement and disguised learning as something that could be described as fun'. The researchers intervention further reflects those of recent studies by Anderson et al. (2018) which produced similar findings that mirror those of (Harmon, 2012). Harmon's exploratory inquiry are also consistent with Education (2011) and the findings of Tirado-Morueta et al. (2019) confirming the engaging pedagogical affordances of iPads and their ability to provide a 'fun' aspect to learning.

5.6.4. Conclusion

There is a consensus within the literature discussed, that technology affords teachers the flexibility in provisioning a more personalised experience of teaching and learning for their students (Barak et al., 2006; Henderson & Honan, 2008; Richardson, 2010). Findings from the study suggest that each of the teachers across all three of the cases were positioned to facilitate learning and to ensure everyone was 'on task'. While some described their role a 'Project Manager' (CS2), others initially suggested they played the role of an 'observer', (CS1). As one of the teachers from (CS2) was to suggest, this type of informal classroom practice activated their students, provisioning a more 'positive'

classroom dynamic, whilst teachers in (CS3) highlighted a change in classroom focus, where students actively took responsibility for their own learning. In adopting a group-based approach to learning, the intervention reflects previous literature whereby students acknowledge the value of group work, while teachers have reshaped their role, resulting in improved classroom engagement (Johnston et al., 2015). The conclusions from the intervention support these findings in affording students an opportunity to achieve their specific learning goals via meaningful and authentic learning.

5.7. Thematic Analysis Findings

The following discussion offers a high-level thematic synthesis of the qualitative data collected from the intervention. In choosing to adopt a thematic approach as defined by Braun and Clarke (2006), the researcher believed this approach provided a rigorous methodical manner in which to yield meaningful, trustworthy and insightful findings from the research data. Whilst advocating thematic analysis in qualitative analysis, Braun and Clarke (2006) additionally provide clear distinct guidelines. While thematic analysis is not aligned to any specific pre-existing theoretical framework, Braun and Clarke do suggest that the theoretical position of any qualitative analysis is made distinctly clear. In arguing that thematic analysis should be considered a method in its own right, the Braun and Clarke approach is considered both independent of theory and epistemology but applicable to 'Conversation analysis', 'Interpretive analysis', 'Grounded theory', 'Discourse analysis' and 'Narrative analysis'.

5.7.1. Dominant themes

As suggested by Braun and Clarke (2006), similar to pieces of a jigsaw puzzle, themes can provide a meaningful and luminous picture of the data analysed. During the analysis process the researcher identified a number of dominant central themes. To ensure the credibility of the findings, these themes were not deemed final until the entire dataset had been re-read on a number of occasions and its relevant coding were subsequently analysed.

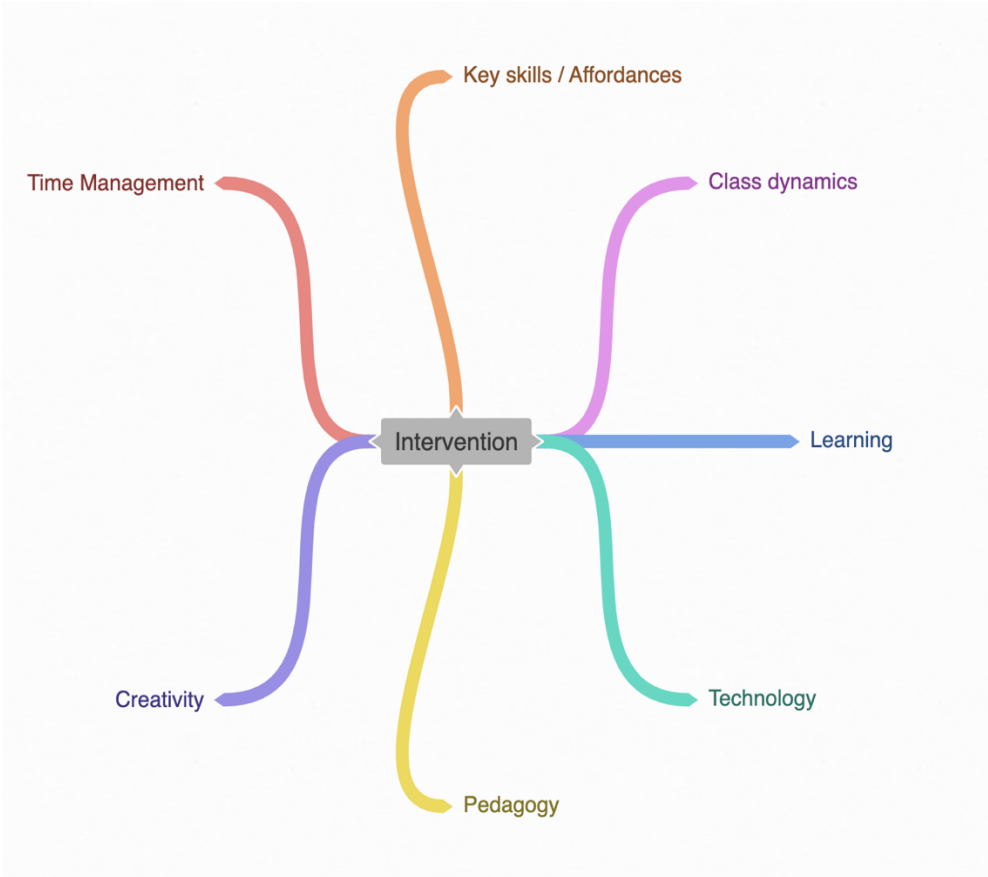


Figure 5-6: Dominant research themes

As one of seven dominant themes identified by the researcher's thematic analysis of the data include, 'key skills/affordances', which chronicles the underpinning subthemes discussed by teacher and student participants in characterising the links between the key affordances of tablet pcs to the key skill elements within the Junior Cycle framework, (Hutchison et al., 2012). The second dominant theme of '*classroom dynamics'* highlights feedback on how technology and a subsequent change in pedagogical practice transformed and redefined classroom relationships during the intervention, (Henderson & Honan, 2008; Richardson, 2010). The third theme of '*Learning*' encapsulates the various effects as a consequence of digital technology adoption within a curriculum, as evident within the intervention, with students acquiring confidence and ownership of their own learning and subsequently sharing this knowledge collaboratively with their peers, (Gray et al., 2017). The forth dominant theme relates to the on-going ICT issues encountered within the intervention, the lack of adequate resources as well as the potential element of distraction in relation to technology adoption. The fifth theme of '*pedagogy*' illustrates the changing role of teachers to that of a 'facilitator', the need for scaffolding with students and the change in role for students as 'content creators', as witnessed by teachers across each study, (Salmon, 2013). As a direct consequence of

this, students were provided an opportunity to develop their creative potential - content creators (Twining et al., 2005), as portrayed and witnessed in the sixth dominant theme of '*creativity*', (Falloon, 2015). The seventh and final dominant theme relates to the underlying issue of '*time management'* during the intervention, when adopting a more learner-centred approach to teaching and learning with the additional technological complexities encountered.

5.7.2. Sub themes

A number of dominant themes including '*key skills/affordances', 'learning', 'technology', 'pedagogy'* and *'creativity'* developed into sub-themes to provide further insight into related patterns, as displayed in the thematic map below, illustrating the relationships between dominant themes and their related subthemes.

Figure 5-7: Research subthemes

Of particular interest are the sub-themes attributable to the dominant theme of 'key skills / Affordances', depicting the relevant links to the aims of the Junior Cycle framework. Secondly, the key theme of '*learning'* contains noteworthy established sub-themes providing variance within a theme. In this instance, the thematic mapping provides

insight into the unique skills/abilities attained by students, as a consequence of the intervention. The dominant theme of '*technology*' provided a number of subthemes in relation to *'distraction' and 'resources'* with pedagogy providing subthemes related to a changing *'*role' and the need for teachers to provide the necessary *'scaffolding'* to students. Also of particular interest was the subtheme of '*Infrastructure*' which reflects findings from Mac Mahon et al. (2016), who encountered similar challenges in relation to infrastructure and additional attitudinal factors among teachers adopting iPads. As such, feedback from interviews were reflected in some negative findings from those attained within survey responses related to technology. Finally '*creativity*', as highlighted earlier, has shown how a change in pedagogical practice combined with the affordances of tablet pcs can potentially provide students an opportunity to firstly have fun while learning, become content creators, with the opportunity to 'shine' within the classroom as they present their work.

Chapter 6. Conclusion and Recommendations

'Placing learners at the heart of the learning process and meeting their needs, is taken to a progressive step in which learner–centred approaches mean that persons are able to learn what is relevant for them in ways that are appropriate. Waste in human and educational resources is reduced as it suggested learners no longer have to learn what they already know or can do, nor what they are uninterested in' (Edwards, 2001, p. 37)

6.1. Introduction

The purpose of this research was firstly to determine how mobile devices (such as tablet pcs) can contribute to the realisation of the aims from within the Junior Cycle framework. To address the three core research questions, a survey and case study approach were adopted to complete the research inquiry. The research sought to further address the affordances of mobile devices with the aims of the Junior cycle key skills, what pedagogies fully leverage using iBooks Author content on mobile devices for teaching & learning, and as a consequence, discover what ways have dynamics changed between the teacher and students. While these questions have not been answered to date and while research in this area continues to be in its infancy, this research has set out to both address and answer each research question accordingly. This chapter will discuss the implications of the research study in relation to practice, policy and potential future research. Moreover, it will include the study's original contribution to knowledge and further address the key limitations to the research. In addition, this chapter will present a number of theoretical implications in relation to the significance of the study. In conclusion, the researcher reiterates the importance of aligning the affordances of mobile devices with key skills within the new Junior Cycle Framework and subsequently present a number of potential avenues for future research within the area of Technology Enhanced Teaching and Learning.

Within this inquiry, the researcher developed an intervention that initially included a number of Continuous Professional Development workshops with teachers and students acting as peer mentors, in using the iBooks Author application to develop interactive content for tablet pcs. The researcher mentored teachers in developing a series of student 'Learning Tasks' based upon the 'Bridge 21' team-based learning model and subsequently provided follow up CPD sessions when necessary. The intervention started in late September 2018 until May/June 2019.

The purpose of this study was to inquire and critically evaluate, within an Irish context, how mobile devices (such as tablet pc's) can contribute to the realisation of the aims of the Junior Cycle framework. In providing a better understanding of the contribution of digital devices in 21st century classrooms the research provides a distinctive insight into such technological adoptions and their perceived affordances for teaching and learning. The available literature on this subject and specifically in the context of the Junior Cycle Framework is inconclusive on several vital questions within the educational discourse.

6.2. Research Questions

The study sought to answer a number of these key questions:

- How can teachers take advantage of the affordances of mobile devices and in particular the iBook Author application in their instructional activities, so as to address the aims of the new Junior Cycle (*motivation, engagement, communication, collaboration, reflection and assistive learning*)?
- What pedagogies fully leverage using iBooks Author content on mobile devices for teaching & learning in the context of the new Junior Cycle framework?
- As a consequence of using iBooks Author with tablet PCs, in what ways have the dynamics changed between the teacher and student?

6.3. Methods adopted to address the research problem

Underpinned by a constructivist epistemology, whilst adopting a combination of both positivist and interpretivist perspectives, the researcher's study sourced both qualitative and quantitative data to answer the research questions guiding the inquiry. Survey and Case Study approaches were adopted to examine the research questions within the inquiry at three post-primary schools in Ireland. The methods adopted, included pre and post-test online questionnaires, followed by development of individual learning templates from the teachers and subsequent teacher interviews and focus group interviews with students. Both statistical (SPSS) and thematic (Nvivo) analysis were conducted on the complete dataset collected.

6.4. Contribution

The original **contribution** that this study has made to **knowledge** is accessing the effect of adopting a more learner-centred approach to teaching and learning using digital devices within a sample of Post-Primary schools in Ireland. As such, the research supported and enabled teachers to plan and implement technology mediated learning approaches. Moreover, this unique study is **original** as it explored the link between the adoption of these approaches and student outcomes, with respect to a number of key skills. The research further augments our understanding of embedding digital devices (such as an iPad) within teaching and learning in general and additionally adds to the growing body of knowledge on this particular topic (Attewell & Webster, 2005; Beauchamp & Hillier, 2014; Burden et al., 2012b; Clarke et al., 2013; Couse & Chen, 2010; Education, 2012b; Falloon, 2015; Fisher et al., 2013; Goodwin, 2012; Hallissy, Gallagher, et al., 2013b; Heinrich, 2012; Leinonen et al., 2014; Sachs & Bull, 2012; Twining & Evans, 2010; Twining et al., 2005; Valstad, 2011). Moreover, this study also attempts to **fill the gap** in assessing the effect of changing dynamics in a classroom as a consequence of adopting iBooks Author, to develop interactive content for tablet pcs.

6.5. Limitations

It is acknowledged that the current research study has certain limitations which need to be addressed. The study has been specifically concerned with the affordances of iPads in relation to the Junior Cycle key-skills, the relevant pedagogical approach necessary to facilitate a more student-centred approach to learning and the subsequent changing dynamics as a consequence of the intervention. From a total of 160 post-primary schools originally contacted as having recently adopted digital tablet technology, only a small number of ‘early adopters’ agreed to formally take part within the study (n=3). Moreover, this investigation within each of the 3 schools was further limited due to the small number of teachers willing to participate in this study (n=5). While exploratory discussions initially began in September 2018, the short time frame for data collection, which occurred between January and May of 2019, created a further limitation to this study. Given the brief timeframe of the intervention, in addition to the small sample data size, limits the generalisability of the researchers study to broader contexts. Moreover, the transferability of these findings may not be plausible due to limited participants and particular school contexts.

A number of technical issues frustrated both teachers and students alike. These included; each school with access to only one MAC desktop computer in which to create and develop interactive iBooks. Limited resources in relation to on-site IT support across all devices, network connectivity and on-going ICT issues. Moreover, in each instance, the teachers and students within the intervention had only limited experience of using the MAC OS desktop operating system and furthermore for some teachers, a limited knowledge of both the pedagogical and technological affordances of digital tablet pcs, such as an iPad. As such, these limitations firstly provide evidence for participants contemplating to replicate the researchers intervention and secondly could potentially offer research opportunities within a follow-up study.

6.6. Empirical Findings

This section will synthesize the empirical findings to answer the study's three research questions.

1) How can teachers take advantage of the affordances of mobile devices and in particular the iBook Author application in their instructional activities, so as to address the aims of the new Junior Cycle (*motivation, engagement, communication, collaboration, reflection and assistive learning*)?

Quantitative data gleaned from pre and post online questionnaires provided unique insights into participant levels of competence in relation to motivation, engagement, collaboration and assistive learning. The findings within each study clearly identified a number of key affordances of tablet pcs, providing a clear link between the affordances and a number of key skills within the Junior Cycle Framework. However, there is less convincing evidence in relation to the skills of reflection and communication due to the aforementioned technology related issues within each study.

The research has found that there is a clear link between a number of the affordances of tablet pcs to some of the core key skills within the Junior Cycle Framework. This type of mapping has been identified as critical to providing insights into participant levels of competence in relation to *motivation, engagement, communication, collaboration, and reflection* and is central to the core key skills within the Junior Cycle Framework. Given that the intervention found consistent increased levels of Motivation, Engagement and Collaboration in particular, the findings suggest that embedding digital devices such as iPads can be effective in this setting.

2) What pedagogies fully leverage using iBooks Author content on mobile devices for teaching & learning in the context of the new Junior Cycle framework?

The intervention did have a clear impact across all three studies as supported by the data. Within each study, the five teachers, within various degrees, did change their pedagogical practice as a consequence of the intervention. The overall findings were predominantly positive from both the teachers and students in acceptance of this change in practice. Moreover, the current research reflects previous literature that suggests teachers would clearly benefit from continuous professional development and related structured support that demonstrates how to effectively incorporate digital devices into their curriculum alongside a shift in practice that leverages the potential affordances of tablet pcs. In many regards the existing inquiry reflected the expectations and findings of previous research by Cochrane et al. (2013, p. 59) whereby their intervention provided an opportunity to '…transition teacher pedagogy from instructivist to constructivism with technology as a catalyst that enabled collaboration, communication and student-generated context and content'. As reflected in research by Falloon (2015), the researchers intervention has provided a unique opportunity for students to interact with their peers as they collaboratively express their creativity as a consequence of a distinct change in pedagogical practice. As recent findings by Dalby and Swan (2019, p. 844) suggest '…many existing pedagogies can be harnessed and used effectively when using iPad technology in a classroom situation'.

The thesis differs from other studies related to a change in pedagogical practice as a consequence of adopting technology. It owes a factual and interpretative debt to early studies by Cochrane (2010) in relation to the success factors related to mobile learning and to Melhuish and Falloon (2010) and Vrtis and Hansen (2010)'s assessment of the collaborative and creative affordances of tablet pcs. In other respects it has benefited from the foresight presented by Huber (2012) and from Thompson (2013a) in relation to the potential of tablet pcs and the subsequent requirement of a comprehensive pedagogy guiding their embedding into teaching and learning. In these writings it is possible to find descriptions and analyses of the 'promises and pitfalls' of digital learning which this thesis does not intend to match. What it rather does is to present a broader perspective on the pedagogical affordances of tablet pcs, creative pedagogical practices, their direct impact on student learning and the accompanying required mandatory guidance required by teachers (Lim, 2011). If it is successful in these respects, then much is owed to the work of Melhuish and Falloon (2010), Heinrich (2012), Hallissy, Gallagher, et al. (2013b) and Johnston et al. (2015).

3) As a consequence of using iBooks Author with tablet PCs, in what ways have the dynamics changed between the teacher and student?

The dynamics within each class of all three case studies have changed in a positive manner with classrooms transformed to becoming ‘active’ in nature with the inclusion of peer mentoring. In a number of instances across all three studies positive feedback, confirmed by focus group comments by students have reaffirmed the positive manner in which the dynamics have changed as teachers begin to see their students adopting ‘leadership roles’, as ‘more relaxed’ with ‘greater focus’. As a consequence group dynamics were key as students agreed various roles building upon their relationships with fellow peers, with some adopting ‘leadership’ roles within each group and their teacher acting in the role as a ‘facilitator’ to learning.

The thesis builds on and contributes to work in the field of ‘active learning’ as described in early research by Barak et al. (2006). Although a number of studies from Barak et al. (2006), Henderson and Honan (2008) and Richardson (2010) have examined a more personalised learning experience in using mobile devices, there has not been a strong focus on the addition of a comprehensive pedagogy guiding their effective use as highlighted by Clarke and Abbott (2016) and Cochrane et al. (2013) . As such, the existing study provides additional insights, within an Irish context, into the changing class dynamics as a consequence of the researchers intervention.

This research further differs from early studies in relation to the provision of a more personalised experience of teaching and learning by identifying the potential to enhance classroom relationships. In doing this it draws strongly on the work of Burden et al. (2012a) and Beauchamp and Hillier (2014) who describe the movement towards empowering teachers and students acquiring the roles as co-facilitators. Overall, the empirical findings have provided an invaluable and interesting insights into the positive changing dynamics in adopting digital devices in the context of developing project-based content. This interpretation challenges the work of those critics who have repeatedly questioned the validity of introducing technologies within a classroom (Bowers, 2011; Cuban, 2009; Oppenheimer, 2007).

6.7. Theoretical Implication

Having presented the study's major empirical findings in the previous section, the following paragraphs will now serve to critically deliberate these findings and determine their theoretical and practical implications as related to each of the three research questions.

6.7.1. Research question 1 – Tablet affordances linked to Key skills

In this thesis I draw on the work of Valstad (2011) to make my argument that there is an immediate impact to student motivation once mobile devices, such as an iPad, are introduced within a classroom. As reaffirmed by both Sachs and Bull (2012) and Twining et al. (2005), digital devices such as an iPad do have a 'positive' effect on student motivation as reflected in the researchers own study, due primarily to their introduction and their subsequent use in a collaborative 'project based' approach to teaching and learning. Clarke et al. (2013) emphasis on the 'iPad Factor' is especially useful to my analysis as it allows me to think through the 'link' between this initial affordance to that of the 'Managing myself' key skill requirement within the Junior Cycle Framework. Karsenti and Fievez (2013) conceptualisation of 'motivation' is generative for grasping how devices such as an iPad reaffirms that initial motivational factor when introduced within classrooms. It is here also that Flewitt et al. (2015) attention to the considerable motivational factor provided by digital devices but also to its potential in improving student literacy, supported by the findings of the researcher's own intervention.

The researchers study further offers suggestive evidence that supports high levels of interest and engagement during the intervention, reflecting previous inquiries by Couse and Chen (2010) and Brown et al. (2014). This pattern is consistent with that presented by McCaffrey (2011) and imitated by Clarke et al. (2013). Of particular significance is the existing study's findings in reaffirming increased levels of engagement when accessing interactive digital content, (Bikowski & Casal, 2018). The early adoption of tablet pcs have highlighted their potential collaborative affordance due primarily to their ubiquitous nature (Fisher et al., 2013). The existing research similarly supports this conclusion in providing unique opportunities to develop and share content, reflecting the previous studies by Jahnke and Kumar (2014) and Falloon (2015). In contrast, the theoretical cases in relation to tablet pcs providing both 1-2-1 or collaborative communications whilst also potentially increasing student communication skills, do provide significant promise, however in reality these are very dependant upon a number of key factors. The existing study is in agreement with the potential but contradicts earlier research by

suggesting that a positive outcome is only dependant upon acquiring the necessary network infrastructure and planning Osmon (2011) and Gray et al. (2017).

6.7.2. Research question 2 – Pedagogy

The theoretical cases for a transformation in practice, as a consequence of tablet adoption, reflect those of the researchers intervention, highlighting the cognitive potential, the changing role of teachers as 'facilitators' while provisioning more learner autonomy, as illuminated by Twining et al. (2005) and Rikala et al. (2013). The existing study is consistent with previous findings in relation to adoption of a more pro-active 'learner-centred' approach to teaching and learning (Hallissy, Butler, et al., 2013), whilst furthermore validating the need for a comprehensive pedagogy with the embedding of technology within classrooms. However, as the findings demonstrate, for deep change to pedagogies to occur, there needs to be curriculum alignment between subject, assessment and teaching and learning approaches.

In adopting this new role as a 'facilitator', the initial challenges expressed by teachers began to quickly abate as they witnessed the positive impact upon student engagement and motivation of the adopted approach. While students are typically subject to traditional didactic teaching methods within their classrooms, the intervention provided a number of clear succinct opportunities for both teachers and students to experience innovative practice using digital technology. Furthermore, as the intervention progressed, students developed unique reusable learning artefacts and skills far exceeding the expectations of their teachers. While students completed each of the three learning activities, the initial scepticism shared by teachers within their newly adopted role as 'facilitator' quickly dissipated as their confidence grew in watching students take a positive and 'active' participatory role in the technology-assisted, learner-based approach. As reflected by Beauchamp et al. (2015, p. 177), this thesis has illustrated the intuitive and easy to use nature of digital mobile devices, such as an iPad, that can act as a '…critical factor in enabling teachers and pupils to co-construct their skills in a fashion which is non-linear, playful and experiential'.

6.7.3. Research question 3 – Class dynamics

In addressing the question of a change in classroom dynamics, the thesis draws upon the early work of Henderson and Honan (2008) and Richardson (2010) in arguing that

the ubiquitous nature of digital devices afford both opportunities and flexibility in providing a more personalised learning experience for students. While in agreement with their comments, this thesis furthermore firmly reaffirms the findings of Burden et al. (2012b) in relation to the shift in responsibility for learning, from the teacher to the student in relation to using digital devices. However, as this thesis has discovered, even with all the relevant facets in place, a school culture (in relation to assessment) can overshadow new approaches to teaching and learning. The distraction issue discussed earlier is ultimately related to student expectations and how students are being taught and the experiences therein. In contrast, the willingness by students to support their teachers was very evident in the thesis as depicted in earlier findings from Beauchamp and Hillier (2014).

6.8. Policy implication

The findings and conclusions of the thesis collectively have a number of policy implications. The objective of the original Lisbon Agenda, replaced in 2010 by 'Strategy Europe 2020', was to develop the EU's economy based on 'knowledge', whilst striving to develop economic dominance within the global market via research, innovation and competitiveness. The newly adopted Strategy Europe 2020 is primarily focused on developing an economy based on knowledge and innovation – Smart Growth; promoting a more resource efficient, greener and more competitive economy – Sustainable growth; fostering a high-employment economy delivering social and territorial cohesion – Inclusive growth. To date, Ireland has only shown a medium-low level of implementation of the strategy compared to high-level implementations from those of Sweden, Finland, Denmark and Austria, (Stec & Grzebyk, 2018).

As highlighted by the OECD, knowledge 'workers' rely on workplace competencies, including '…communication skills, problem-solving skills, the ability to work in teams and ICT skills, among others, are becoming important and complementary to basic core or foundation skills', (Co-operation & Development, 2000). As such, education plays a pivotal role in helping students to develop the necessary higher-order thinking skills, to both think critically and creatively while working collaboratively with their peers. Whilst originally influenced by the Lisbon Agenda, the full implementation of the Junior Cycle Key-skills Framework is therefore critical to student success, in an integrated format within many areas of the curriculum. Key to this success is the alignment of the subjects with assessment and approaches to teaching and learning. This research supports this

observation in adopting a more 'learner-centred' approach to teaching and learning, as reinforced by OECD Secretary-General Angel Gurria who advocates that, ' …skills have become the global currency of the 21st century', (DES, 2016a, p. 6).

This research has used empirical findings to show that to implement key skills in second-level schools at Junior cycle level requires the changing of how teachers teach and how their students learn. Furthermore, the current research has presented findings to illustrate that the affordances of mobile devices, such as a tablet pc, do have the potential to be aligned with the key skills within the Junior Cycle Framework. However, as the evidence further suggests from several studies including Butler et al., 2015 and this thesis, the successful embedding of digital technologies for the implementation of key skills firstly requires a change of practice, secondly a change in pedagogical approach to teaching and learning, thirdly ongoing professional development and finally an alignment of subjects with assessment and revised curriculum.

The findings from this study question if national policy initiatives such as Schools IT 2000 have made the anticipated impact within Irish schools. The theoretical arguments for this justification suggest the need for clarity regarding educational purpose and a policy review in relation to a digital strategy for schools in Ireland as reflected in the release in October 2015 of the Digital Strategy for Schools 2015-2020 initiative. One particular policy program with extended theoretical underpinnings was the Digital Learning Framework, that supports the Digital Strategy for Schools initiative (DES, 2017b). The current research aligns and complements 'The Digital Learning Framework for Post Primary Schools' in relation to embedding digital technologies into teaching and learning practice and its strategic long-term objectives, based upon adopting constructivist principles that foster a student-centred approach to teaching, learning and assessment. As such, research-informed reviews continue to analyse and discuss and evaluate effective learning and how it relates to key 21st century competences (McGuinness, 2018) and (OECD, 2018). Findings by the European Commission (2020) based upon a recently updated open consultation between June – September 2020, suggest that 60% of respondents have not used distance and online learning prior to the COVID-19 crisis. Furthermore, 95% consider the crisis marks a change in the use of technology in education and training. With the need for content to be both interactive and relevant, over 60% suggest an improvement in the digital skills as a consequence of the crisis with more than 50% wanting to do more. Whilst a complex challenge, future policy is

now linked and guided by EU research and policy, with an awareness to adapt, as has been achieved within the researchers current study and progress this to online/remote teaching and learning.

6.9. Future Research

In both an Irish and international context, the scale of the debate within education in relation to technology embedded within teaching and learning and the potential impact to student learning, is both extensive and multifaceted. To generate and develop achievable educational policy strategies with regards to pedagogy, curriculum, assessment and continuous professional development, there is a requirement for additional case studies at a national level to further assess the unique dimensions of this ongoing discussion.

The study has resulted in identifying a number of recommendations for potential future research. Firstly, one avenue for further study would include further research into the alignment between curriculum, pedagogy, assessment, key skills and technology, with particular emphasis on alignment. Secondly, there is a further opportunity to explore the adoption of mobile digital devices in the context of remote learning, as students develop their skills to become effective online learners.

6.10. Conclusion

6.10.1. Introduction

This thesis has attempted to document and evaluate an intervention designed by the researcher to address the three core research questions within the overarching inquiry. A number of tools and pedagogical frameworks have been highlighted to help foster the use of innovative education technologies within teaching and learning to assess teacher training and students' digital competence. This thesis also addressed the history and culture of technology in education and the educational drive for change. The thesis has sought to present relevant pedagogical frameworks, studies and practices to successfully implement a key skills approach to teaching and learning using tablet pcs. This thesis has further argued that policy needs to reflect the transformative change in learning through collaborative content creation by students, that also supports the need for Continuing Professional Development of teachers coupled with changes to

curriculum and assessment. The researcher acknowledges the limited sample size of within the research study.

This research supports the need for the adoption of a social constructivist, technology assisted project-based approach to teaching and learning to ensure engagement with students as life-long learners while meeting the needs of a 21st century society. Accordingly this research study, whilst reflecting similar studies related to mobile device adoption within education, aims to inform future policy, educational practice and inquiries into embedding technology within teaching and learning. However, as discussed by Fullan and Donnelly (2013, p. 10) '…the complex and dynamic relationship between technology, pedagogy and change knowledge will need to be developed and nurtured if we are to get 'whole system reform'.

A number of salient factors have emerged from the findings, including the adopted role of facilitator by teachers and the subsequent role of content creator as adopted by students, actively taking ownership and responsibility for their own learning. Furthermore, this inquiry has demonstrated the successful alignment of mobile device affordances linked directly to a number of related key skills and their overall potential within teaching and learning. The findings clearly suggest increased confidence levels in Motivation, Engagement, Collaboration and Communication. However, the researcher acknowledges the limited sample size of the participants within the research study, therefore these results must be viewed with caution.

The thesis builds on and contributes to work in the field of teaching and learning with embedded technology. Although a number of studies by Goodwin (2012), Sachs and Bull (2012) and Clarke et al. (2013) related to motivation, Attewell and Webster (2005), Boyce et al. (2014) and McCaffrey (2011) with engagement, Sneller (2007) on communication, Falloon (2015) and Fischer et al. (2013) on collaboration and Leinonen et al. (2014) and Pegrum et al. (2013) regarding reflection, there has not been a strong focus on the impact of digital tablet pcs and their affordances in relation to key skills and competences. As such, this study provides additional insights into a change in pedagogical practice and the subsequent change in roles and class dynamics for teachers and students (Cochrane, 2010; Huber, 2012; Lim, 2011; Melhuish & Falloon, 2010; Thompson, 2013a). This research, in an Irish context, differs from previous

studies by identifying and documenting the affordances of digital tablet pcs aligned with this change in pedagogical practice for students to attainment of the necessary 21st century skills. In doing so it draws strongly on a number of key previous studies, (Beauchamp & Hillier, 2014; Burden et al., 2012b; Education, 2011; Goodwin, 2012; Hallissy, Gallagher, et al., 2013b; Heinrich, 2012; Melhuish & Falloon, 2010; Twining et al., 2005).

In conclusion, it is hoped that this research model and its subsequent intervention findings, will provide teachers within post-primary schools with the necessary guidelines to develop a relevant short course of their own, as part of the new Junior Cycle Framework (NCCA, 2019).

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Appendix A – Junior Cycle Key skills

Appendix B: Research literature

Authors	Study	Methodology	Methods
Twining, P., Evans, D., Cook, D., Ralston, J., Selwood, I., Jones, A., . . . Heppell, S. (2005). Tablet PCs in schools: Case study report: A report for Becta by the Open University.	Tablet PC's in Schools **Research Questions/Objectives:** How are tablets being used in these schools? What is the impact on the curriculum, staff and students?	Multiple Site Case Study: Mixed Methods approach	1. Questionnaire completed by the ICT co-ordinator and followed by an interview 2. Interview with a member of the senior management team (SMT) 3. Separate observations of two key users, who were then interviewed 4. Portfolios illustrating how Tablet PCs were used, compiled by the two key users 5. Logs of Tablet PC use over a two-week period, compiled by the two key users 6. Further interviews with the two key users to follow up on the portfolios and usage logs.
Attewell, J., & Webster, T. (2005). Engaging and supporting mobile learners.	Mobile learning anytime everywhere: A book of papers from mLearn 2004 **Research Questions/Objectives:** The m-learning project involved four years of planning, research and development plus reflection and large-scale trials of mobile learning systems and learning materials with hard-to-	Case Study	1. Questionnaire 2. Interviews

	reach learners in diverse situations in three European countries .		
Education, C. (2011). Diocese of Parramatta.(2011).	iPads in schools: Use testing. **Research Questions/Objectives:** Exploring six focus areas, including: the learning settings best supported by the *iPad*, learning affordances of the *iPad*, student engagement, use with students with learning difficulties, the educational value of Apps and any technical or administrative issues encountered in the management of *iPad*s in schools.	Multiple site Case Study	1. Pre- and post-pilot surveys 2. End-of-pilot school presentation 3. Apps used by each site 4. Post-pilot interview 5. Project blog
Heinrich, P. (2012). The iPad as a tool for education:	A study of the introduction of iPads at Longfield Academy **Research Questions/Objectives:** Initial impact of the iPad on learning and teaching throughout the school and the social and technical issues arising.	Survey Research	1. Surveys 2. Structured site visit (Interviews) 3. Observations
Goodwin, K. (2012). Use of tablet technology in the classroom. NSW Department of Education and Communities.	Use of Tablet Technology in the Classroom. **Research Questions/Objectives:** Providing information to schools to allow informed purchasing decisions. Identifying critical ramifications of tablet technologies on teaching	Case Study. Mixed Methods approach	1. Surveys 2. Semi-structured interviews 3. Observations.

	and learning. Identifying appropriate opportunities for professional learning for teachers.		
Burden, K., Hopkins, P., Male, T., Martin, S., & Trala, C. (2012). iPad Scotland evaluation. University of Hull	A case study of mobile technology adoption from eight individual educational locations in Scotland. **Research Questions/Objectives:** What does learning and teaching look like when students and teachers have access to a personal tablet device? How does personal ownership of a tablet device by students impact on parents and other carers? What are the leadership and management implications associated with the shift to a tablet device strategy for schools? What models of professional learning and development are effective in supporting the take up of tablet pcs by teachers?	Case Study. Mixed Methods approach	1. Online surveys 2. Interviews 3. Focus groups 4. Analysis of documents.
Clarke, B., Svanaes, S., & Zimmermann, S. (2013). One-to-one tablets in secondary schools: an evaluation study. Tablets for Schools.	One-to-One tablets in Secondary Schools **Research Questions/Objectives:** The overall research objectives for the research study were to find out whether the feasibility of providing Tablets to secondary school pupils in the UK can be justified in terms of pupil benefit,	Multiple Case Study: Mixed Methods approach	The three schools were in Belfast, Kent and Essex. 1. Interviews with school leadership were carried out in all schools 2. Plus observation of tablet learning. 3. In addition eighteen focus groups were carried out with pupils, parents and teachers.

	teacher benefit, pupil learning, potential risks including safety and security, cost, and acceptance by pupils, teachers and parents.		
Johnson, L., Adams, S., Cummins, M., Estrada, V., Freeman, A., & Ludgate, H. (2013). The NMC horizon report: 2013 higher education edition.	**Research Questions/Objectives:** Examines emerging technologies for their potential impact on and use in teaching, learning, and creative expression within the environment of pre-college education.	Survey Research	This process takes place online, where it is captured and placed in the NMC Horizon Project wiki. The wiki is intended to be a completely transparent window onto the work of the project, and contains the entire record of the research for each of the various editions.
Beauchamp, G., & Hillier, E. (2014). An Evaluation of iPad Implementation Across A Network of Primary Schools in Cardiff: Cardiff: Cardiff Metropolitan University.	An Evaluation of iPad Implementation Across A Network of Primary Schools in Cardiff **Research Questions/Objectives:** The main focus of the study was to explore how the iPads were introduced and implemented, as well as assess the impact they had on the attitudes and motivations of teachers, parents and pupils.	Multiple Site Case Study: Mixed Methods approach	Data was collected via surveys and interviews. Online surveys were completed by 52 parents from four schools and 70 teachers from five of the schools. In addition, small group interviews were conducted with 120 pupils from years 1, 3, 5 and 6 and 23 teachers from all six schools.

Appendix C - Schedule of CPD Workshops

Workshop 1 (Coaching)

- Meet with teachers (Digital Leaders) and provide a brief overview of iBA
- Highlight existing popular eBooks
- Provide basic principles of engaging layout and design – best practice
- Detail the pedagogical affordances of using iBA as related to curricular needs
- Develop a basic example eBook with text-based content
- Incorporate a number of widgets
- Add images and interactive galleries – supplement content
- Add audio content – encourage autonomous learning
- Add recorded video content
- Add review questions to eBook – encourage student reflection
- Ask the teacher to complete an evaluation form related to Workshop 1

Workshop 2 (Coaching)

- Develop an example interactive multi-media based lesson in iBook format
- Develop and embed a HTML 5 custom widget
- Add a Google Feedback form
- Discuss and apply the lawful use of copyright material
- Discuss how to publish/distribute digital eBooks both publicly and privately
- Discuss ideas on developing potential artefacts related to the curricular needs
- Ask the teacher to complete an evaluation form related to Workshop 2

Workshop 3 (Mentoring)

- In the role as catalyst, the researcher will mentor the teachers on the agreed ideas in developing learning artefact's (eBook)
- Ask the teacher to complete an evaluation form related to Workshop 3

Workshop 4 (Professional Learning Community)

- Meet with all the relevant teachers (Digital Leaders) to develop a 'best practice' framework for creating learning artefacts
- Arrange a number of interviews to discover their collective thoughts and aspirations on using iBA

Post Implementation

- Survey student's thoughts on using the developed artefacts
- Survey teachers' thoughts on pedagogical affordances of iBA

Appendix D – Student Attitudinal Pre-Survey

Pre-test Student Survey - iPad Study

Welcome

Introduction to the research

This stage of the research addresses the development and adoption of eBooks using Apples iBooks Author application in a sample of Irish post-primary schools. This stage of the study will specifically involve multiple site case-study research to evaluate the effectiveness of an intervention (development of interactive multi-touch eBooks for an iPad).

Participation is voluntary
Your participation in this stage is entirely voluntary. If you decide to participate, you are still free to withdraw at any time, without giving any reasons, and with no consequences. If you decide not to participate, you do not have to justify your decision.

Details of what involvement in the research study will entail
Involvement in the research firstly involves attending four CPD 3 hour training sessions in the development and pedagogical affordances of using iBooks Author. This stage (Stage 2) will include three phrases.

Phase 1: CPD (Training workshops for participant teachers)
Following a presentation of both basic and elaborate examples of multi-touch interactive iBooks, Workshop 1 will encompass the available features within iBA and subsequently afford each teacher an opportunity to develop a sample iBook. In highlighting both advanced features (widgets) and pedagogical affordances of developing iBooks using iBA, Workshop 2 will illustrate how to incorporate the varied interactive multimedia features into a sample iBook. The researcher will also demonstrate how iBA can supplement content with learning activities that incorporate images and interactive galleries from pre-defined installed widgets within the application, thus affording an educationalist the opportunity to transmit information, explore ideas and ultimately provide students with a variety of ways to learn.

Phase 2: Development of learning activities by participant teachers (Coaching & mentoring)
While adopting the role of mentor, the researcher will scaffold the teachers in the augmentation of authentic learning activities within their iBook. The researcher will collectively mentor the teachers in Workshop 3 in developing a learning activity related to their specific curricular needs, in which their own students would be afforded the opportunity to develop their own unique iBook. Additionally, the researcher will guide the teachers by demonstrating examples of how students can independently integrate recorded content into developed iBooks using iBA or with using an app like Book Creator. Upon completion of their digital artefacts, each of the teachers will be afforded the opportunity to share these with their peers thus facilitating a peer-learning dimension.

Phase 3: Implementation & Evaluation of learning activities involving participant students
This third and final phase will involve the teachers to implementing the learning activity they had previously designed with a selected group of their own classroom students. Student participation will entail the inputting of relevant digital material, by developing their own multi-media content using the Book Creator App (accessible on their own tablets) and/or using the iBook Author software.

1

In providing an insight into the impact of mobile digital devices on pedagogical practices, the data collection process in Stage 2 will include both pre-test & post-test surveys for teachers and students and semi-structured interviews/focus groups with both teachers and students. All information retrieved from the questionnaires and interviews will be downloaded and securely stored by the researcher on an encrypted memory stick.

Potential risks to participants from involvement in the research study
We foresee no negative consequences or risks from your valued participation in this research. Your participation will enable the collation of a significant data set regarding tablet adoption and use in Irish schools which may inform future policy and practice in this area of educational provision.

Stage 2: Student Consent Form

Research Study Title: The Adoption and Use of Tablet Devices in Irish Post-Primary Schools

Researcher: David Hamill

Address: School of Education, Trinity College, Dublin

Email: dhamill@tcd.ie

* 1. Please click on each of the following to confirm your agreement to participate in the above study

- [ ] I am invited to participate in this research project, which is being carried out by David Hamill. My participation is entirely voluntary. Even if I agree to participate now, I understand that I can withdraw at any time without any consequences of any kind.
- [ ] Stage 2 will involve multiple site case-study research to evaluate the effectiveness of an intervention (development of interactive multi-touch eBooks for an iPad) in a sample of Irish post-primary schools. I understand that participation will involve attendance at CPD sessions related to iBook development using Apple iBooks Author and implementation of learning activities based on it. Furthermore, I understand that participation will entail completion of a pre-test and post-test survey which will address a number or areas of interest relative to eBook development using iBooks Author. I also understand that I am asked to respond to both questionnaire items and semi-structured interviews based on my perspective.
- [ ] I understand that data collected will be held confidentially and no individual will be identified in the reporting of the study. I understand that the data will only be used for the stated purpose, that it will be stored securely and destroyed after the study is complete.
- [ ] If I have any questions about this research, I can e-mail David Hamill at dhamill@tcd.ie. I am also free, however, to contact the research supervisor to seek further clarification and information (kjohnsto@tcd.ie)

Pre-test Student Survey - iPad Study

Technology & Learning - Key Skills

2. What is your name?

3. What is your gender?

- Male
- Female

4. What is your age?

5. What is the name of your school?

6. What year are you in in school?

7. What teacher is running this survey with you?

8. What is your first language?

9. How confident are you to...(“When we describe ourselves as being confident to do something we mean that we feel we are able to complete a task, answer a question, use a tool, report back, talk about, solve a problem, present, summarise, analyse, list, describe etc.”)

	Very Confident	Confident	Neutral	Not Confident	Not at all confident
Use technology to work in a team (e.g., shared workspaces, email exchanges, giving and receiving feedback, etc.)?	○	○	○	○	○
Use technology to talk with experts or members of communities?	○	○	○	○	○
Use technology to keep track of your work on assignments?	○	○	○	○	○
Try to solve problems or answer questions that have no single correct solution or answer?	○	○	○	○	○
Work in pairs or small groups to complete a task together?	○	○	○	○	○
Work with other students to set goals and create a plan for your team?	○	○	○	○	○
Create joint products using contributions from each student?	○	○	○	○	○
Present your group work to the class, teacher or others?	○	○	○	○	○
Work as a team to use feedback on group tasks ?	○	○	○	○	○
Give feedback to peers or assess other students’ work	○	○	○	○	○

10. How confident are you to...(“When we describe ourselves as being confident to do something we mean that we feel we are able to complete a task, answer a question, use a tool, report back, talk about, solve a problem, present, summarise, analyse, list, describe etc.”)

	Very Confident	Confident	Neutral	Not Confident	Not at all confident
Judge how good and useful online resources are?	○	○	○	○	○

5

	Very Confident	Confident	Neutral	Not Confident	Not at all confident
Use technology to analyse information (e.g., databases, spreadsheets, graphic programs, etc.)?	○	○	○	○	○
Use technology to help to share information (e.g., multi--media presentations using sound or video, presentation software, blogs, podcasts, etc.)?	○	○	○	○	○
Compare information from different sources before completing a task or assignment?	○	○	○	○	○
Draw your own ideas based on analysis of numbers, facts, or relevant information?	○	○	○	○	○
Summarise or create your own interpretation of what you have read or been taught?	○	○	○	○	○
Analyze different arguments, perspectives or solutions to a problem?	○	○	○	○	○
Use evidence to develop arguments?	○	○	○	○	○
Structure data for use in written products or oral presentations (e.g., creating charts, tables or graphs)?	○	○	○	○	○
Communicate you ideas using media other than a written paper (e.g., posters, video, blogs, etc.)	○	○	○	○	○
Prepare and deliver an oral presentation to the teacher or others?	○	○	○	○	○
Answer questions in front of an audience?	○	○	○	○	○
Decide how you will present your work?	○	○	○	○	○
Use idea creation techniques such as brainstorming?	○	○	○	○	○

	Very Confident	Confident	Neutral	Not Confident	Not at all confident
Generate your own ideas about how to solve a problem or answer a question?					
Test out different ideas and work to improve them?					
Invent a solution to difficult problems?					
Create something new that can help you express your ideas					

11. How confident are you to...(“When we describe ourselves as being confident to do something we mean that we feel we are able to complete a task, answer a question, use a tool, report back, talk about, solve a problem, present, summarise, analyse, list, describe etc.”)

	Very Confident	Confident	Neutral	Not Confident	Not at all confident
Take the lead when faced with a difficult problem or question?					
Choose your own topics of learning or questions?					
Plan the steps you will take to accomplish a difficult task?					
Choose for yourself what to study or what to use to help you study?					
Track your own progress and change things if you are not working the way that you should be to complete a task?					
Assess the quality of your work before it is completed?					
Use peer, teacher or expert feedback to change your work?					
Use technology or the Internet to help you learn things for yourself (e.g tutorials, self-instructional websites, etc.)?					

12. How often have do you do the following things in your classroom...

	Never	Occasionally	1-3 times a month	1-2 times a week	Daily
Use technology to work in a team (e.g., shared work spaces, email exchanges, giving and receiving feedback, etc.)?	○	○	○	○	○
Use technology to talk with experts or members of communities?	○	○	○	○	○
Use technology to keep track of your work on assignments?	○	○	○	○	○
Try to solve problems or answer questions that have no single correct solution or answer?	○	○	○	○	○
Work in pairs or small groups to complete a task together?	○	○	○	○	○
Work with other students to set goals and create a plan for your team?	○	○	○	○	○
Create joint products using contributions from each student?	○	○	○	○	○
Present your group work to the class, teacher or others?	○	○	○	○	○
Work as a team to use feedback on group tasks ?	○	○	○	○	○
Give feedback to peers or assess other students' work	○	○	○	○	○

13. How often do you do the following things in the classroom....

	Never	Occasionally	1-3 times a month	1-2 times a week	Daily
Judge how good and useful online resources are?	○	○	○	○	○
Use technology to analyse information (e.g., databases, spreadsheets, graphic programs, etc.)?	○	○	○	○	○

	Never	Occasionally	1-3 times a month	1-2 times a week	Daily
Use technology to help to share information (e.g., multi--media presentations using sound or video, presentation software, blogs, podcasts, etc.)?					
Compare information from different sources before completing a task or assignment?					
Draw your own ideas based on analysis of numbers, facts, or relevant information?					
Summarize or create your own interpretation of what you have read or been taught?					
Analyze different arguments, perspectives or solutions to a problem?					
Use evidence to develop arguments?					
Structure data for use in written products or oral presentations (e.g., creating charts, tables or graphs)?					
Communicate you ideas using media other than a written paper (e.g., posters, video, blogs, etc.)					
Prepare and deliver an oral presentation to the teacher or others?					
Answer questions in front of an audience?					
Decide how you will present your work?					
Use idea creation techniques such as brainstorming?					
Generate your own ideas about how to solve a problem or answer a question?					
Test out different ideas and work to improve them?					

	Never	Occasionally	1-3 times a month	1-2 times a week	Daily
Invent a solution to difficult problems?					
Create something new that can help you express your ideas?					

14. How often do you do the following things in your classroom...

	Never	Occasionally	1-3 times a month	1-2 times a week	Daily
Take the lead when faced with a difficult problem or question?					
Choose your own topics of learning or questions?					
Plan the steps you will take to accomplish a difficult task?					
Choose for yourself what to study or what to use to help you study?					
Track your own progress and change things if you are not working the way that you should be to complete a task?					
Assess the quality of your work before it is completed?					
Use peer, teacher or expert feedback to change your work?					
Use technology or the Internet to help you learn things for yourself (e.g tutorials, self-instructional websites, etc.)?					

Pre-test Student Survey - iPad Study

Integrating Technology

15. Have you used technology in your classroom before?

- ◯ Yes
- ◯ No

16. If yes, how effective do you feel it was?

- ◯ Very effective
- ◯ Effective
- ◯ Somewhat effective
- ◯ Slightly effective
- ◯ Not at all effective

17. How was the technology used?

18. Have you used eBooks in your classroom before? (An eBook is defined as as electronic version of a printed book which can be read on a computer or a specifically designed handheld device).

- ◯ Yes
- ◯ No

19. If yes, how effective do you feel it was?

- Very effective
- Effective
- Somewhat effective
- Slightly effective
- Not at all effective

20. How were they used in the classroom?

21. Have you used iBooks in your classroom? (An iBook is defined as an Interactive, multi-touch, multi-media eBook)

- Yes
- No

12

Pre-test Student Survey - iPad Study

iBook experience

22. How effective do you feel it was?

- ◯ Very effective
- ◯ Effective
- ◯ Somewhat effective
- ◯ Slightly effective
- ◯ Not at all effective

23. How were they used in the classroom?

24. Have you used iBook Author in your classroom? (iBook Author is an application that allows you to develop iBooks)

- ◯ Yes
- ◯ No

Pre-test Student Survey - iPad Study

iBook Experience

25. If yes, how effective do you feel it was?

- Very effective
- Effective
- Somewhat effective
- Slightly effective
- Not at all effective

26. How was it used in the classroom?

Pre-test Student Survey - iPad Study

Interest in Using iBooks

27. How interested would you be in using iBooks Author in your classroom?

- ◯ Considerable interest (Very Interested)
- ◯ Moderate interest
- ◯ Some interest
- ◯ Little interest
- ◯ No interest

28. How motivating do you think using iBooks Author would be for you and your classmates?

- ◯ Very motivating
- ◯ Moderately motivating
- ◯ Slightly motivating
- ◯ Not at all motivating
- ◯ No basis for knowing

Appendix E – Teacher Attitudinal Pre-Survey

Pre-test Teacher Survey - iPad Study

Welcome

Stage 2: Teacher Information Sheet

Study Title: The Adoption and Use of Tablet Devices in Irish Post-Primary Schools

Researcher: David Hamill

Address: School of Education, Trinity College, Dublin

Email: dhamill@tcd.ie

Introduction to the research

This stage of the research addresses the development and adoption of eBooks using Apples iBooks Author application in a sample of Irish post-primary schools. This stage of the study will specifically involve multiple site case-study research to evaluate the effectiveness of an intervention (development of interactive multi-touch eBooks for an iPad).

Participation is voluntary
Your participation in this stage is entirely voluntary. If you decide to participate, you are still free to withdraw at any time, without giving any reasons, and with no consequences. If you decide not to participate, you do not have to justify your decision.

Details of what involvement in the research study will entail
Involvement in the research firstly involves attending four CPD 3 hour training sessions in the development and pedagogical affordances of using iBooks Author. This stage (Stage 2) will include three phrases.

Phase 1: CPD (Training workshops for participant teachers)
Following a presentation of both basic and elaborate examples of multi-touch interactive iBooks, Workshop 1 will encompass the available features within iBA and subsequently afford each teacher an opportunity to develop a sample iBook. In highlighting both advanced features (widgets) and pedagogical affordances of developing iBooks using iBA, Workshop 2 will illustrate how to incorporate the varied interactive multimedia features into a sample iBook. The researcher will also demonstrate how iBA can supplement content with learning activities that incorporate images and interactive galleries from pre-defined installed widgets within the application, thus affording an educationalist the opportunity to transmit information, explore ideas and ultimately provide students with a variety of ways to learn.

Phase 2: Development of learning activities by participant teachers (Coaching & mentoring)

While adopting the role of mentor, the researcher will scaffold the teachers in the augmentation of

1

authentic learning activities within their iBook. The researcher will collectively mentor the teachers in Workshop 3 in developing a learning activity related to their specific curricular needs, in which their own students would be afforded the opportunity to develop their own unique iBook. Additionally, the researcher will guide the teachers by demonstrating examples of how students can independently integrate recorded content into developed iBooks using iBA or with using an app like Book Creator. Upon completion of their digital artefacts, each of the teachers will be afforded the opportunity to share these with their peers thus facilitating a peer-learning dimension.

Phase 3: Implementation & Evaluation of learning activities involving participant students
This third and final phase will involve the teachers to implementing the learning activity they had previously designed with a selected group of their own classroom students. Student participation will entail the inputting of relevant digital material, by developing their own multi-media content using the Book Creator App (accessible on their own tablets) and/or using the iBook Author software.

In providing an insight into the impact of mobile digital devices on pedagogical practices, the data collection process in Stage 2 will include both pre-test & post-test surveys for teachers and students and semi-structured interviews/focus groups with both teachers and students.

Confidentiality of data
All data collected will be held confidentially and no individual will be identified in the reporting of the study. Data collected as part of this study will only be used for the purposes of the research dissertation and related academic outputs and will be destroyed after the study is completed. All information retrieved from the questionnaires and interviews will be downloaded and securely stored by the researcher on an encrypted memory stick

Potential risks to participants from involvement in the research study
We foresee no negative consequences or risks from your valued participation in this research. Your participation will enable the collation of a significant data set regarding tablet adoption and use in Irish schools which may inform future policy and practice in this area of educational provision.

Stage 2: Teacher Consent Form

Research Study Title: The Adoption and Use of Tablet Devices in Irish Post-Primary Schools

Researcher: David Hamill

Address: School of Education, Trinity College, Dublin

Email: dhamill@tcd.ie

* 1. Please click on each of the following to confirm your agreement to participate in the above study

- [ ] I am invited to participate in this research project, which is being carried out by David Hamill. My participation is entirely voluntary. Even if I agree to participate now, I understand that I can withdraw at any time without any consequences of any kind
- [ ] Stage 2 will involve multiple site case-study research to evaluate the effectiveness of an intervention (development of interactive multi-touch eBooks for an iPad) in a sample of Irish post-primary schools. I understand that participation will involve attendance at CPD sessions related to iBook development using Apple iBooks Author and implementation of learning activities based on it. Furthermore, I understand that participation will entail completion of a pre-test and post-test survey which will address a number or areas of interest relative to eBook development using iBooks Author. I also understand that I am asked to respond to both questionnaire items and semi-structured interviews based on my perspective.
- [ ] I understand that data collected will be held confidentially and no individual will be identified in the reporting of the study. I understand that the data will only be used for the stated purpose, that it will be stored securely and destroyed after the study is complete.
- [ ] If I have any questions about this research, I can e-mail David Hamill at dhamill@tcd.ie. I am also free, however, to contact the research supervisor to seek further clarification and information (kjohnsto@tcd.ie)

Pre-test Teacher Survey - iPad Study

CPD & Pedagogy

2. If you would like to give your name, please do. This is optional.

3. What is your gender?

- Male
- Female

4. How old are you?

- Under 25
- 25-29
- 30-39
- 40-49
- 50-59
- 60+

5. Please list the subjects you teach

6. During the last 18 months, did you participate in any of the following kinds of professional development activities, and what was the impact of these activities on your development as a teacher?

For each question below, please mark one choice in part (A). If you answer 'Yes" in part (A) then please mark one choice in part (B) to indicate how much impact it had upon your development as a teacher.

	(A) Yes	No	(B) No Impact	A small impact	A moderate impact	A large impact
a) Courses/workshops (e.g. on subject matter or methods and/or other related topics)	○	○	○	○	○	○

	(A) Yes	No	(B) No Impact	A small impact	A moderate impact	A large impact
b) Education conferences or seminars (where teachers and/or researchers present their research results and discuss educational problems)						
c) Qualification programme (e.g. Masters degree)						
d) Participation in a network of teachers formed specifically for the professional development of teachers						
e) Presented on your teaching to your colleagues at a staff event						
f) Individual or collaborative research on a topic of interest to you professionally						
g) Mentoring and/or peer observation and coaching, as part of a formal school arrangement						
h) observation visits to other schools						
i) using proposed Junior Cycle Key Skills framework to plan for teaching						

Other (please specify)

5

7. I would like to ask about your professional beliefs on teaching and learning. please indicate how much you disagree or agree with each of the following statements. Please mark one choice in each row.

	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
a) Effective/good teachers demonstrate the correct way to solve a problem	○	○	○	○	○
b) When referring to a 'poor performance', I mean a performance that lies below the previous achievement level of the student	○	○	○	○	○
c) It is better when the teacher - not the student- decides what activities are to be done	○	○	○	○	○
d) My role as a teacher is to facilitate students' own inquiry	○	○	○	○	○
e) Teachers know a lot more than students; they shouldn't let students develop answers that may be incorrect when they can just explain the answers directly	○	○	○	○	○
f) Students learn best by finding solutions to problems on their own.	○	○	○	○	○

	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
g) instruction should be built around problems with clear, correct answers, and around ideas that most students can grasp quickly.	○	○	○	○	○
h) How much students learn depends on how much background knowledge they have- that is why teaching facts is so necessary.	○	○	○	○	○
i) Students should be allowed to think of solutions to practical problems themselves before the teacher shows them how they are solved.	○	○	○	○	○
j) When referring to a 'good performance', I mean a performance that lies above the previous achievement level of the student.	○	○	○	○	○
k) A quiet classroom is generally needed for effective learning.	○	○	○	○	○
l) Thinking and reasoning processes are more important than curriculum content.	○	○	○	○	○

Other (please specify)

7

8. How often do you do the following in this school? Please mark one choice in each row.

	Never	Less than once per year	Once per year	3-4 times per year	Monthly	Weekly
a) Attend staff meetings to discuss the vision and mission of the school.	○	○	○	○	○	○
b) Discuss and decide on the selection of instructional media (e.g. textbooks).	○	○	○	○	○	○
c) Exchange teaching materials with colleagues.	○	○	○	○	○	○
d) Ensure common standards in evaluations for assessing student progress.	○	○	○	○	○	○
e) Engage in discussion about the learning development of specific students.	○	○	○	○	○	○
f) Use co-teaching or team-teaching strategies with colleagues in the same class	○	○	○	○	○	○
g) Observe other teachers' classes and provide feedback.	○	○	○	○	○	○
h) Discuss and coordinate homework practice across subjects.	○	○	○	○	○	○
i) Discuss and coordinate ICT practice across subjects	○	○	○	○	○	○

9. Thinking about your teaching over the last year, please indicate how often you use each of the following teaching methods?

	Every day	Less than 3 x times per week	More than 3 x times per week	Used once in the last year	Never used
Lecture/teacher talk	○	○	○	○	○
Question and answer	○	○	○	○	○
Demonstration or modelling	○	○	○	○	○
Interactive whiteboard	○	○	○	○	○
Overhead projector	○	○	○	○	○
Free flowing whole class discussion	○	○	○	○	○

	Every day	Less than 3 x times per week	More than 3 x times per week	Used once in the last year	Never used
Exam paper questions	○	○	○	○	○
Powerpoint	○	○	○	○	○
Commercially produced handouts	○	○	○	○	○
Experiments 'recipe type'	○	○	○	○	○
Experiments 'discovery' type	○	○	○	○	○
Regular tests	○	○	○	○	○
Library research/ information seeking	○	○	○	○	○
Case studies	○	○	○	○	○
Data projector	○	○	○	○	○
Interviewing/surveys/questionnaires	○	○	○	○	○
One-to-one teaching	○	○	○	○	○
Reading textbook	○	○	○	○	○
Note taking	○	○	○	○	○
Note making by students	○	○	○	○	○
Mobile Devices	○	○	○	○	○
Buzz groups	○	○	○	○	○
Cooperative learning	○	○	○	○	○
Drama	○	○	○	○	○
Debate	○	○	○	○	○
Group assignments	○	○	○	○	○
Peer correcting	○	○	○	○	○
Peer teaching	○	○	○	○	○
Graphic organisers	○	○	○	○	○
Games	○	○	○	○	○
Problem Based Learning	○	○	○	○	○

Other (please specify)

10. Thinking about your teaching over the last year, please indicate how often you use each of the following teaching approaches or strategies.?

	Every day	Less than 3 x times per week	More than 3 x times per week	Used once in the last year	Never used
Watching a video	○	○	○	○	○
White/blackboard	○	○	○	○	○
Teacher led whole class discussion	○	○	○	○	○
Visits/Visitors	○	○	○	○	○
Worksheets or other individual work	○	○	○	○	○
Self produced handouts	○	○	○	○	○
Regular tests	○	○	○	○	○
Self evaluation & individual target setting	○	○	○	○	○
Reading textbook	○	○	○	○	○
Use of the internet	○	○	○	○	○
Use of iBooks	○	○	○	○	○
Role play	○	○	○	○	○
Student presentations	○	○	○	○	○
Show me boards	○	○	○	○	○
Traffic lights	○	○	○	○	○

Other (please specify)

10

Pre-test Teacher Survey - iPad Study

Integrating Technology - Using iBooks

11. Have you used technology in your classroom before?

- Yes
- No

12. If yes, how effective do you feel it was?

- Very effective
- Effective
- Somewhat effective
- Slightly effective
- Not at all effective

13. How was the technology used?

14. Have you used eBooks in your classroom before? (An eBook is defined as an electronic version of a printed book which can be read on a computer or a specifically designed handheld device).

- Yes
- No

15. If yes, how effective do you feel it was?

- ◯ Very effective
- ◯ Effective
- ◯ Somewhat effective
- ◯ Slightly effective
- ◯ Not at all effective

16. How were they used in the classroom?

17. Have you used iBooks in your classroom? (An iBook is defined as as Interactive, multi-touch, multi-media eBook).

- ◯ Yes
- ◯ No

18. If Yes, how effective do you feel using the iBook was?

- ◯ Very effective
- ◯ Effective
- ◯ Somewhat effective
- ◯ Slightly effective
- ◯ Not at all effective

19. How were they used in the classroom?

20. Have you used iBook Author in your classroom? (iBook Author is defined as an application that allows you to develop iBooks).

- Yes
- No

Pre-test Teacher Survey - iPad Study

iBook experience

21. How effective do you feel it was?

- ◯ Very effective
- ◯ Effective
- ◯ Somewhat effective
- ◯ Slightly effective
- ◯ Not at all effective

22. How were they used in the classroom?

14

Pre-test Teacher Survey - iPad Study

Interest in using iBooks

23. How interested would you be in using iBooks Author in your classroom?

- Considerable interest
- Moderate interest
- Some interest
- Little interest
- No interest

24. How motivating do you think using iBooks Author would be for your students?

- Very motivating
- Moderately motivating
- Slightly motivating
- Not at all motivating
- No basis for knowing

Appendix F – Teacher – Learning activity planning template

Implementation cycle: **1, 2 or 3**

Approx. dates of implementation: **-**

Subject/subjects: _____

Topic(s)/Theme(s): _____

Year/Class Group: _____

Summary of the learning activity (*what students will be asked to do / create*) :

The learning intention (*what students will learn as a result in relation to subject area content & key skills*)
Subject content knowledge that students will learn:

1.
2.
3.
4.

Key skills that students will learn (*NCCA Junior Cycle key skills*):

1.
2.
3.
4.

Breakdown of the task - over how many classes will it span and what will be the main activity/stage in each class? How will students be organised or grouped? What tasks/roles will they be taking on at the various stages? Where will the classes take place and how will the space be organised? What will the teacher role be at the various stages?

Resources that students will need to access/use during the learning activity (mapped onto the deferent stages):
Evidence of learning (*how students will demonstrate their understanding & skills and what criteria/rubric will be used to assess the artefact and process*):

Appendix G – Parent – Information sheet and consent form

TRINITY COLLEGE DUBLIN

Parent Information Sheet

Re: The Adoption and Use of Tablet Devices in Irish Post-Primary Schools

Dear Parent(s)/ Guardian(s),

My Name is David Hamill and I am currently pursuing postgraduate studies with the School of Education at Trinity College Dublin. I am writing to ask your permission for your child to participate in a research project in relation to the adoption and use of tablet devices in Irish post-primary schools. This research will be conducted at a number of locations including your school over the coming months. The research will involve your son/daughter being involved in a number of planned learning experiences involving the authoring of multi-touch interactive iBooks. Furthermore, participation of your son/daughter will include their involvement in data collection via the completion of related surveys and research interviews. This research aims to address student attitudes and perceptions towards technology and learning, specifically in the areas of engagement, motivation, communication, collaboration, research, assistive-learning, reflection and problem solving (Key Skills).

Your child or their school will not be identified in the research report. Only children who have parental permission, and who themselves agree to participate, will be involved in the study. Also, children or parents may withdraw their permission at any time during the study, without penalty, by indicating this decision to the researcher.

I would like to assure you that this study has been reviewed and has received ethical clearance at TCD. In addition, it has been approved and has the support of the Principal at your child's school. I would appreciate if you would permit your child to participate in this project, as I believe it will contribute to furthering our knowledge of how young people learn. Please complete the attached permission form, indicating whether or not you give permission for your child to participate, and return it to the school by the date specified.

If you have any questions about the study, or if you would like additional information to assist you in reaching a decision, please feel free to call me at 01-896-2365 or to contact me by email at dhamill@tcd.ie

Thank you in advance for your interest and support of this research project.

Yours sincerely,

David Hamill

TRINITY COLLEGE DUBLIN

Parent Consent Form

Research Study Title: The Adoption and Use of Tablet Devices in Irish Post-Primary Schools

Researcher: David Hamill

Address: School of Education, Trinity College, Dublin

Email: dhamill@tcd.ie

I have read and understood the information sheet. My son/daughter has been invited to participate in this research project, which is being carried out by David Hamill. Their participation is entirely voluntary. Even they agree to participate now, I understand that they can withdraw at any time without any consequences of any kind.	**[ ]**
The project will involve research to evaluate the effectiveness of the development of interactive multi-touch eBooks for an iPad in a sample of Irish post-primary schools. Participation will involve my son/daughter in a number of planned learning activities using this technology. Furthermore, I understand that the participation of my son/daughter will include their involvement in data collection via the completion of related surveys and research interviews.	**[ ]**
I understand that data collected will be held confidentially and no individual or school will be identified in the reporting of the study. I understand that the data will only be used for the stated purpose, that it will be stored securely and destroyed after the study is complete.	**[ ]**
If I have any questions about this research, I can e-mail David Hamill at dhamill@tcd.ie. I am also free, however, to contact the research	**[ ]**

supervisor to seek further clarification and information (kjohnsto@tcd.ie).

Please tick the box below to confirm your agreement to participate in the above study.

[ ] I agree to my son/daughters participation in the above study
Name of Son/Daughter: _____

Signature _____

Date_____

Appendix H – School Principals – Research Study (Tablet adoption)

Research Study - Tablet Adoption

Trinity College Dublin - Participant Information Sheet

Survey title: The Adoption and Use of Tablet Devices in Irish Post-Primary Schools
Researcher: David Hamill
Address: School of Education, Trinity College, Dublin
Email: david.hamill@tcd.ie

Introduction to the research

The research survey addresses the adoption and use of tablet pc devices in a sample of Irish post-primary schools. It addresses the following areas: reasons for adoption, consultation process with stakeholders, funding model employed, use by teachers and students, challenges and enabling factors, perceived impacts on teachers and students.

If your School is interested in being part of a follow-up study researching the adoption of tablet devices in post-primary schools in Ireland, this will include free CPD/training on using iBooks Author to develop interactive multi-media learning activities within eBooks.

Participation is voluntary

Your participation in the survey is entirely voluntary. If you decide to participate, you are still free to withdraw at any time, without giving any reasons, and with no consequences. If you decide not to participate, you do not have to justify your decision.

Details of what involvement in the research study will entail

Involvement in the research survey involves completion of a mainly check box survey consisting of 27 questions. The survey addresses the following areas: reasons for adoption, consultation process with stakeholders, funding model employed, use by teachers and students, challenges and enabling factors, perceived impacts on teachers and students. You are asked to respond to the survey items based on your perspective as School Principal. On completion of the survey you will be asked if your school would be interested in participating in a further follow up phase of this research and to provide the appropriate contact details should you wish to do so.

Confidentiality of data

All data collected will be held confidentially and no individual will be identified in the reporting of the study. Data collected as part of this study will only be used for the purposes of the research dissertation and related academic outputs and will be destroyed after the study is completed. All information retrieved from the online survey will be downloaded and securely stored by the researcher on an encrypted memory stick.

Potential risks to participants from involvement in the research study

We foresee no negative consequences or risks from your valued participation in this research survey. Your participation will enable the collation of a significant data set regarding tablet adoption and use in Irish schools which may inform future policy and practice in this area of

educational provision.

Consent Form

Research Study Title: **The Adoption and Use of Tablet Devices in Irish Post-Primary Schools**

Researcher: **David Hamill**

Address: **School of Education, Trinity College, Dublin**

Email: **david.hamill@tcd.ie**

* 1. Please confirm the following

- [ ] I am invited to participate in this research project which is being carried out by David Hamill. My participation is entirely voluntary. Even if I agree to participate now, I understand that I can withdraw at any time without any consequences of any kind.
- [ ] The survey is designed to investigate the adoption and use of tablet pc devices in a sample of Irish post-primary schools. I understand that participation will entail completion of an online survey which will address a number or areas of interest relative to tablet pc adoption. I understand that I am asked to respond to the survey items based on my perspective as School Principal.
- [ ] I understand that data collected will be held confidentially and no individual will be identified in the reporting of the study. I understand that the data will only be used for the stated purpose, that it will be stored securely and destroyed after the study is complete.
- [ ] If I have any questions about this research, I can e-mail David Hamill at david.hamill@tcd.ie. I am also free, however, to contact the research supervisor Dr Keith Johnston, to seek further clarification and information (kjohnsto@tcd.ie).
- [ ] Please click on the button below to confirm your agreement to participate in the above study.

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Research Study - Tablet Adoption

Page 2 of 8 - Background Information

2. School Type

- Commmunity/Comprehensive
- Secondary
- Private/Fee paying

3. School gender type:

- Boys
- Girls
- Mixed

4. Number of students in your school?

5. Number of teachers in your school?

6. Please state your position within the school

7. Are you currently or have you in the past been engaged in using tablet devices within your school?

- Yes
- No

Research Study - Tablet Adoption

Page 3 of 8 - Tablet Introduction

8. When were tablet devices first introduced for use by students in your School (please state the month/year)?

9. Which year groups are currently using these devices? (please tick all that apply)

- [ ] 1st year
- [ ] 2nd Year
- [ ] 3rd Year
- [ ] TY
- [ ] 5th Year
- [ ] 6th Year

Other (please specify)

4

10. What were the main reasons for your adoption of tablet devices? Please read through each of the following statements and then rank your preference where 1 is the most important, 2 is the second most important etc. You can only rank each statement once.

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
To improve student engagement in class	○	○	○	○	○	○	○	○	○
To improve student performance in state examinations	○	○	○	○	○	○	○	○	○
To introduce a more personalised learning approach	○	○	○	○	○	○	○	○	○
To provide students with access to digital content including eBooks and Apps	○	○	○	○	○	○	○	○	○
To reduce the weight of students' school bags	○	○	○	○	○	○	○	○	○
To provide easy access to the Internet	○	○	○	○	○	○	○	○	○
To provide a more up to date and modern school environment	○	○	○	○	○	○	○	○	○
To improve students and teachers technology skills	○	○	○	○	○	○	○	○	○
To modernise teaching and schooling	○	○	○	○	○	○	○	○	○

Other (please specify)

11. Which of the following stakeholders were consulted as part of the decision to adopt tablet devices? (please tick all that apply)

- ☐ School Management
- ☐ Teachers
- ☐ Students
- ☐ Parents

Other (please specify)

12. Briefly outline the consultation/decision making process employed when contemplating investment in tablet devices?

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Research Study - Tablet Adoption

Page 4 of 8 - Tablet Use

13. Please rank your level of agreement with the following statements

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
The adoption of tablet devices caused us to re-evaluate our school vision for learning in the 21st century	○	○	○	○	○
This vision was outlined in a 'School Vision' or similar type document prior to adoption of the tablet devices	○	○	○	○	○
The ability of the selected device to support this vision for learning was a key consideration in its adoption	○	○	○	○	○
Changing roles for teachers and students is a likely consequence of tablet adoption in the context of learning for the 21st century	○	○	○	○	○

14. How was the purchase of the tablet devices funded in your School? Please tick one.

- ○ The School purchased the devices
- ○ Students/their parents purchased the devices themselves (outright purchase)
- ○ Students/their parents purchased the devices themselves with support from a localised funding arrangement organised by the school (e.g. through a local Credit Union or similar)
- ○ The purchase of the devices was funded by a third party e.g. external grant
- ○ Other (please specify)

15. How are the tablet devices being used in your School?

	Yes	No
The devices are allocated by the school to individual students for use during class time only	○	○
Students have their own devices which they use both inside and outside of school	○	○
The tablet devices are used generally across the full range of subjects within the school	○	○

If you answered 'No' to the above please state the subjects in which the devices are most commonly used:

8

16. Please rate the frequency with which teachers (on average) use the devices for the following purposes? Please answer based on your overview of use in your school.

	Daily	A few times per week	One a week	Monthly	Never
To prepare lesson materials/resources	○	○	○	○	○
To research lesson content online	○	○	○	○	○
For in class teaching purposes e.g. teacher presentations	○	○	○	○	○
To facilitate active learning/group work by students	○	○	○	○	○
To communicate with students e.g. via email	○	○	○	○	○
To share resources with colleagues	○	○	○	○	○
To communicate with parents	○	○	○	○	○
For assessment and feedback to students	○	○	○	○	○

Other (please specify)

9

17. Please rate the frequency with which students (on average) use the devices for the following purposes in School? Please answer based on your overview of use in your school.

	Daily	A few times per week	Once a week	Monthly	Never
For researching online	○	○	○	○	○
For creating presentations	○	○	○	○	○
For completing assignments	○	○	○	○	○
For group work with other students	○	○	○	○	○
To communicate with teachers e.g. via email	○	○	○	○	○
To access eBooks	○	○	○	○	○
To access educational apps	○	○	○	○	○
To take notes	○	○	○	○	○
To make videos	○	○	○	○	○
To take photographs	○	○	○	○	○
For social networking/gaming	○	○	○	○	○

Other (please specify)

10

Research Study - Tablet Adoption

Page 5 of 8 - Challenges & Enablers

18. Based on your experiences please rate the significance of the following items as enabling or facilitating factors for tablet deployment in your School settling. If a particular item did not apply within your School please tick the 'not relevant' box.

	Highly significant	Moderately significant	Not so significant	Not relevant/No basis for comment
A clear vision statement for use of the devices	○	○	○	○
A clear implementation plan	○	○	○	○
Teacher consultation prior to implementation	○	○	○	○
Student consultation prior to implementation	○	○	○	○
Parental consultation prior to implementation	○	○	○	○
CPD for teachers	○	○	○	○
Information sessions for parents	○	○	○	○
Familiarisation 'courses' for students	○	○	○	○
Provision of time for teacher familiarisation and planning	○	○	○	○
Provision of technical support	○	○	○	○
The presence of an ICT 'champion' in the school	○	○	○	○
Good wireless capacity	○	○	○	○
Ongoing monitoring, evaluation and review of the initiative	○	○	○	○

Other (please specify)

11

19. Based on your experiences please rate the significance of the following items as barriers or challenging factors for tablet deployment in your School settling. If a particular item did not apply in your School please tick the 'not relevant' box.

	Highly significant	Moderately significant	Not so significant	Not relevant/No basis for comment
The relatively high costs involved	○	○	○	○
Classroom management challenges due to the ready availability of 'distractions' such as games and social networks	○	○	○	○
The existing workload of teachers	○	○	○	○
Existing exam pressures	○	○	○	○
The presence of written State examinations	○	○	○	○
Concerns regarding the increased potential for cyberbullying	○	○	○	○
Concerns regarding the potential for theft of the devices	○	○	○	○
Low teacher confidence in using the devices	○	○	○	○
The perceived poor quality of some eBooks	○	○	○	○
The limited availability of 'good' educational apps	○	○	○	○
The difficulty in using the device to its full potential	○	○	○	○
Student preference for books (hard copy) rather than eBooks	○	○	○	○

Other (please specify)

20. In order to support their deployment of the tablet devices which of the following types of CPD provisions were made available for teachers in your School? (Please tick all that apply).

- [ ] CPD in relation to the technical capabilities of the device i.e. how to use the device
- [ ] CPD in relation to the pedagogical potential of the device i.e. how to use the device for teaching/learning
- [ ] CPD in relation to using the device within a particular subject area i.e. subject specific CPD
- [ ] Provision for familiarisation/experimentation with the device supported by follow-up discussion and reflection i.e. a school-based approach
- [ ] Provision for the sharing of information, experiences and resources with colleagues i.e. a community of practice based approach
- [ ] No CPD was provided

Other (please specify)

21. Which of the above were the most effective types of CPD provisions based on your experiences in your School?

Research Study - Tablet Adoption

Page 6 of 8 - Impacts on Students & Teachers

22. Based on your experiences in your School please rate your level of agreement with the following statements which relate to impacts on students as a consequence of the deployment of tablet devices.

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
Students are more motivated to learn	○	○	○	○	○
Students are taking more responsibility for their own learning	○	○	○	○	○
Students are more engaged with their learning	○	○	○	○	○
Students have a more positive attitude to school	○	○	○	○	○
Students have experienced more individualised and personalised learning	○	○	○	○	○
Students are participating more in project based learning	○	○	○	○	○
Students are participating more in inquiry based learning i.e. doing independent research	○	○	○	○	○
Students are better organised as all their materials are stored on one device	○	○	○	○	○
Students have easy access to educational content and resources	○	○	○	○	○
Students are developing their creativity	○	○	○	○	○
Students are developing their problem-solving and critical thinking skills	○	○	○	○	○
Students are developing their ICT skills	○	○	○	○	○
Students are participating more in group activities	○	○	○	○	○

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
Students are working together more often					
Students are creating their own learning resources					
Students are learning more deeply					
Students are more prone to distraction in class from online games and social networks					
The standard of students work has improved					
Students are showing evidence of improved academic achievement					

Other (please specify)

23. Based on your experiences in your School please rate your level of agreement with the following statements which relate to impacts on teachers as a consequence of the deployment of tablet devices.

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
Teachers are creating more interactive lessons					
Teachers are using a greater range of resources in their lessons					
Teachers are collaborating more with their colleagues e.g. sharing ideas and resources					
Teachers are experiencing less classroom management issues					

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
Teachers are experiencing a new role as co-learners alongside their students	○	○	○	○	○
Teachers are able to monitor student progress more closely	○	○	○	○	○
Teachers are experiencing less difficulties due to students mislaying their books and other materials	○	○	○	○	○
Teachers are experimenting with the layout of their classrooms	○	○	○	○	○
Teachers are communicating more with their students i.e. via email	○	○	○	○	○
Teachers are providing more feedback to students	○	○	○	○	○
Teachers are facilitating more student centred learning	○	○	○	○	○
Teachers are facilitating more collaboration between students	○	○	○	○	○
Teachers are giving students more personalised attention	○	○	○	○	○
Teachers are better able to tell if students are having difficulty with the content	○	○	○	○	○
Teachers are able to do classroom administration more efficiently	○	○	○	○	○
Teachers are able to provide more individualised instruction for students	○	○	○	○	○
Teachers are better organised	○	○	○	○	○

Other (please specify)

16

24. What is your overall perception of the success or otherwise of tablet adoption in your school?

25. Do you plan to deploy tablet devices in your School in the near future? (Only answer this question if you answered ‘No’ to Q.6 - [Are you currently or have you in the past been engaged in using tablet devices within your school?])

- Yes
- No
- If you have already considered this possibility and decided against it please outline the main reasons below.

Research Study - Tablet Adoption

Page 7 of 8 - Impacts on Students & Teachers

26. What information would you find most helpful in reaching a decision regarding the possible deployment of tablet devices? Please read through each of the following statements and then rank your preference where 1 is the most helpful, 2 is the second most helpful etc. You can only rank each statement once.

	1st	2nd	3rd	4th	5th	6th	7th	8th
Information on costs and funding	○	○	○	○	○	○	○	○
Information on the different types of devices	○	○	○	○	○	○	○	○
Information on appropriate wireless networks	○	○	○	○	○	○	○	○
Information on maintenance and technical support	○	○	○	○	○	○	○	○
Information on how to use the devices to support learning	○	○	○	○	○	○	○	○
Information on the most appropriate CPD for teachers	○	○	○	○	○	○	○	○
Information regarding the effects on learning	○	○	○	○	○	○	○	○
Information regarding the effects on student motivation and engagement	○	○	○	○	○	○	○	○

Other (please specify)

Research Study - Tablet Adoption

Page 8 of 8 - Follow up study

27. Would your School be interested in being part of a follow-up study researching the adoption of tablet devices in post-primary schools in Ireland? This will include free CPD/training on using iBooks Author to develop interactive learning activities within iPads.

- ◯ Yes
- ◯ No

28. If yes, please insert a contact name and email address