The Bridge21 model of technology-mediated, team-based, 21st century learning in post-primary classrooms in Ireland: Evolution, experiences and evaluation

A Thesis Submitted in Fulfilment of the Requirements for the Award of Doctor of Philosophy

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Summary

The classroom of the future is generally described in terms of the availability and use of the latest advances in technology as a central component, along with student-centred, skills-focussed pedagogies. A common pattern across many of the recent global reform programmes aimed at leveraging the potential of technology in schools is learning outcomes defined by proficiency in core subject knowledge and also by the development of 21st century skills, such as creativity, collaboration and problem-solving. Ireland is no exception, with many recent studies and reform programmes calling into question the structure and purpose of schooling in an education system characterised by rote-learning, formal assessments of traditional subjects in an overcrowded curriculum and the restricted teaching day and year that is typical at post-primary level (NCCA, 2005; McMurrow, 2006; Jeffers, 2011; Collins & Dolan, 2011; Smyth, 2016). Despite this, there has been a persistent dearth of practical, replicable models as to how such ideals might translate into practice in the authentic setting of the classroom.

Professional development (PD) in an era of reform must provide teachers with the opportunity to reflect critically on their practice and to develop new knowledge and beliefs about content, pedagogical approaches, role identity, student outcomes and what it means to be a learner (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Voogt, Knezek, Cox, Knezek & ten Brummelhuis, 2013; Prestridge, 2012). The most effective programmes of professional development tend to be those that are grounded in collective professional discourse focussed on shared experiences and practice (Little, 2003). Teachers typically look towards resources, practical designs and collegial support in bringing about change in their classrooms.

Bridge21 is a learning model that resonates with much of the literature on 21st century learning. Developed in 2007, it is centred on the rationale that technology has the potential to support a structured collaborative, project-oriented, learning context. The core components of a Bridge21 learning experience include technology as an integral tool in the learning process and the delivery of content through structured team-based, student-led projects in a physical learning space explicitly designed and configured to support collaborative learning. In the laboratory setting, the learning model has been shown to have a positive impact on students' intrinsic motivation (Lawlor, Marshall & Tangney, 2015), attitudes towards personal learning and ability (Lawlor, Conneely & Tangney, 2010; Sullivan, Marshall & Tangney, 2015), and

to positively impact perceptions of computer science (Tangney, Oldham, Conneely, Barrett & Lawlor, 2010). The focus of this research is the progression of the learning model from its initial conception as an innovative outreach project delivered to post-primary students on a university campus, into a school-university partnership aimed at supporting teachers to use the model as a pragmatic approach to designing 21st century learning experiences in school for the formal curriculum. This thesis documents and critically evaluates the iterative design and implementation of a programme, over a four-year period (2010-14), to support teachers to utilise the Bridge21 learning model to teach the formal curriculum in post-primary classrooms in Ireland.

The study seeks firstly, to ascertain whether the Bridge21 learning model can be used by a cohort of teachers within the confines of the formal post-primary school system in Ireland and the impact it has on their students and on classroom learning experiences. Secondly, the research aims to explore and define the elements of a conceptual framework to bring a particular model of 21st century learning from its original context in a university laboratory into the authentic setting of school classrooms, with particular focus on the approach to PD for teachers that was conceptualised, trialled and developed during the research. A total of 600 students and 160 teachers from 16 post-primary schools participated in the programme between 2010 and 2014, of which an opportunistic sample was selected for the purposes of the study. The research follows a critical qualitative approach in a multi-phase mixed methods design, drawing on data from interviews with principals and teachers, questionnaires with teachers and students, along with documentary evidence from the researcher's journal and field observation notes.

The results suggest that the Bridge21 learning model has the potential to be used in post-primary classrooms in Ireland and that such learning experiences can engender the development of key 21st century skills in students. The findings also point towards a number of key features of a conceptual framework for a school-university partnership to support teachers to effectively adopt the Bridge21 model of 21st century learning as a pragmatic approach to teaching the formal curriculum. In particular, several defining characteristics of the model of PD developed during the research process are identified.

Related Publications & Conference Presentations

Journal Papers

Lawlor, J., Conneely C., Oldham, E., Marshall, K. & Tangney, B. (In press), *Teamwork, Technology and Learning: A Pragmatic Model for Effective 21C Team-based Learning,* Technology, Pedagogy and Education.

Girvan C., Conneely C. & Tangney B. (2016), *Extending Experiential Learning in Teacher Professional Development*, Teaching and Teacher Education, vol. 58, pp. 129 - 139.

Johnston K., Conneely C., Murchan D. & Tangney B. (2015), *Enacting Key Skills-based Curricula in Secondary Education: Lessons from a Technology-mediated, Group-based Learning Initiative*, Technology, Pedagogy and Education, vol. 24, pp. 1-20.

Book chapters

Conneely C., Girvan C., Lawlor, J. & Tangney B. (2015), *An Exploratory Case Study into the Adaptation of the Bridge21 Model for 21st Century Learning in Irish Classrooms*, Shaping the Future: How Technology Can Lead to Educational Transformation, Butler, D., Marshall, K., & Leahy, M. (Eds.), The Liffey Press, pp. 348 - 381.

Peer-reviewed Conference Papers

Conneely C., Murchan D., Tangney B. & Johnston K. (2013), *21st Century Learning – Teachers' and Students' Experiences and Views of the Bridge21 Approach within Mainstream Education*, Proceedings of the Society for Information Technology & Teacher Education International Conference, March, AACE, pp. 5125 – 5132

Reports

Conneely C., Girvan C., & Tangney, B. (2012), *An Exploration into the Adaptation of the Bridge21 Model for 21st Century Learning in Irish Classrooms - Case Study Report for the National Council for Curriculum and Assessment*, Trinity College Dublin.

Conference Presentations

Conneely C. & Tangney, B. (2014), *Exploring the effectiveness of Bridge21as a catalyst for school reform in Ireland,* British Educational Research Association Conference, London.

Johnston K., Murchan D., Conneely C., & Tangney B. (2012), *Enacting Key skills-based Curricula in Secondary Education: Lessons from a Technology-mediated, Group-based Learning Initiative,* The European Conference on Educational Research, Cádiz.

Conneely C., Lawlor, J. & Tangney, B. (2011), *A Pragmatic Model for Team-based Technology-enhanced Learning in Second-level Schools,* Computers and Learning Conference, Manchester.

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List of Abbreviations

CAO	Central Applications Office
CAQDAS	Computer-Assisted Qualitative Data Analysis Software
CSO	Central Statistics Office
DBR	Design-based Research
DES	Department of Education and Skills (Ireland)
DfE	Department for Education (United Kingdom)
ELT	Experiential Learning Theory
EU	European Union
ICT	Information and Communication Technologies
ITL	Innovative Teaching and Learning
JCN	Junior Cycle Network
LCA	Leaving Certificate Applied
NCCA	National Council for Curriculum and Assessment
OECD	Organisation for Economic Co-operation & Development
PD	Professional Development
PISA	Programme for International Student Assessment
SAMR	Substitution, Augmentation, Modification, Redefinition
SPRinG	Social Pedagogic Research in Group-work
STEM	Science, Technology, Engineering and Mathematics
TIMSS	Trends in International Mathematics and Science Study
TPACK	Technology Pedagogy and Content Knowledge
UNESCO	United Nations Educational Scientific & Cultural Organisation
WOSM	World Organisation of the Scout Movement

"*If we teach today's students as we taught yesterday's, we rob them of tomorrow.*"

- John Dewey

"*The fact is that given the challenges we face, education doesn't need to be reformed – it needs to be transformed. The key to this transformation is not to standardise education, but to personalise it, to build achievement on discovering the individual talents of each child, to put students in an environment where they want to learn and where they can naturally discover their true passions.*"

- Ken Robinson

1 Introduction

This research describes the progression of an innovative model of 21st century learning - the Bridge21 model - from its initial conception as a social outreach project delivered to post-primary students on a university campus, into a school-university partnership focussed on supporting teachers and school leaders to embrace the model as a pragmatic approach to 21st century learning in the formal classroom. Specifically, the study seeks to document and critically evaluate the iterative design and implementation of a programme, over a four-year period (2010-14), to support and enable a cohort of teachers to use and adapt the Bridge21 learning model to teach the formal curriculum in post-primary classrooms in Ireland.

This introductory chapter will firstly provide a background to the study, followed by the context and rationale for the intervention under investigation. The research aims and research questions will be outlined, along with an overview of the research methods. The contributions of the thesis will then be stated. The chapter will conclude with a roadmap of the remainder of the thesis and a brief synopsis of the content in each of the chapters that follow.

1.1 Background

It is generally accepted that technological advances in recent years have made information instantly and more easily available to learners. Information and Communication Technologies (ICT) are deemed to be powerful teaching and learning aids, particularly given their potential to support and encourage the development of 21st century skills and to act as a potential catalyst for change in education (McGarr, 2009; OECD, 2010). Education reform movements throughout the world are continuously attempting to re-design and implement new curricula and innovative models of learning and teaching that will embrace the affordances of the latest advances in technology, and enable students to develop 21st century skills, such as creativity, collaboration and problem-solving.

However, the influence of innovative technological developments on models of educational practice remains debatable. The accepted norm of learning *about* technology rather than *with* it persists in many classrooms today (McGarr, 2009; Petko, Eggera, Cantienia & Wespia, 2015). Despite the pervasiveness of ICT in Western society – both in our professional and personal lives – technology has not been widely adopted into formal education (OECD, 2015). Moreover, there has been little or no improvement in student achievement scores in the

Programme for International Student Assessment (PISA) in countries where there has been significant investment in ICT (ibid).

Diverse approaches to pedagogy that challenge the prevailing practice of the traditional classroom are required in order to fully realise and exploit the potential of ICT for teaching and learning in the 21st century. While many teachers value 21st century pedagogies, teaching practice does not always reflect that belief (Schleicher, 2015). Despite the presence of studies that focus on a blended approach of pedagogy and technical skills, and provide models of PD for technology integration, many professional development (PD) programmes for teachers have a tendency to concentrate mainly on the technical capabilities of new tools, separated from actual teaching practice (Jung, 2005; Aslan & Zhu, 2016). Yet, as stated in the recent PISA report, "technology can amplify great teaching, but great technology cannot replace poor teaching" (OECD, 2015, p.17). PD programmes must include both practical strategies and pedagogical models so that teachers will be able to deal with the numerous barriers they encounter when integrating technology into the classroom (Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Voogt et al., 2013; Twining, Raffaghelli, Albion & Knezek, 2013; Kopcha, 2012). Teachers typically look towards resources, practical designs and collegial support in bringing about change in their classrooms – the most effective source of help for teachers tends to be other teachers (Fullan, 2007).

1.2 Context

Since the start of the 21st century, there has been a continuous debate about the structure and purpose of schooling in Ireland (NCCA, 2005; Jeffers, 2011; Collins & Dolan, 2011). In recent decades, the Irish post-primary education system has been characterised by rigid structures and traditional subject-based rote learning in an inflexible, overcrowded, exam-focused curriculum (Smyth, 2016). In 2011 a complete reform of the Junior Cycle (years 1-3 at post-primary) was launched to address these prevailing issues. A greater emphasis on key 21st century skills was proposed, along with a student-centred approach to assessment, whereby students would become responsible for generating, gathering and presenting evidence of their own learning (NCCA, 2010a; NCCA, 2011b). A central principle of the reform approach was that schools, teachers and students would be integral to the change process and would be given the flexibility and creativity to embrace innovation. The proposed reform programme was firmly grounded in research evidence from national studies and also informed by international literature, studies and best practice.

Bridge21 is an innovative model of 21st century learning that was initiated in 2007 under the auspice of a social outreach programme in the researcher's university. The original aim of the programme was to positively engage young people from areas of social disadvantage in learning and to encourage them to improve their attitudes towards education. The programme and related activities, delivered in a laboratory classroom setting on the university campus, were designed to leverage the affordances of ICT to empower young people to become creative learners with technology, and emphasised teamwork, problem-solving and constructivist learning approaches. The social outreach initiative expanded and developed year on year to eventually become a longitudinal university-school partnership programme, with an ambitious agenda of nationwide education reform. Today it provides multiple strands of programme activity and service delivery at scale to participant schools from a broad range of socioeconomic areas, both in the laboratory classroom setting (a purpose-designed learning space on the university campus) and in the classrooms of primary and post-primary schools across Ireland. Since the initial pilot project in the 2007-08 academic year, with approximately 100 students from a small sample of schools in Dublin, more than 13,000 participants from approximately 250 schools in Ireland have experienced a Bridge21 workshop or programme. These participants include primary and post-primary students from a diverse range of schools in a variety of learning contexts, postgraduate students of initial teacher education programmes and practising teachers engaged in continuous PD. A more detailed account of the historical development of Bridge21, including the scope of the programme, how it operated in practice, and descriptions of the learning model and its components, is provided in Chapter 3.

1.3 Rationale

The rationale for this study, conducted over a four-year period (2010-14), was first and foremost grounded in the researcher's experience and participation as an educator, designer and researcher in the Bridge21 programme from its inception in 2007. As a co-founder of the programme and a collaborator in the iterative development of the educational model in the early years, the researcher gained a wealth of knowledge, insight and practical experience of using the model in the purpose-designed school-laboratory setting on the university campus. Findings from early research on the effectiveness of the model, in which the researcher was co-author, suggested its potential as a vehicle for delivering effective 21st century learning activities to post-primary students (Lawlor et al., 2010; Tangney et al., 2010; Lawlor et al., 2015). Whilst these

results were by no means conclusive, they served as the foundation for the design of a programme to bring the model into a new context – its use by teachers in the post-primary classroom.

Secondly, the rationale for the study was influenced by the external context of the wider education system at the time. As discussed above, a programme to reform Junior Cycle education in Ireland was launched in 2011, as a result of research evidence, public and political consensus and growing professional concern about the "dilemma of lower secondary education" (NCCA, 2010a, p.9). A greater emphasis on 21st century skills was proposed than had heretofore featured as a learning outcome. Hence it was a time when school leaders and teachers were seeking pragmatic models of learning that could support a move away from traditional approaches to teaching and learning towards ones that could facilitate the development of 21st century skills and improved learner autonomy. Flexibility and creativity were central principles of the reform approach, recognising the importance of allowing schools to embrace innovation within the context of their existing culture. Several school leaders and teachers from Bridge21 partner schools, with whom the researcher had built strong positive relationships during the early years of the social outreach project, inquired as to the possibility of expanding the intervention and trialling the use of the Bridge21 learning model in the formal classroom to teach the curriculum. These demands, set against the backdrop of an education sector on the cusp of major reform, served as a motivating factor for the researcher to embark on the current study.

Third and finally, the rationale for the study was firmly rooted in international studies and literature as briefly outlined above. A critical body of literature that formed the basis of this work included the Innovative Teaching and Learning (ITL) global research project (Fullan, 2011; Bernard & Langworthy, 2011; Leahy & Butler, 2011) which found that whilst innovative teaching supports students' development of 21st century skills, it is scarce in practice and a "coherent and integrated set of conditions to support the adoption of innovative teaching" is lacking in most schools and nearly all education systems (Bernard & Langworthy, 2011, p.12). Additionally, results from the SPRinG (Social Pedagogic Research in Group-work) project - the first large scale research project in England designed to develop and evaluate effective group-work in school classroom settings - revealed improvements in students' learning and attainment scores, motivation and attitude towards school work and classroom behaviour when engaged in structured interactive collaborative learning (Blatchford, Kutnick, Baines & Galton, 2003; Blatchford, Baine,

Bassett, Rubie-Davies & Chowne, 2006; Baines, Blatchford & Rubie-Davies, 2009; Galton, Hargreaves & Pell, 2009; Kutnick & Berdondini, 2009).

Given the external context of the imminent changes to the Irish education system and the preliminary indications of the effectiveness of Bridge21 as a model of 21st century learning and guided by key findings from international studies and literature, a pilot programme was launched in 2010. The goal of the pilot was to explore the potential of the Bridge21 learning model to enable teachers in post-primary schools in Ireland to increase their provision of technology-mediated, team-based, innovative 21st century learning experiences for their students. Results from the pilot in 2010-11, which involved 20 teachers and 100 students from 5 schools (Conneely, Girvan, Lawlor & Tangney, 2015; Conneely, Girvan & Tangney, 2012) led to the development of a full-scale programme in 2011-12, with 35 teachers and 330 students across 8 schools. The programme expanded in subsequent years and by Year 3 of the intervention (2013-14) there were 160 teachers and 600 students participating in 16 partner schools.

Hence the motivation for this study was to document and critically evaluate the iterative design, development and implementation of the programme, in particular the school engagement framework and the approach to PD, over a four-year period (2010-14), and examination of the impact the programme had on a sample of the participant schools, teachers and students. An opportunistic sample of schools, teachers and students was selected as the lens through which to examine data collected through mixed methods during the first phase of the research (2010-2012). A purposive sampling strategy was used during the second phase (2012-2014) to select a nominated sample of participants, based upon the initial analysis. The research methods are discussed in more detail in 1.6.

1.4 Research Aims

The overall aim of this study is to document and critically evaluate the design, development and implementation of a programme to support teachers to use the Bridge21 model in the post-primary classroom. The primary goal is to define the required elements of a framework to engage with schools in order to bring the Bridge21 learning model into the classroom, with particular focus on the approach to PD for teachers that was conceptualised, trialled and developed during the research.

The overall aim may be divided into a number of key objectives that are the focus of the two phases of research. The first set of objectives relate to the

potential of the Bridge21 learning model as a pragmatic approach to 21st century learning in the formal classroom. Specifically, these objectives are:

- To gather evidence to illustrate students' and teachers' overall experiences and views regarding the use of Bridge21 in an authentic setting, i.e. the post-primary classroom.
- To determine specific ways in which the Bridge21 model can be effectively used to deliver the curriculum in the post-primary classroom.
- To identify whether the Bridge21 model facilitates teachers to increase their provision of 21st century learning experiences and the effect these experiences have on student skill development.

The second set of objectives focus on the evolution of the programme to support teachers to understand and adopt the learning model to teach the post-primary curriculum. Specifically, these objectives are:

- To identify the professional development needs of teachers and define the key features of a robust model of PD and a school-university partnership to support the use of Bridge21 in the post-primary classroom.
- To build a repository of best practice learning activities that can be shared with the wider community of teachers and schools in the post-primary sector in Ireland.

1.5 Research Questions

In order to address the aims and objectives of the study described above, two primary research questions are identified. The first question (**RQ1**) seeks to explore whether the Bridge21 learning model has the potential to be transferred from its original use in the context of a laboratory classroom setting (the university outreach project) into the authentic setting of post-primary schools in Ireland. The question is divided into two parts:

> **RQ1(a)**: What are the primary factors that affect the use of the Bridge21 learning model in the post-primary classroom?
>
> **RQ1(b)**: How does participation in such learning experiences affect the development of students' 21st century skills?

The second question (**RQ2**) focuses on developing a conceptual framework for a school-university partnership aimed at supporting teachers to adopt a 21st

century learning approach to the post-primary curriculum using the Bridge21 model. The two parts of this question are as follows:

> **RQ2(a)**: What are the key elements of a school-university partnership framework designed to support teachers to use the Bridge21 model of technology-mediated team-based learning in the post-primary classroom?
>
> **RQ2(b)**: How do the defining features of the framework, including the approach to PD, facilitate teachers to use this model to teach the curriculum and to increase their provision of 21st century learning experiences for their students?

A multiphase mixed methods design was proposed to enable the researcher to examine these two questions (Creswell, 2014). The study is qualitative dominant; however, the research instruments facilitated the collection of qualitative and quantitative data during two separate, sequential phases of research. The research questions are explored simultaneously through both phases and the final interpretation of the entire analysis of data is the basis for the presentation of overall results. A more detailed overview of the research methods adopted to answer the research questions is presented in the proceeding section.

1.6 Overview of Research Methodology

This study is centred on the documentation and critical evaluation of the iterative design, development and implementation of a programme to support teachers to use a technology-mediated team-based model of 21st century learning in the post-primary classroom. Given the fluid and iterative nature of the social outreach programme from which the study originated, a mixed methods design encompassing two phases of research and underpinned by a pragmatic philosophy, was proposed. Creswell (2014) identifies multiphase mixed methods as an advanced approach generally suitable to cases of programme intervention. Mixed methods have also shown promise for transforming research in teacher learning (Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 1998). The multiphase mixed methods design allowed the researcher to collect and analyse data during an initial (exploratory) phase, the results of which informed the second (explanatory) phase, which included new iterations of the design of the intervention and the design and administration of additional research instruments to build on the earlier analysis. Each phase of the research was treated as an embedded single-case

design, comprising several units of analysis to bind the case by specific points in time. Figure 1-1 displays an overview of the research design.

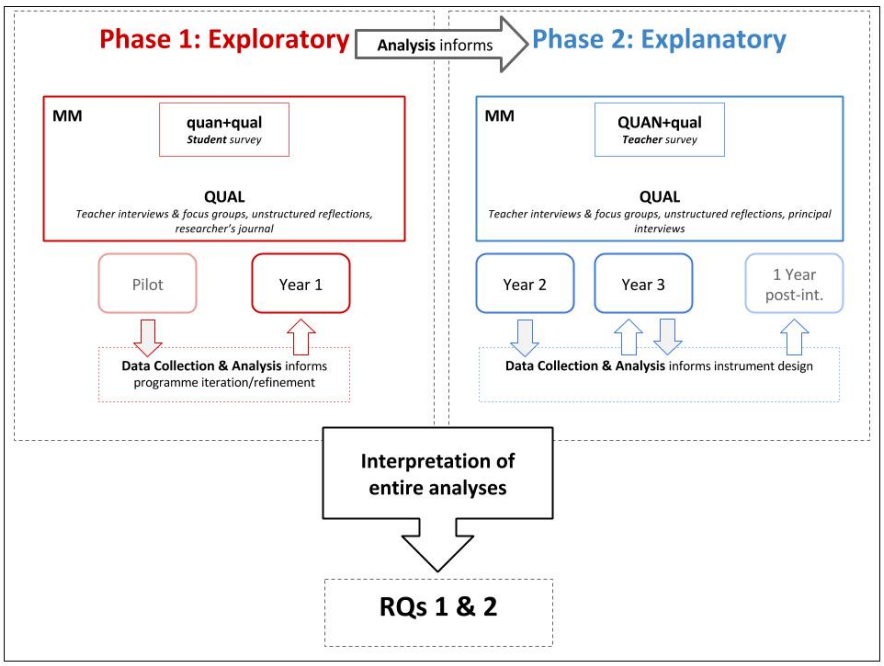

Figure 1-1 Research Design

In addition, design-based research (Anderson and Shattuck, 2012) was considered as it suited the pragmatic nature of the study, owing to the scope and design of the intervention that evolved through multiple iterations over an extended period of four years (Pilot and Years 1-3). One of the overarching aims of the study was to identify the key elements of a framework, including a model of PD, to contribute to the understanding of how the Bridge21 learning model could be transferred from an outreach context into the authentic setting of the post-primary classroom. Further, it was intended that at the end of the study, the learning model and schools programme would have the potential to "migrate from our experimental classroom to average classrooms operated by and for average students and teachers, supported by realistic technological and personal support" (Brown, 1992, p.143).

Data were collected at multiple levels, including the classroom, school principal, teacher and student, during two phases of the research. Teacher and student questionnaires were used to explore the relationship between the use of the Bridge21 learning model and student and teacher self-reported classroom practice. Simultaneously, the critical design features of the programme, including the PD needs of teachers, were explored using qualitative interviews with teachers and principals, along with observations and qualitative

unstructured reflections from a sample of participant teachers and schools. Whilst the research instruments were designed to yield both qualitative and quantitative data, the study was qualitative dominant overall. Data were collected, integrated and analysed during both phases, followed by a final interpretation of the entire analyses to answer **RQ1** and **RQ2** and to present overall findings and results.

This study is typical of what Glesne and Peshkin (1992) refer to as "backyard" research - the rationale for the work undertaken was strongly grounded in the researcher's participation, as both an educator and a researcher, in the Bridge21 programme from its inception through to early developments and expansion. The researcher was highly cognisant of the fact that past experiences, tacit knowledge and close personal ties to the programme under investigation had the potential to result in bias towards certain themes, the active pursuit of evidence to support personal viewpoints or the creation of favourable or unfavourable conclusions about the schools or participants (Creswell, 2014). Multiple strategies for data validation were employed to avoid bias and to ensure the accuracy of information collected. Chapter 3 provides a detailed account of the research approach, the design process and the methods utilised for data collection, analysis and validation.

1.7 Contributions

Three primary contributions have been identified from the research. Each is presented in turn in the sections below, with more in-depth discussion to follow in Chapters 7 and 8.

1.7.1 Best practice and guidelines in 21st century learning

Data gathered from multiple sources during both phases of the study, including teacher interviews and questionnaires, student questionnaires, and the researcher's field observation notes and research journal, provide a degree of evidence to suggest that the Bridge21 learning model has merit in a broader, authentic setting beyond the laboratory classroom from where it originated. A number of salient factors that directly affect the use of the model to teach the curriculum in post-primary classrooms in Ireland have been identified and are discussed at length in Chapter 7. Given the specific context of the case study, these results may be of use to the wider cohort of post-primary schools in Ireland that are participating in the systematic reform now underway on a national scale.

Analysis of data collected during the initial (exploratory) phase led to the development of best practice resources, including sample learning activities, and a set of guidelines for teachers, to support them to develop and deliver effective technology-mediated team-based learning activities for the post-primary classroom. This iteration of key resources, activity templates and guidelines were used to inform the development of the refined model of PD implemented during the second (explanatory) phase (further discussed in Chapter 6). This PD model formed the basis of the conceptual model, which is the second contribution of the research, presented in 1.7.2 below. In addition, the best practice resources and guidelines continue to be developed through further research and are widely used in the subsequent large-scale programmes discussed in 1.7.3 below.

Results from both phases of the research suggest that the Bridge21 model has the potential to support teachers to increase their provision of 21st century learning experiences in the post-primary classroom. Additionally, there is evidence to suggest that participation in such learning experiences can support students to develop particular 21st century skills, including creative thinking, problem-solving, teamwork and using technology to work with others. The results show that the use and adaptation of the Bridge21 model in the post-primary classroom addresses some of the challenges surrounding 21st century learning and skills, as identified in the literature. These findings are discussed in detail in Chapters 7 and 8, which synthesise the results and conclude the study with an evaluation of the overall impact of the intervention on teachers and students in the participant schools.

1.7.2 Conceptual model and PD design features

A review of literature (Chapter 2) and the results of early research into the effectiveness of Bridge21 as a model of 21st century learning (Chapter 3) formed the basis of a preliminary design of a framework to bring the model out of its original context of the university laboratory into the authentic setting of the post-primary classroom. Central to this framework was an initial concept of PD for the participant teachers that would be experiential and centred on constructivist pedagogy. The framework and PD model were trialled, developed and refined through multiple iterations across two phases of the four-year study, as described in Chapter 4.

To achieve greater and more sustainable impact of research in education systems, it is critical to provide conceptual frameworks, so that solutions and interventions, particularly those related to ICT, can be more easily integrated

into the classroom, school and wider education system (Prieto, Dlab, Gutiérrez, Abdulwahed & Balid, 2011). Accordingly, findings in relation to the design features of the PD model and the overall programme of engagement between the university and school, along with the critical factors relating to the experiences of students and teachers, form the basis of a proposed conceptual framework to facilitate and support the use of Bridge21 as a pragmatic approach to 21st century learning in the authentic setting of the post-primary classroom. The conceptual framework is a key contribution of the research as it may be applicable to future school-university partnerships or research programmes, particularly where the relationship and collaboration between teachers and university staff is critical. Within the overall framework, the results also revealed a number of specific features of the approach to PD that were necessary to support and enable teachers to use the Bridge21 model to effectively teach the curriculum in the post-primary classroom. This approach to PD addresses many of the challenges and barriers to technology integration and 21st century teaching and learning identified in the literature. Given the specific context of the study, the results suggest that the framework and model of PD are a viable option for post-primary schools in Ireland wishing to engage in school reform and utilise a 21st century technology-mediated team-based model of learning. The final version of the model of PD and the proposed conceptual framework are presented for discussion in Chapters 6 and 7.

1.7.3 Subsequent large-scale programme and research developments

The intervention under exploration in this study, which was initiated, trialled and developed by the author through an iterative design process over a four-year period, has evolved into a large-scale longitudinal school-university partnership with an ambitious agenda of national education reform. Since its inception in 2007, the programme has engaged a total of 13,208 students and 1,905 teachers from more than 100 schools across Ireland (Tangney, 2017). In the 2017-18 academic year, the programme will provide multiple strands of programme activity and service delivery at scale to participant schools from a broad range of socioeconomic areas across Ireland, both in the laboratory classroom setting on the university campus and in the classrooms of primary and post-primary schools. In addition, it has recently joined three European research projects, working in partnership with international universities, schools and practitioners to extend the use of the learning model to additional authentic settings.

As part of the systemic reform of the Irish education system, Bridge21 is involved in both PD and initial teacher education and is regarded as a significant partner in the field. It delivers accredited modules in 21st century learning and STEM (Science, Technology, Engineering and Mathematics) pedagogy to pre-service teachers participating in the Professional Masters in Education at Trinity College Dublin, and to qualified teachers participating in the Postgraduate Certificate in 21st Century Teaching and Learning[1].

As the project has expanded and begun operating a broad suite of activities and interventions at scale, an extensive body of research has simultaneously been undertaken in collaboration with several research groups within the university, including the Trinity Access Programmes[2]. While the current study does not amount to conclusive evidence about the effect of the Bridge21 model in post-primary classrooms in Ireland, it has provided a strong foundation for continued research and development in the area. Evidence of the efficacy of the learning model in authentic learning settings is beginning to emerge from additional studies that have been undertaken as a direct result of the intervention described in this thesis, encompassing a broad range of diverse fields and curricula including: mathematics, physics, history, language learning, peer learning, computer science teacher education and educational disadvantage.

Below are some examples of the emerging findings and results, which show that the Bridge21 model:

- Has the potential to foster intrinsic student motivation (Lawlor, Marshall & Tangney, 2016).
- Can be used to support peer teaching in technology-mediated collaborative workshops (Sullivan, Marshall & Tangney, 2015).
- Can enhance student engagement in the contextual learning of mathematics (Bray & Tangney, 2016).
- Can positively impact student engagement and confidence in physics (Wickham, Girvan & Tangney, 2016).

[1] See tcd.ie/courses/postgraduate/az/course.php?id=DPCED-TCTL-1P09

[2] Trinity Access Programmes (TAP) work in partnership across the education sector and with students, teachers, families, communities and businesses to widen access and participation at third-level of under-represented groups. TAP offers a range of access programmes for people with the enthusiasm, motivation and ability to succeed at third-level. See tcd.ie/Trinity_Access/

- Is an appropriate 21st century teaching and learning approach to Computer Science education (Byrne, Fisher & Tangney, 2016; Byrne, O'Sullivan & Sullivan, 2017).
- Aligns with Computer Mediated Communication (CMC) language learning methodologies (Bauer, Devitt & Tangney, 2015).
- Can be used in a college-focused mentoring programme for students in socio-economically disadvantaged schools (O'Sullivan, Mulligan, Kuster, Smith & Hannon, 2017).

1.8 Thesis Roadmap

This chapter has presented an introduction to the study and a broad overview of the rationale, aims, research questions, methods and contributions of the research. The chapters that follow will provide a detailed account of the work undertaken, results and conclusions. Below is roadmap of the remainder of the thesis, with a brief summary of each chapter.

Chapter 2: Literature Review

This chapter presents a comprehensive review of the literature that informed, influenced and shaped the direction and development of the study. Specifically, literature relating to 21st century learning, educational technology and teacher PD are synthesised and discussed. The review methods employed and the criteria for selection of relevant literature are also described.

Chapter 3: Context

Chapter 3 situates the research in the context of the wider education system at the time the study was conducted. Synopses of the evolution of policy relating to ICT in education in Ireland and the education landscape relating to 21st century learning and skills are presented. A detailed account of the background to the research is also provided, including a description of the key elements of the Bridge21 learning model, early research on its effectiveness and the conditions that influenced the logic and rationale for this study.

Chapter 4: Intervention Design

This chapter reports on the iterative design of the intervention, guided by two key design considerations identified at the outset relating firstly, to teacher PD and secondly, to the practical application of the Bridge21 learning model in the

classroom. The programme schedule for delivering the intervention and the provision of teacher resources are also described.

Chapter 5: Research Methodology

In Chapter 5, the overall research approach, the design process and the methods utilised for data collection and analysis are described. The epistemology and theoretical perspective of the researcher is also stated, along with the logic of the inquiry, so as to establish how the researchers' prior activities and experiences influenced the focus of the study and the approach undertaken. The chapter also includes a review of the ethical considerations and measures taken. Finally, measures to ensure validity and reliability of the data are considered.

Chapter 6: Data analysis and results

Chapter 6 gives an account of the research aims, context and analysis of data (qualitative and quantitative) for the Exploratory and Explanatory phases of study. An overview of the key results and findings from both phases is also presented, which relate to the experiences of students and teachers, degrees of use of the Bridge21 model in the post-primary classroom and the iterative design of the model of PD and practitioner support materials and resources.

Chapter 7: Discussion of Findings

In Chapter 7, the final interpretation of the entire analyses of data from the two phases of the study is presented. Firstly, the primary factors that affected the use of the Bridge21 model in the post-primary classrooms under investigation in the study are discussed. Data relating to critical aspects of the design of the PD model and the overall programme of engagement with schools are also discussed, in order to explore the development of a conceptual framework.

Chapter 8: Conclusion

This chapter draws a conclusion to the study, based on the primary findings and answers to the research questions. The limitations of the study are noted and some areas of future research are outlined.

2 Review of Literature

2.1 Introduction

This chapter presents a review of the literature that informs, influences and shapes the direction and development of the study. The aim of the review is to critically examine, analyse and synthesise a selected body of literature, which includes research papers, academic articles and government reports and publications, in order to set the context of the research, to rationalise and define key aspects of the study and to guide the design of the intervention. It is intended that this literature review influences the "choice and justification of research topic, choice and justification of methods of data collection and analysis, and discussion of the findings, conclusions, and implications" (Boote & Beile, 2005, p.10).

The literature review takes a concept-centric approach whereby key concepts determine the organising framework of the review (Webster & Watson, 2002; Levy & Ellis, 2006). The key concepts identified for this study are: education technology, 21st century learning and teacher PD. The review methods and criteria for selection of literature are guided by Boote and Beile's (2005) literature review scoring rubric (adapted from Hart, 1999), which has been purposefully designed for the field of education research. The key concepts, review methods and criteria for selection of literature are discussed in the next section.

2.2 Review Methods

The complex nature of education research demands a substantive, thorough and sophisticated literature review - it is the solid foundation upon which an investigation is built and collective understanding is advanced (Boote & Beile, 2005). The objectives of this literature review are to:

1. Set the broad context of the research and situate it within the field
2. Rationalise and define the problem, research questions and aims of the study
3. Inform and guide the design of the intervention.

The literature review takes a concept-centric approach whereby key concepts determine the organising framework of the review (Webster & Watson, 2002; Levy & Ellis, 2006). The review method and criteria for selection of literature are guided by Boote and Beile's (2005) literature review scoring rubric (adapted from Hart, 1999) that identifies five key categories and related criterion to

evaluate the quality of dissertation literature reviews: *coverage, synthesis, methodology, significance* and *rhetoric*. Each of the categories are explained in brief below, along with a summary of how the criterion, as described by Boote and Beile (2005), were applied to guide the review of literature and other aspects of this research process.

2.2.1 Criteria for selection of literature

Coverage

Coverage relates to the justification of criteria for inclusion and exclusion of literature. Due to the large volume of literature in the field of research in which this work is situated, this review focuses on a number of key concepts identified in the areas of education technology, 21st century learning and teacher PD. Identification of the key concepts was guided by the elements of the 21st century learning model under investigation and the context within which the research would take place (post-primary classrooms and schools in Ireland). The electronic databases used during the literature review process were selected for their relevance to these key concepts. The aim was to conduct a purposeful review of relevant literature, without confining it to "one research methodology, one set of journals, or one geographic region" (Webster & Watson, 2002, p.xv).

Synthesis

Synthesis, in the context of the literature, equates to a critical examination of the state of the field and how the topic or problem is placed in the historical context of the research area and the broader scholarly literature. The aim of this review was to summarise, analyse and synthesise the selected body of literature in order to gain a perspective that would inform the current study. A concept matrix (Webster & Watson, 2002) was developed for each of the three key themes, with sub-themes and additional units of analysis for subheadings under each concept. Figure 2-1 shows the concept matrix template that was developed. An excerpt from the coding matrix developed for the concept of education technology is shown, by way of example, in Figure 2-2.

Concept name:	[concept definition]					
[Concept subheading]	**Concept 1**		**Concept 2**		**Concept n**	
[Unit of analysis]						
Ref 1	x					
Ref 2	x	x				
Ref n						

Figure 2-1 Literature review concept matrix (Webster & Watson, 2002)

Concept: Education and Technology ->	role of computer technology/ICT in teaching & learning						
[Concept subheading]	**Background / context**		**ICT integration**			**Technology-enhanced learning**	
[Unit of analysis]	Historical evolution	Research/policy developments	Integration of tech	Barriers	Factors of success	Constructivist practices	
McGarr, 2009	x	x	x	x			
Marshall & Anderson, 2008		x					
Orlando, 2013						x	
Ertmer, 1999				x			
Ertmer & Ottenbreit-Leftwich, 2(			x	x	x		
Selwyn, 2008	x	x					
Khalid & Buus, 2017			x	x			
Conole, 2008						x	
Fullan & Langworthy, 2014				x	x		
Conole et al, 2004						x	
Drenoyianni, 2006						x	
McGarr & O'Brien, 2007		x	x				
Somekh, B. (2008). Factors affec					x		
Butler, Leahy, Shiel & Cosgrove, 2		x					

Figure 2-2 Concept matrix for education technology (excerpt)

Methodology

This category includes criteria firstly for identifying the main methodologies and research techniques used and secondly, for considering how the overall methodology relates to the primary ideas and theories put forward. The aim of the review in this study was to "not only report the claims made in the existing literature but also examine critically the research methods used to better understand whether the claims are warranted" (Boote & Beile, 2005, p.7). In addition, the criterion in this category inform the choice and justification for the proposed methods of data collection and analysis, which are discussed at length in Chapter 5.

Significance

Significance relates to the discussion of the practical and scholarly implications of the existing literature, and ambiguities or shortcomings in the literature. The aim of this review was to critically examine the significance of the findings and

results of the selected literature in order to rationalise and define the problem, research questions and aims of this study.

Rhetoric

This category highlights the need to present a well-developed, coherent articulation of the core ideas and central themes of the selected literature. Additionally, the literature review should be written in an organised and clear manner. The goal of this chapter was to adopt a coherent, clear structure to support the review of the selected literature.

2.2.2 Structure of the literature review

Guided by the above framework, the structure of the literature review in the remainder of this chapter is as follows:

- Section 2.3 discusses **Educational Technology**, beginning firstly with a brief examination of the history of ICT in education. This is followed by a summary of approaches to ICT integration in schools, along with an exploration of the barriers and factors for success. Orchestration is explored as an example of a framework for ICT integration, as it is an approach that aligns closely with the intervention under focus of this study.
- **21st Century Learning** is discussed in Section 2.4. First, 21st century skills are defined, international frameworks are examined and two competencies that are pertinent to the central concepts of this study are selected for in-depth discussion. Following that, some issues and challenges encountered in implementing 21st century skills are discussed.
- The discussion of **Teacher Professional Development** in Section 2.5 begins with an exploration of the characteristics and critical features of effective PD programmes. The focus then narrows to examine issues and challenges associated specifically with PD for technology integration. Three models of effective PD for technology integration are selected for discussion.
- The central concepts and emerging research problem are discussed in Section 2.6, followed by a brief summary and conclusion of the review of literature in Section 2.7.

It should be noted that the evolution of ICT in education policy and the concepts of 21st century learning and reform in the Irish education system are

discussed separately in Chapter 3, which outlines the context for the current study, along with a detailed account of the model of technology-mediated team-based learning under investigation.

The definition of ICT used throughout this chapter is taken from the *Digital Strategy for Schools 2015-2020*, which states that ICT is "a diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information" (DES, 2015, p.9). This definition and the policy document from which it is referenced are based on the *UNESCO ICT Competency Framework for Teachers* that is aimed at "helping countries worldwide to develop comprehensive national teacher ICT competency policies and standards" (UNESCO, 2011, p.1). While the myriad of related terms in the literature, such as digital technologies, computer technology, digital learning tools, digital devices etc., must be acknowledged, this definition of the term was selected for use throughout this chapter, and in the remainder of this thesis. Critical factors that informed the selection of this definition included the research context (post-primary schools in Ireland), the particular model of technology-mediated 21st century learning and the process of developing a programme of PD that were under investigation.

2.3 Educational Technology

The classroom of the future is often described in terms of the availability and effective use of the latest advances in technology. ICT creates "new possibilities, dilemmas, and directions" and it encourages teachers to harness new opportunities to create more meaningful, rewarding and rich teaching and learning experiences (Levin & Wadmany, 2008, p.233). Yet, a significant gap persists between these visions for ICT in education and how technologies are used in practice in the classroom (Voogt, 2008; OECD, 2015). This section will firstly set the historical context of educational technology, followed by an overview of the range of approaches to integration of ICT in schools. Following that, some of the primary barriers to and enabling factors for effective technology integration are discussed. This section will conclude by exploring a framework for ICT integration, selected for its relevance to the model of technology-mediated team-based learning under investigation in this study.

2.3.1 Historical context

The field of educational technology research has been dominated primarily by questions of what should happen, and what could happen when new

technologies and digital media are placed into educational settings (Selwyn, 2008). Many argue that there is little doubt of the potential of technology to enhance teaching and learning and to act as a potential catalyst for change, innovation and educational improvement (McGarr, 2009; OECD, 2010). It is suggested that since technological advances in recent years have made information instantly and more easily available to learners, the learning landscape has been fundamentally changed and new methods and perspectives are required to "capture the new capabilities and learning processes that have emerged" (Voogt, Knezek, Cox, Knezek & ten Brummelhuis, 2013, p.4).

While ICTs are deemed to be powerful tools for teaching and learning, particularly given their potential to support constructivist practices (Orlando, 2013) and to facilitate the development of new capabilities and 21st century skills (Voogt & Pelgrum, 2005; Levin & Wadmany, 2008; Dede, 2010; Fullan & Langworthy, 2014), several studies have highlighted the significant gap between these visions for ICT in education and how technologies are used in practice in the classroom (e.g. Law, Pelgrum & Plomp, 2008; Voogt, 2008). Recent results from PISA show that technology has not been widely adopted into formal education but, in countries where there has been significant investment in ICT, there has been little or no improvement in student achievement scores (OECD, 2015). Many authors caution against viewing technology as an agent of change, suggesting that it is teachers who must assume this role (Fisher, 2006; NCCA, 2009a; Ertmer & Ottenbreit-Leftwich, 2010). There is no doubt that "technology can amplify great teaching, but great technology cannot replace poor teaching" (OECD, 2015, p.17). For this reason, positioning ICT as a "lever" rather than a "catalyst" for education reform (Venezky & Davis, 2002) appears to be a less radical viewpoint.

According to Butler, Leahy, Shiel and Cosgrove, "today's world of a changing workforce, rapid advancements in technology and increased global competition mean that learning is more critical than ever" (2013, p.2). However, while the development of the global knowledge economy has been, for the most part, enabled by the widespread innovative use of ICT, its influence on reforming models of educational practice remains debatable. Taking the United States as an example, at the turn of the century the National Research Council stated that new technologies were providing students with opportunities to "apply complex content and skills" that were deemed difficult to attain through traditional teaching approaches (NRC, 2001, p.22). However, almost a decade later, the National Education Technology Plan (2010) argued that the use of technology up until then had amounted to little more than "evolutionary

tinkering" and presented concepts to yield "revolutionary transformation." (NETP, 2010, p. ix). This expectation of policy makers that the use of ICT will revolutionise the processes of education is contested by some researchers in the field who argue that it can, in fact, only strengthen and reinforce established educational practice, curriculum, teaching and learning methods (Drenoyianni, 2006).

Many studies suggest that the mere presence of technology in schools does not necessarily lead to changes or improvements in learning experiences and outcomes (Dynarski et al., 2007; Prieto, Villagrá-Sobrino, Jorrín-Abellán, Martínez-Monés, & Dimitriadis, 2011). Others argue that the potential of technology to enhance teaching and learning for the 21st century remains underexploited, as pedagogical approaches in many classrooms today remain largely didactic, behaviourist and individual-led (Blatchford et al., 2003). Levin and Wadmany (2008) assert that while the "techno reformers" are encouraging teachers to use ICT to develop student inquiry, collaboration, and transform the teacher-student relationship, many are persistently mundane in their use of technology, limiting it to teacher-led presentations, information delivery, and as management tools. Similarly, Egan, Fitzgibbon and Oldham (2013) found that pre-service teachers in Ireland are lacking in vision and practical teaching strategies for effective and meaningful use of technology in the classroom. The increasing dependence on technology to enhance teaching and learning in the 21st century has resulted in a variety of complex challenges for both students and practitioners, particularly in authentic educational settings, where there exists a diverse range of pedagogical approaches (ranging from traditional didactic approaches to inquiry- or collaborative-based learning) and where there are constraints such as the demands of the curriculum, examination systems and rigid timetable structures (Selwyn, 2011).

2.3.2 Approaches to ICT integration in schools

In order to meaningfully integrate technology across the curriculum, policies should be presented not as ICT initiatives, but as initiatives in teaching and learning (McGarr, 2009; Petko et al., 2015). Similarly, in considering the role of leadership in technology integration in schools, Dexter (2008) suggests that initiatives will be successful if clear learning goals that can be accomplished with the help of technology are established at the outset, along with a reliable ICT support system and a learning environment conducive to teachers' development of technological, pedagogical and content knowledge competencies. Educational leaders engage with ICT integration programmes for a myriad of reasons, for example, to transform the learner experience

(UNESCO, 2011), to increase student achievement (Cox, 2008) and to enhance the role of schooling in the 21st century (Lawless & Pellegrino, 2007). A framework for ICT in education initiatives should include dimensions beyond the mere use of technology, including "student-centred pedagogy, learning opportunities that transcend the school walls and the integration of ICT into teaching and learning" (OECD, 2010, p. 109).

However, despite these claims and the existence of several studies which focus on both pedagogy and the development of technical skills, and models of PD for technology integration, most PD programmes for teachers continue to concentrate mainly on the technical capabilities of new tools, separate from actual teaching practice (Zhao, Pugh, Sheldon and Byers, 2002; Jung, 2005; Aslan & Zhu, 2016). Knowing how to use ICT is not enough - teachers need to be able to use it in a way that supports meaningful student learning (Ertmer & Ottenbreit-Leftwich, 2010) and to have the capacity to develop new pedagogies (Fullan & Langworthy, 2014). Teachers' beliefs are also a key influencer on the successful use and integration of ICT in the classroom, which has implications for both teacher education and models of PD (Ertmer & Ottenbreit-Leftwich, 2010; Voogt et al., 2013). There is a need to develop accurate insights into teachers' beliefs so as to gain a deeper understanding of the complexity involved in teachers' learning to use ICT effectively in the classroom (Levin & Wadmany, 2008). Guskey (2002) contends that teacher beliefs follow, rather than precede or cause, changes in behaviour and practice. The issues relating specifically to the design of PD for teachers to support them to integrate ICT in schools are discussed in greater detail in Section 2.5.

The introduction of new technology alone guarantees neither improved learning experiences, nor enhanced learning outcomes (Prieto et al., 2011). To fully exploit the potential of ICT in the formal classroom, diverse approaches to pedagogy must be explored and the practice of the traditional, teacher-led classroom must be radically changed. At a basic level, ICT "can make it quicker or easier to teach the same things in routine ways"; moreover, it also has the potential to facilitate teachers to "adopt new and arguably better approaches to instruction and/or change the content or context of learning, instruction, and assessment" (Lawless & Pellegrino, 2007, p. 581). However, in practice, it is rarely the case that technological environments are designed in adherence to pedagogical or instructional theories of learning and teaching (Laurillard, 2009) and hence, these new pedagogical approaches and changes pose a significant challenge for teachers and school systems alike to overcome.

Many studies highlight the potential for technology to enable a student-centred approach to learning (Mitra, 2005; Christensen, Johnson & Horn, 2008). Figure 2-3 shows the student learning process at the core of ten Brummelhuis and Kuiper's (2008) conceptual framework for ICT in education, which identifies four key elements (*learner, teacher, content, infrastructure*) and two influencing factors (*the school environment, the wider context of society*). Frequency of ICT use and a pedagogical orientation towards 21st century learning are positively related (Voogt, 2010). Salomon and Perkins (1996) suggest that technology can serve as both a tool that enables a student-centred curriculum, as well as a stage on which meaningful learning activities can be played out. In the context of the classroom, learning should be focussed on more than the mere acquisition of information, but instead on the interactions and relationships within which learning takes place (Blatchford et al., 2003), between teachers and students and amongst students themselves. ICT has a critical role to play in facilitating such learning activities, partnerships and changing relationships (both of students and teachers and among teachers), particularly as digital technologies give access to a broader, richer and more varied range of content (Fullan and Langworthy, 2014).

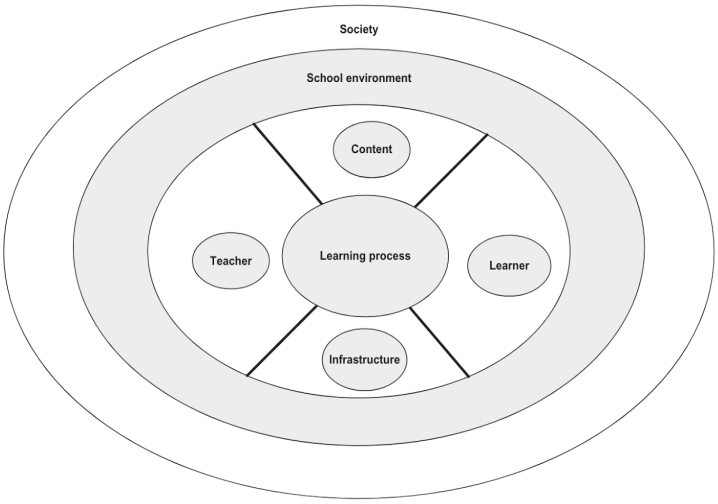

Figure 2-3 Driving forces - ICT in learning (ten Brummelhuis & Kuiper, 2008)

2.3.3 Barriers to ICT integration in schools

A significant body of literature is dedicated to critically examining the barriers to integrating ICT in teaching and learning by individual teachers, schools and education systems. A systemic perspective is needed to gain a clearer understanding of why teachers adopt or do not adopt ICT in the classroom (Levin & Wadmany, 2008). Ertmer (1999) proposes a categorisation of first- and second-order barriers that limit efforts to integrate technology into

curricula. Extrinsic, or first-order, barriers relate to provision of technology in schools, resources and access issues. Whilst regarded as easy to measure and thus eliminate, they often give rise to second-order barriers, which are more intrinsic in nature, relating to teachers' beliefs about teaching and learning, and willingness to make changes in their classroom practice. Programmes of PD for teachers must include practical strategies and pedagogical models so that they are equipped to deal with both types of barriers (Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010). Moreover, if effective integration of ICT in schools is to be achieved, it is imperative that educators and researchers continue to critically examine how teachers' current classroom practices are rooted in, and mediated by, existing pedagogical beliefs (Ertmer, 2005). A more detailed examination of the barriers to technology integration through the lens of PD for teachers will be discussed in Section 2.5.

Kopcha (2012) identifies five categories of critical barriers that teachers face when integrating technology into teaching and learning in their classroom. These categories are: *access, vision, beliefs, time* and *professional development* (ibid, p.1109). Laferrière, Hamel and Searson (2013) take their analysis one step further by probing tensions and contradictions that arose as barriers during a technology integration (design-based research) project in Canada. Based on an activity theory framework, the authors contend that a number of 'pivotal actions' taken by agents in the project eased the process of technology integration in the schools and uncovered the dynamics between barriers and conditions for success, resulting in tensions and contradictions becoming the "driving forces for transformation" (ibid, p. 470). Barriers to integrating ICT in classrooms may be viewed as somewhat of an inevitability, and overcoming them should form a central component of school and systemwide programmes for technology-enhanced learning.

In a study of 228 peer-reviewed articles, Khalid and Buus (2013) identify existing categorisations of barriers and propose a macro-meso-micro level approach as a theoretical framework for mapping and analysing barriers in the literature:

- *Macro* level barriers are those at a national level in a country, such as provision of teacher PD, objectives of the national examination system, funding and resource allocation, and policy development.
- At the *meso* level, barriers include the subject-specific teaching culture of schools, leadership support, classroom environment and design, collaboration as organisation culture and freedom to incorporate new ideas at an individual level within an institution.

- *Micro* level barriers are those that affect individuals, grouped into the attitudes and beliefs of teachers, administrators, students and parents.

Goals set at the macro (national) level often conflict with expectations for ICT integration set by the meso (institutional) level, and factors at both the macro and meso levels influence integration and adoption by the individual at the micro-level (ibid). The implications for this dichotomy, particularly in the context of a high stakes examination system that "favours content regurgitation" such as in Ireland, is that teachers will be reluctant to attempt effective ICT integration into classroom teaching and learning (Donnelly, McGarr & O'Reilly, 2011, p. 1477). Although any single barrier has the potential to significantly impede meaningful ICT use in classrooms (Ertmer, 1999), it is difficult to consider one barrier as a single-tier problem. Multiple stakeholders and levels of the education system, including political, institutional and individual, must be engaged in understanding the complex dependencies and addressing the root causes of barriers (Khalid and Buus, 2013; Twining et al., 2013).

2.3.4 Factors for successful integration of ICT in schools

The educational technology literature contains a number of meta-analyses of the factors and conditions under which ICT has a positive effect on teaching and learning (Voogt & Pelgrum, 2005; Means, 2010; Voogt et al., 2013). Means (2010) categorises the factors for successful integration of technology as firstly, school practices (including principal support, establishing a consistent instructional vision for the school and teacher collaboration) and secondly, teacher practices (including classroom management). The combination of the natural diversity of pedagogical approaches in educational settings with the increasing complexity of ICT gives rise to a variety of challenges for practitioners and students alike (Prieto, Dlab et al., 2011).

Facilitating factors to tackle these challenges, summarised by Voogt et al. (2013), include establishing a clear view on the role of ICT in 21st century learning and developing alternative modes of assessments designed to measure the outcomes of technology-enhanced learning experiences. Additionally, the existence of practical models for teacher PD help to facilitate successful integration of technology in the classroom, along with a model of distributed leadership so that practitioners are engaged in leading change at multiple levels within a school, or across the system (ibid). In order to leverage the affordances of technology for learning, the following conditions should exist: a shared vision, empowered leaders, implementation planning, consistent and adequate

funding, equitable access, skilled personnel, ongoing professional learning and development, technical support, a curriculum framework, student-centred learning, assessment and evaluation, engaged communities, support policies and supportive external context (ISTE, 2009).

If technology is to be a lever for change in education, it is critical to focus on deep student learning. Practitioners and researchers alike need to understand the types of learning outcomes that can be enhanced by technology (Means, 2010) and to develop the infrastructure, digital content and pedagogies to better prepare schools to use ICT in a way that benefits student learning (Voogt et al., 2013). When ICT is used to facilitate students working on topics that are meaningful to them or are embedded in an authentic context, innovative teaching practices can emerge (Voogt & Pelgrum, 2005). Moreover, ICT skills should not be taught in isolation but as part of more complex, 21st century skills, such as managing information, collaboration and communication (ibid).

There are a number of established theories and frameworks for technology adoption in the literature, for example, Diffusion (Rogers, 1995), Concerns-Based Adoption Model (Hall, 1979), and the Technology Acceptance Model (Davis, 1989; Venkatesh & Davis, 2000). Yet, adoption of ICT remains a "complex, inherently social, [and] developmental" process (Straub, 2009, p. 625). Levin and Wadmany (2008) question the "one-stage-at-a-time" approach common to many of the above technology adoption models, proposing instead a more cyclical and dynamic process for teachers to develop their views and practices concerning the effective use of ICT, whereby their learning, cognitive views, feelings and behaviours are affected by "multifarious and multidimensional" characteristics. Means contends that few learning technologies have managed to "cross the chasm" from adoption by the "enthusiasts and visionaries" to acceptance by the majority of teachers, who are pragmatists and conservatives (Means, 2010, p.285). Zhao et al. (2002) examined what they describe as the "complex and messy process of technology integration in real classrooms" (p.484) and identified three domains of conditions under which technology integration can happen: the teacher, the project and the context. Similarly, Selwyn (2011) highlights the "messy realities" (p.33) of technology use in schools and the importance of including measures to address contextual factors in the design of reform programmes.

Successful technology integration in schools requires not just basic resources (funding, ICT equipment etc.) but continuous effort from and prioritisation by teachers, principals and entire education systems, following a process of iteration and refinement, whereby the results from monitoring and evaluating

one implementation cycle inform and refine the following phase, and thus an iterative cycle of development is continued (Means, 2010). Active, collaborative partnerships between teachers and schools participating in ICT interventions and those who design and research such interventions can facilitate successful integration and adaptation of the intervention in the particular context of the school and its learners (ibid). To achieve greater and more sustainable impact of technology-enhanced learning research in education systems, it is critical to provide conceptual frameworks, so that solutions designed to overcome the challenges and barriers associated with using ICT can be more easily integrated into the classroom, school and system (Prieto, Dlab et al., 2011).

2.3.5 Orchestration – a review framework for ICT integration

Orchestration of learning is an emergent phenomenon in the field of educational and learning technology research, overlapping with established areas of the field including instructional design and teacher facilitation. In the context of the emergent needs of the knowledge economy and the development of new technologies, the role of the teacher is changing from "monologic to dialogic actor" (Hämäläinen & Vähäsantanen, 2011, p.177), which involves practices such as orchestrating, scaffolding, supporting and structuring students' shared knowledge construction processes (Craft, 2008; Dillenbourg et al., 2009; Fischer & Dillenbourg, 2006; Sawyer, 2006; Scardamalia & Bereiter, 2006; Wells & Arauz, 2006).

A broad range of definitions for the term orchestration exist, the simplest being "a process that leads to knowledge construction in a student-centred approach under teacher guidance" (Chamberlain, Williams, Cowan, & Mistree, 2001). Fischer and Dillenbourg (2006) use the term 'orchestrating learning' to refer to the means by which teachers coordinate different learning activities at diverse social levels and in a wide range of contexts, using a variety of available technologies (including ICT and pen, paper, books etc.). Hämäläinen and Vähäsantanen (2011) assert the central idea of orchestration as a combination of design and improvisation of learning activities, although there is some tension in the literature between descriptive and prescriptive frameworks of orchestration (Prieto, Dimitriadis, Asensio-Pe´rez, & Looic, 2015).

Specific to the context of technology-enhanced learning in the formal classroom, orchestration may be defined as "the process of designing and managing in real-time (including awareness and adaptation mechanisms) the learning processes in an authentic computer-supported learning scenario"

(Prieto et al., 2015, p.12). According to Roschelle, Dimitriadis, and Hoppe (2013), there is ongoing debate about the role that ICT can play in orchestration and the degree to which it should be used to enhance a learning setting. In a review of 11 papers on the topic, they highlight a pattern of drawing "attention to the challenges of classroom use of technology" and the need to develop frameworks and guidance to support teachers in their role of facilitator (ibid, p.523). In the context of collaborative learning, it has been found that teachers must have sufficient pedagogic expertise and professional skills to effectively orchestrate learning activities, and their professional interests, attitudes, beliefs and goals can affect how they design and orchestrate collaboration amongst their students (Hämäläinen and Vähäsantanen, 2011).

The conceptual framework of Prieto, Holenko Dlab, Gutiérrez, Abdulwahed and Balid (2011) and Prieto et al. (2015) outlines the key aspects of orchestration in order to provide a more structured and sustainable approach to integrating technology in the formal classroom, situated within the practical context of the wider education ecosystem and all of its constraints and complex barriers. The framework, shown in Figure 2-4 includes five key aspects in characterising orchestration - *Design, Management, Awareness, Adaptation,* and *Role of the teacher and others* - and three aspects describing key factors that shape the way orchestration should be undertaken - *Theory, Synergy* and *Pragmatism* (Prieto et al., 2011). Given the increasing complexity of educational practice in authentic technology-enhanced classroom settings, such a conceptual tool has the potential to help teachers to effectively support ICT learning activities and thus should feature in programmes of PD (Prieto et al., 2011).

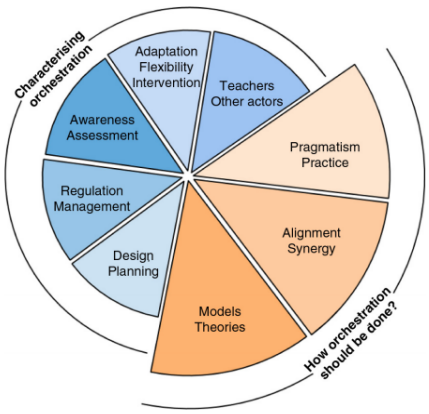

Figure 2-4 Orchestration conceptual framework (Prieto et al. 2011)

In recent years, orchestration has become an important pillar of educational and learning technology research, particularly in the context of a continuously

changing information society, pervasive educational technologies and the associated 21st century skills such as problem-solving, creativity and collaboration. Hämäläinen and Vähäsantanen (2011) describe the orchestration process as firstly beginning with pre-determined aims, goals and plans for a learning activity based on the curriculum. Problem(s) are then presented to students in such a way that they are encouraged to share and collaboratively construct knowledge. Following that, the teacher's role is to:

1. Lead the learning process towards a specific outcome;
2. Ensure an open and flexible learning environment for collaboration and creativity;
3. Support and monitor the learning process during the group work, based on contextual needs;
4. Be a fellow collaborator, joining the students in the collaboration process; and
5. Focus on enhancing the collaboration processes, instead of providing correct answers.

Concrete resources and structured frameworks, such as those described above, along with practical examples of successful uses of technology, are an important source of support and guidance for teachers wishing to apply orchestration techniques to integrate ICT into the authentic setting of the classroom.

2.3.6 Summary

The historical evolution of technology in education has led to a significant gap between visions of how ICT can transform teaching and learning and the reality of how it is used in daily classroom practice. This section has presented an overview of the complex challenges associated with the meaningful use of ICT in authentic educational settings. Despite several decades of research on how best to integrate technology in schools, the literature reviewed above indicates that numerous barriers persist at multiple levels of the education system, including access, vision, beliefs, time and PD (Kopcha, 2012; Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010).

It is reasonable to conclude that in order to achieve greater and more sustainable impact of technology-enhanced learning initiatives, it is critical to develop conceptual frameworks and concrete resources, so that solutions designed to overcome the challenges and barriers associated with using ICT can be more effectively integrated into the classroom, school and system (Prieto, Dlab et al., 2011). This is a particularly important consideration in the context

of the continuously changing information society, pervasive educational technologies and the emergence of 21st century learning and skills as a key feature of global curricula (Hämäläinen and Vähäsantanen, 2011). 21st century skills and competencies, including international frameworks and issues and challenges related to 21st century learning are discussed in the next section.

2.4 21st Century Learning

2.4.1 Introduction

In recent years, dramatic changes have taken place in the global economy and society, largely due to advances in ICT (Claxton, 2008). People need very different skills "for work, citizenship and self-actualisation" (Dede, 2010, p. 51) in the 21st century, compared to the previous 100 years. Trends in ICT development are transforming the world of work, revolutionising how we live and learn, creating an increasingly competitive economy (Anderson, 2008) and requiring advanced levels of cognitive skills and learning capacities of today's workforce (Partnership for 21st Century Skills, 2006, 2011; Scheuermann & Pedró, 2009). ICT is considered to be the catalyst for education reform, and also, by many, to be the means to achieve it (Levin & Wadmany, 2008).

A common theme identified in the review of literature is that the economic and social trends of the 21st century have significant implications for education practices and policies and, indeed pose many challenges. Carr (2008) proposes that the urgent task of education must be to assist young people in preparing for "the diversity of the 21st century wilderness that they will encounter" (p. 36). A widely accepted viewpoint is that the increasing pace of globalisation and technological progress means that children who are just beginning school will end up with a job that does not yet exist and will most likely have multiple careers in their lifetime (Voogt & Pelgrum, 2005; Gerver, 2010; Dede, 2010). Today's students should be expected to move beyond solely learning subject-specific facts and figures, towards acquiring a broad range of competencies, which include complex skills and deep content knowledge (NRC, 2001; Dede, 2010; Fullan & Langworthy, 2014;). There is a requirement to develop 'Learners' with positive transferable learning dispositions rather than 'Knowers' who can absorb and reproduce received information (Claxton, 2006). The continuously changing information society demands an improvement in communications in order to facilitate the shared construction of new knowledge (Hämäläinen & Vähäsantanen, 2011).

By way of response, education reform movements throughout the world are attempting to re-design and implement new curricula and innovative models of learning and teaching. However, it is argued that education systems have been slow to respond to the changing external environment and continue to emphasise information transfer and 20th century proficiencies over the development of contextual skills and metacognitive strategies (Dede, 2010). The challenge to educators lies in the fundamental shift that is required in both "*what* has to be learned and *how* this learning is to happen" (Voogt, Erstad, Dede & Mishra, 2013, p.403).

This section will firstly discuss 21st century skills and competencies, including a definition and brief analysis of international frameworks. A comparison of international frameworks for 21st century learning will follow, along with a discussion of specific 21st century skills (namely ICT literacy and collaboration) as key concepts related to this research. There then follows a brief examination of the issues and challenges surrounding the implementation of 21st century skills in practice.

2.4.2 Definition of 21st century skills and competencies

Core skills for the 21st century have been the focus of developments in education systems around the world in recent years. Learning outcomes for the 21st century are defined not only by proficiency in subject knowledge but also the development of certain skills that are "expected and highly valued in school, work and community settings" (Kay, 2010, p.xii). Moreover, in response to the challenges and dynamic changes of the information society, much research has focussed on the development of innovative pedagogical practices that lead to student learning outcomes relevant to the 21st century (Voogt & Plomp, 2010). Such skills and learning dispositions should be action words which cut across multiple subject areas, and require students to be "ready, able and willing to learn" (Carr, 2008, p. 37). These higher-order thinking and learning skills have a range of associated terms, the most common being: 21st century competences, lifelong learning competences (or dispositions), 21st century learning and 21st century skills. Fullan and Langworthy (2014) propose the term 'deep learning' to describe the learning, creating and active dispositions that young people need to thrive now and in the future. For the purposes of this thesis, the term 21st century skills is used throughout to mean the knowledge, skills, attributes and attitudes that individuals need to live and learn in the 21st century (Voogt et al., 2013), as this is the definition that most closely aligns with the particular model of 21st century learning under investigation.

In an attempt to recognise these skills and competencies as important learning outcomes, many countries are redesigning school curricula to promote their integration. For example, the school curriculum in New Zealand[3], renewed in 2007, aligns a range of key competencies alongside core curriculum strands from early childhood through to primary and secondary education. Guided by national and international research and best practice, 21st century skills have featured on the education policy agenda in Ireland in recent years. Referred to as 'key skills', they are now a central component of primary and post-primary curricula, with the goal of deepening students' learning and developing their self-awareness of *how* and *what* they learn (NCCA, 2011b). These key skills are discussed in greater detail in Chapter 3 (see Section 3.3).

However, the focus on 21st century skills is often at odds with the 20th century, high-stakes assessment practices that prevail in this and many countries and the ongoing debate about what is core in the curriculum, which has proved to be a significant barrier to implementing them in practice. The argument for more valid and appropriate assessment approaches to measure 21st century skills and to reflect innovative pedagogical practices is made in Section 2.4.6.

Voogt and Roblin (2012) present a comparative analysis of eight international frameworks for 21st century skills, drawing on key publications and reports associated with each framework. The authors suggest the following as key characteristics of 21st century skills:

1. *Transversal:* not directly linked to a specific subject but relevant across numerous subjects
2. *Multidimensional:* include knowledge, skills and attitudes
3. *Higher order skills and behaviours:* represent the ability to cope with complex problems and unpredictable situations.

Additionally, their analysis reveals evidence of strong agreement across international frameworks on the following 21st century skills:

- Communication
- Collaboration
- ICT literacy
- Social and/or cultural skills / citizenship
- Creativity
- Critical thinking
- Problem-solving

[3] See nzcurriculum.tki.org.nz/

- Productivity

ICT tends to be at the heart of the majority of international approaches to 21st century skills, with some emphasising ICT-related competences as separate domains, whilst others propose integration with other skills (Voogt & Roblin, 2012). Levin and Wadmany (2008) contend that the ability to use ICT has become the new literacy for the 21st century. The literature indicates a great deal of diversity between definitions, approaches and assumptions regarding the integration of 21st century skills and core subject content knowledge. A more detailed discussion of international frameworks for 21st century learning is presented in Section 2.4.3.

Not all competencies, nor their impact on learners, are unique to the 21st century. Some authors contend that many of the competencies categorised as 21st century skills have, in fact, been valued in the workplace for centuries and throughout the history of education, for example collaboration, communication and critical thinking (Mishra & Kereluik, 2011; Dede, 2010). Dede (2010) describes these as 'perennial' skills and distinguishes them from new, contextual skills, unique to the 21st century largely due to advances in ICT that have resulted in a paradigm shift in their nature and degree of importance. There is no doubt that technology has a significantly influential and innovative role to play in not only shaping the competencies that are needed in today's, and indeed tomorrow's world, but also defining how learners effectively use, manage, evaluate and produce information across a range of ICT tools and media (Voogt and Roblin, 2012).

2.4.3 International frameworks for 21st century skills

A myriad of conceptual frameworks and resources have been developed by policy-makers and education organisations the world over to "delineate content and processes that teachers should convey as part of students' schooling" (Dede, 2010, p. 51). Amongst the most widely adopted of international frameworks for 21st century skills are:

1. Partnership for 21st Century Skills (2006) [USA]
2. Definition and Selection of Competencies project (Rychen & Salganik, 2005) [OECD]
3. Key competences for lifelong learning: European reference framework (2007) [EU]
4. ICT Competency Framework for teachers (2011) [UNESCO]

Recent reviews and comparisons of different international frameworks (Binkley et al., 2012; Anderson 2008; Dede, 2010; Mishra & Kereluik, 2011; Voogt &

Roblin, 2012) generally concur with the competencies that are critical for the 21st century learner (as defined in 2.4.2 above). For example, a number of common domain areas have been identified for classifying 21st century skills in the most prominent frameworks in the United States:

- ICT literacy
- cognitive skills
- inter-personal skills
- self- and task management skills
- personal characteristics (BIE, 2010)

Despite this consensus, there are differences in the degree of emphasis placed on particular skills within each framework, from those that contain general overarching concepts of 21st century skills, to those that focus primarily on issues relating to the integration of technology, and those that define 21st century skills through the lens of assessment (Voogt & Roblin, 2012). A key difference across international approaches appears to be whether or not to include the competences related to core subjects in a definition of 21st century skills. For example, the Key Competences for Lifelong Learning (EU, 2007) is one of only a few frameworks that explicitly references core curriculum.

Mentioned in *all* frameworks	**Mentioned in *most* frameworks**	**Mentioned in a *few* frameworks**	**Mentioned only in *one* framework**
• Collaboration • Communication • ICT literacy • Social and/or cultural skills, citizenship	• Creativity • Critical thinking • Problem-solving • Develop quality products/ Productivity	• Learning to learn • Self-direction • Planning • Flexibility & adaptability • Mathematics, communicatio n in mother tongue, science • History & arts	• Risk-taking • Manage & solve conflicts • Sense of initiative & entrepreneurship • Interdisciplinary themes • Core subjects: economics, geography, government & civics

Table 2-1 Comparison of international frameworks for 21st century skills (Voogt & Roblin, 2012, p.309)

Table 2-1 summarises the differences and similarities in international frameworks as identified by Voogt and Roblin (2012). The varying levels of emphasis suggest a lack of clarity about the nature of 21st century skills and an inconsistency with current classroom practice, which is noted by Dede as potentially problematic for education reform (Dede, 2010). Issues relating to

implementation of 21st century skills and classroom practice are discussed in Section 2.4.6.

Given the focus of this study on the design of a conceptual framework to bring a technology-mediated team-based model of 21st century learning into the authentic setting of post-primary classrooms in Ireland, the 21st century skills of ICT literacy and collaboration have been selected as key concepts for review. and are explored in the following sections.

2.4.4 ICT literacy

As already noted above, ICT tends to be a central component in the majority of international frameworks for 21st century skills, with some emphasising broad ICT-related competences as separate domains, whilst others propose integration with other skills (Voogt & Roblin, 2012). Many frameworks make a strong case for a comprehensive approach to what are perceived as the 'new literacies' associated with digital technology (Voogt et al., 2013). Tyner (1998) draws a distinction between 'tool literacies', which refer to the necessary skills to be able to use technology, and 'literacies of representations', which relate to having the knowledge and ability to take advantage of the possibilities offered by ICT.

Three types of literacies relating to ICT are found in Voogt and Roblin's (2012) comparative analysis of international frameworks for 21st century skills. Table 2-2 (p. 37) shows the distinction made between *Information Literacy* (the capacity to access, evaluate and use information), *ICT Literacy* (the ability to effectively and efficiently use digital technology, communications tools etc. and to make use of technology to access, manage, integrate, evaluate and create information) and *Technological Literacy* (the capacity to understand the principles and strategies to use technology to develop solutions to complex problems and to understand the interplay between technology and society).

Apart from the development of ICT literacy, technology has a key role to play in mediating the development of other 21st century skills, for example, by affording learners the opportunity to access, create and share information in new and different ways, and in a range of diverse, meaningful learning activities. It is suggested that ICT literacy should be embedded across subjects as it is in this context that students can simultaneously develop 21st century skills such as managing information, communication, and collaboration (Voogt & Pelgrum, 2005). The acquisition of complex metacognitive skills as an unexpected outcome of technology-mediated innovative practice is appropriately summarised as the change in students from "receivers who simply swallow

presented materials to constructors who create their personal knowledge" (Ibid, p. 171).

ICT-related competence	Definition
Information Literacy	The capacity to • access information efficiently and effectively • evaluate information critically and competently • use information accurately and creatively
ICT Literacy	The capacity to • use digital technology, communication tools and/or networks effectively and efficiently • make use of technology to access, manage, integrate, evaluate and create information
Technological Literacy	The capacity to • use, understand and evaluate technology • understand the principles and strategies to use technology to develop solutions to complex problems • understand the interplay between technology and society

Table 2-2 Comparison of ICT-related 21st century skills (Voogt & Roblin, 2012)

2.4.5 Collaboration

Much theoretic rationale exists for the use of collaborative learning in instructional settings. Long before its establishment as a core 21st century skill, Piaget's (1937, 1962) constructivist theory and the work of Vygotsky (1978) and others in cultural-historical psychology and sociocultural theory highlighted the importance of the interaction between social, affective and cognitive states in a student's development and learning. According to Leont'ev (1981), "the human individual's activity is a system of social relations" without which it cannot exist (p.46). The constructivist approach to learning involves creating an environment where learners actively participate and interact with their surroundings, construct their own knowledge, interpret what is happening around them and reflect on those interpretations – all of which will be influenced by what the learner already knows, previous experiences they have had, and the knowledge structures they have constructed from those experiences (Jonassen, Carr & Yueh, 1998). In other words, knowledge is not information to be transmitted from teacher to learner, but rather "knowledge is experience that is acquired through interaction with the world, people and things" (Ackermann, 2001, p.3). Vygotsky (1978) developed the idea of 'socio-cultural learning', focussing on the importance of discussion and peer interaction as a critical aspect of the learning process (Rieber & Wollock, 1997). Laurillard (2009) suggests that the term 'collaborative learning' is derived from

both Piaget and Vygotskian theory to combine both social and constructivist elements of the learning process.

However, in today's classrooms there is frequently a gap between the above theories and the actual practice of group-work and collaboration. Blatchford et al. (2003) argue that existing theory does not do justice to the huge potential of collaboration, with the authors regarding Vygotskian and Piagetian theory, in particular, as limited in terms of its practical application to learning situations involving co-learners in classrooms. This is particularly evident in Ireland where there is a dearth of empirical evidence of the use of active learning and collaboration in formal classrooms to inform current practice (Kirk, 1997). With the adoption of ICT in today's classrooms, Orlando (2011) found that most teachers are not changing to constructivist practices, favouring teacher-centred methods. In an attempt to bridge the gap between theory and practice, Laurillard's (2002, 2009) 'Conversational Framework' captures the essential theoretical and practical elements of collaborative learning and represents them as a complex yet "continual interaction between teachers and learners, and between the levels of theory and practice" (Laurillard, 2009, p.11).

Much of the early research on collaboration is focussed on learning activities in a group-based scenario. Johnson and Johnson (1994) promote cooperative learning as more effective than competitive or individualistic learning that typically occurs in formal classrooms. Within the majority of primary school classrooms, it was found that children sat in groups, but rarely worked and learned collaboratively (Galton, Simon & Croll, 1980). Historically, classroom practice of group-work has been found to be rare and often of a very low quality. Teachers and students doubt the value of group-work and thus experience difficulties implementing it in the classroom (Galton & Williamson, 1992). Teachers' concerns relate specifically to disruptive behaviour, believing that group-work will lead to a loss of control on their part, and therefore increased disruption and off-task behaviour (Cohen, 1994).

Many teachers also hold the belief that children are unable to learn from one another and that there is potential for increased conflict amongst students when engaged in group discussions (Lewis & Cowie, 1993). However, Laurillard (2002) contends that *cognitive* conflict arising between conversations amongst peers during a collaborative learning task can enhance a learner's intrinsic motivation, encouraging them to reflect on the learning process and revise their actions. Due to a lack of PD in the appropriate skills, teachers have great difficulties with the selection and design of effective tasks and

assessments for groups (Bennett & Dunne, 1992), believing it to be overly time consuming (Plummer & Dudley, 1993).

Table 2-3 shows Galton and Williamson's (1992) classification of different grouping arrangements in the primary classroom. Co-operative and collaborative groups usually allow for more effective and efficient use of teachers' contact time with students (Galton and Williamson, 1992). Knowledge construction during a collaborative learning activity involves students working together to build on one-another's ideas and thoughts (Mercer, 2010). Group-work methods have led to positive outcomes in student learning and attainment, student motivation and attitude towards schoolwork, and classroom behaviour (student-student and student-teacher interactions) (Blatchford et al., 2003; Galton et al., 2009).

Type	Task demand	Intended outcome	Example
Seating Group	Each student has a separate task	Different outcomes: each student completes a different assignment	Writing stories on themes chosen by the students
Working Group	Each student has the same task	Same outcome: each student completes the same assignment independently	Mathematics worksheet
Co-operative Group	Each student has separate but related task	Joint outcome: each student has a different assignment	Making a map
Collaborative Group	Each student has the same task	Joint outcome: all students share same assignment	Problem solving e.g. discussing a social or moral issue

Table 2-3 Classification of different grouping arrangements (Galton & Williamson, 1992, p.10)

Although the terms cooperation and collaboration are often used synonymously, much of the recent discourse defines them as distinctly different approaches and, within the field of 21st century learning, there has been a shift in focus from cooperative learning to collaboration (Hämäläinen & Vähäsantanen, 2011). In a co-operative group, each student has a different assignment whereas collaborative group-work involves all students contributing to a single outcome (Dillenbourg et al., 2009; Galton & Williamson, 1992). Collaboration is typically viewed in terms of shared learning processes (for example, joint creation of understanding, knowledge building, shared knowledge construction or collective thinking) and shared learning activities

(for example, negotiation of shared meaning, explaining, arguing or reasoning) (Hämäläinen & Vähäsantanen, 2011).

The potential of collaboration as a 21st century skill is that it combines both individual and social processes (Dillenbourg et al., 2009). Successful collaboration is best described as leading to the creation of something that exceeds what an individual student could achieve alone. However, despite the potential of collaborative learning, recent studies have shown that in reality, high-level, productive collaboration is relatively rare (Hämäläinen, 2011; Kollar & Fischer, 2010), is challenging to create (Dillenbourg & Jermann, 2010; Vass & Littleton, 2009) and is often limited by an overburdened compulsory curriculum (Hämäläinen & Vähäsantanen, 2011).

In order to successfully support teachers to use collaboration in the classroom it is suggested that a relational approach is undertaken, whereby a developmental sequence is followed of firstly developing social skills (e.g. trust, sensitivity, respect etc.) and communication skills (ability to engage in high level conversation involving explanation and arguments etc.) before advancing to effective group working skills (Blatchford et al., 2003; Galton et al., 2009). This relational approach is designed to foster connectedness within groups, in terms of increasing the degree of participation of all group members and sustaining a positive and inclusive group ethos (Blatchford et al., 2006). Additionally, teachers need to be supported in their changing role from "monologic to dialogic actor, which includes orchestrating, scaffolding, supporting and structuring students' shared knowledge construction processes" during a collaborative learning activity (Hämäläinen & Vähäsantanen, 2011, p.177).

The quality of group interaction during collaborative tasks is highly dependent on the teacher's approach to planning and preparing lessons, scaffolding learning tasks and activities, and the overall structure of lessons in order to allow time for rich classroom dialogue, reflection, briefing and debriefing etc. (Blatchford et al., 2006; Howe & Abedin, 2013). Indeed, Howe and Abedin (2013) found that student-student interaction via collaboration in small groups can lead to a richness of classroom dialogue not often found in teacher-student interaction, which tend to be characterised by patterns of what is termed "initiation-response-feedback (IRF)" dialogue (p.334). In the context of technology-enhanced learning, Hämäläinen and Vähäsantanen (2011) contend that tasks should be designed to encourage learners to challenge themselves in shared-knowledge construction with the combined support of teacher scaffolding and digital learning resources and tools. Online discussion has been found to facilitate rich peer interaction and to support increased levels of

student contribution to classroom dialogue (Howe & Abedin, 2013). While the nature of classroom interaction in student collaborative learning is considered crucial for effective pedagogy, particularly in the context of 21st century skills, a more in-depth exploration of the concept of student dialogue was deemed to be beyond the scope of the current study.

2.4.6 Implementation of 21st century skills – issues and challenges

Despite general agreement about the nature and importance of 21st century skills, their uptake in schools and classrooms is not guaranteed, owing to a number of prevailing issues and challenges. There is general agreement in the literature that the most significant challenges include firstly, defining the role and place of 21st century skills in the school curriculum and how they will be assessed; secondly, exploring the changing role of teachers, suitable pedagogical practices (including the use of ICT) and necessary teacher PD; and thirdly, defining the roles and responsibilities of multiple diverse stakeholders, from policy-makers and researchers, to school leaders and parents and families. Each of these issues is discussed briefly in the sections that follow.

Guiding the implementation and assessment of 21st century skills

Voogt and Roblin's (2012) analysis of international frameworks suggests three approaches to the implementation of 21st century skills in the curriculum:

1. Added to the **existing curriculum** as new subjects (or as new content within traditional subjects)
2. Integrated **across the curriculum** as **skills that underpin subjects** and emphasise the acquisition of a wider set of key skills
3. Become part of a **completely new curriculum**, in which the traditional structure of subjects is transformed and schools are regarded as sites of learning.

An overcrowded curriculum is often quoted as a barrier to the lack of emphasis on 21st century skills and aspects of learning in the formal classroom (NCCA, 2011b; Dede, 2010). Notwithstanding the range of international approaches, there is general consensus that 21st century skills demand some level of change and restructuring of national curricula (Voogt & Roblin, 2012). There is a need to shift the focus of teaching from covering all of the content required in a curriculum to the process of learning itself, supporting students to be self-

directed learners and to develop meta-cognition of their skills and abilities (Fullan & Langworthy, 2014).

Assessment poses a major challenge to the implementation of 21st century skills in the classroom. The theoretical underpinnings and measurement approaches of many current assessment practices were designed "to fulfil the social and educational needs of a different time" (NRC, 2011, p. 25). Changed expectations of how teaching and learning should happen in the 21st century classroom are not reflected in prevailing 20th century assessment practices. Related factors include the predominance of teacher evaluation and school accountability regimes that define success for many education systems across the globe (Fullan & Langworthy, 2014). New forms of assessment – that are valid, reliable and practical - must be introduced to appropriately measure the kinds of competencies and skills that are expected of 21st century learners (Dede, 2010).

Fullan and Langworthy (2014) suggest that learner outcomes in the 21st century should be measured by: 1) the capacity to build new knowledge and be an autonomous learner, 2) the disposition to persevere through challenges and to solve problems, and 3) the development of lifelong learning skills. There is a need to develop complex tasks and authentic questions that provide students with the opportunity to demonstrate their ability to solve problems, to apply knowledge to real-world situations, to think critically and to work collaboratively (Dede, 2010). It is evident that ICT offers an opportunity to expand and enrich both the mode of testing and the nature of tasks, which in turn can provide the means to examine new skills that heretofore have been difficult to assess (Voogt & Roblin, 2012). These new approaches to assessment must encourage an appropriate pedagogy that will enable and build the development of 21st century skills in learners.

Pedagogical practices for 21st century learning

A new balance of pedagogical approaches is necessary to align formal education practices with the needs of 21st century learners. Teachers, who in traditional models of schooling were 'Knowers', are nowadays encouraged to become "paragons of learning" (Claxton, 2008, p.155), by engaging with their students as co-learners and modelling best practice in 21st century learning skills. Teachers and students are expected to become excellent life-long learners, both individually and collectively (Fullan & Langworthy, 2014). A number of constructivist pedagogical approaches, including problem-based learning,

cooperative learning, experiential learning, and formative assessment, are regarded as particularly suitable for supporting learner acquisition of 21st century skills (Voogt & Roblin, 2012; Voogt et al., 2013). Moreover, those teachers of a constructivist pedagogical orientation tend to make creative and innovative use of ICT and digital media in the classroom (Voogt, 2010; Petko, 2012).

As already discussed in Section 2.4.5, many of the espoused 21st century instructional approaches are not new - they can be traced back to the seminal work of Dewey, Montessori, Vygotsky and others. In particular, Dewey (1900, 1916) championed the belief that students thrive in an environment where they are allowed to experience and interact with the curriculum, and that all students should have the opportunity to actively take part in their own learning. It is evident that much of the literature on 21st century teaching and learning can be traced back to Dewey's view of education not only as a means of gaining content knowledge, but also as a place to learn how to live - the purpose of education should not revolve around the acquisition of a predetermined set of skills, but rather the realisation of one's full potential and the ability to use those skills for the greater good (Dewey, 1916).

However, the application of these pedagogies in the context of pervasive digital technology deems them to be 'new' for the 21st century. Fullan and Langworthy define new pedagogies for the 21st century as "a new model of learning partnerships between and among students and teachers, aiming towards deep learning goals and enabled by pervasive digital access" (Fullan & Langworthy, 2014, p.2). In examining ICT-supported pedagogical practices from 28 countries, Voogt and Pelgrum (2005) identify particular elements of pedagogy that are expected to be more dominant in an information society, compared to those suited to an industrial society (see Table 2-4). For example, active learning should comprise less activity prescribed by the teacher and more activity determined by the learners themselves; and for the development of creativity, there should also be less reproductive learning, where students apply known solutions to problems and more productive learning, with students encouraged to seek new solutions to problems.

A teacher's pedagogical capacity in the 21st century may be determined by their expertise in a wide range of teaching strategies that they draw upon to form learning partnerships with students whereby they discover, create and master content together (Fullan & Langworthy, 2014). Such insights about new pedagogical approaches, along with omnipresent developments in technology, demand that teachers develop their capacity for 'innovative behaviour'

(Thurlings, Evers & Vermeulen, 2015). Innovative behaviour is defined by Janssen (2003) as a three-stage process of firstly, intentional idea generation, followed by idea promotion, and finally, idea realisation, within a classroom or school in order to benefit their students, the school or the wider education system.

Aspect	**Less** (pedagogy in an industrial society)	**More** (pedagogy in the information society)
Active	Activities prescribed by teacher Whole class instruction Little variation in activities Pace determined by the program	Activities determined by learners Small groups Many different activities Pace determined by learners
Collaborative	Individual Homogeneous groups Everyone for him/herself	Working in teams Heterogeneous groups Supporting each other
Creative	Reproductive learning Apply known solutions to problems	Productive learning Find new solutions to problems
Integrative	No link between theory & practice Separate subjects Discipline based Individual teachers	Integrating theory & practice Relations between subjects Thematic Teams of Teachers
Evaluative	Teacher-directed Summative	Student-directed Diagnostic

Table 2-4 Overview of pedagogy: industrial-v-information society (Voogt & Pelgrum, 2005)

Few opportunities for appropriate PD are often cited as a primary reason for the persistence of "industrial-era operating practices in schools" (Dede, 2010, p. 55) and a lack of emphasis on 21st century skills. A further challenge is the prevailing gap between theories or models associated with 21st century learning (for example, constructivism and experiential learning) and their application in practice, particularly in the context of e-learning where practitioners need to have a clear understanding of the inherent affordances of technology and guidance on how to use and effectively integrate different learning technologies into their teaching (Conole, Dyke, Oliver & Seale, 2005). The challenges and issues relating to teacher PD are discussed in greater detail in Section 2.5.

Multiple stakeholders

Similar to any change process, leadership is a key factor to support the implementation of 21st century skills (Voogt & Roblin, 2012; Fullan & Langworthy, 2014). School principals, and others in school management roles, who foster a culture of collaboration and risk-taking, and who create the conditions to encourage teachers' initiative and develop students' potential, are key drivers in the transformation of teaching and learning in schools (Fullan & Langworthy, 2014). Other critical groups of stakeholders, identified in many of the international frameworks for 21st century skills, include the public sector (e.g. state and local authorities), the private sector (e.g. business, parents, and families), and the wider educational community (e.g. teachers, professional organisations, institutes of teacher education, academia, etc.) (Voogt & Roblin, 2012).

The degree of involvement of each of these stakeholders, and their interests and responsibilities, must be considered in the design and implementation of 21st century learning initiatives (ibid). Despite this, research shows that real change towards 21st century learning is often driven and sustained by "heroic individuals who innovate their teaching practices and their schools in relative isolation" (OECD, 2010, p. 107). These isolated pockets of innovation are mostly confined to schools and districts, and, in many countries, significant barriers prevail to prevent radical change across entire systems.

2.4.7 Summary

Education reform movements throughout the world are attempting to re-design and implement new curricula and innovative models of 21st century learning, which has been defined as the knowledge, skills, attributes and attitudes that individuals need to live and learn in the 21st century (Voogt et al., 2013). The comparison of international frameworks presented in this section is an attempt to synthesise the range of definitions, approaches and assumptions regarding the definition of 21st century skills and their integration with existing curricula and core subject content knowledge. ICT tends to be at the centre of the majority of international approaches to 21st century skills. Given the focus of this study on the design of a framework to bring a technology-mediated team-based model of 21st century learning into the authentic setting of post-primary classrooms in Ireland, the 21st century skills of ICT literacy and collaboration were explored as key concepts.

Despite agreement in the literature about the nature and importance of 21st century skills, the sections above have described how their uptake in schools

and classrooms is not guaranteed, owing to a number of prevailing challenges, including implementation, assessment, pedagogical practices and multiple diverse stakeholders. The concept of teacher PD will be explored in greater detail in the following section.

2.5 Teacher Professional Development

2.5.1 Introduction

Teacher professional learning and development are long-time focus areas within the field of education research and are usually synonymous with education reform, quality of schools and improvements in student achievement (Twining et al., 2013; Desimone, 2009; Scheerens, 2010; Guskey, 2002). Teacher PD may be defined as "the body of systematic activities designed to prepare teachers to do their job at several stages of their professional life" (Twining et al., 2013, p.427). Guskey (2002) states that PD programmes are generally centred on three areas of change: teacher classroom practice, teacher attitudes and beliefs, and student learning outcomes. Professional learning for teachers includes a vast range of activities and interactions - from formal to informal, and embedded to discrete - that can support them to develop their knowledge and skills, and improve their teaching practice (Desimone, 2009).

Teacher PD should not be viewed as an 'add-on', but integral to the work and professional learning of a teacher (Hogan et al., 2007). As Lieberman (1995) suggests, PD is a continuous and complex series of interrelated, dynamic learning opportunities, embedded in teachers' daily lives. Twining et al. (2013) highlight the recent rise in the importance of informal elements of PD, such as practice-based learning networks, collegiality and teacher cooperation.

This section will firstly explore the characteristics of designing effective PD programmes and discuss critical features of PD identified in the literature. The focus will then narrow to PD for technology integration. Particular attention will be given to the issues and challenges associated with PD to support teachers in leveraging the affordances of ICT to facilitate student learning in the 21st century. Three models of effective PD for technology integration will be presented. To conclude, there will be a brief synopsis on the evaluation of teacher PD and a summary of the key points covered in the section.

2.5.2 Characteristics of effective PD

If the goal of education in the 21st century is to "produce more powerful learning on the part of students, we have to offer more powerful learning

opportunities to teachers" (Feiman-Nemser, 2001, pp. 1013–1014). In order to facilitate teacher PD, Clarke and Hollingsworth (2002) contend that the complex process by which "teachers grow professionally and the conditions that support and promote that growth" (p.947) must be understood. The critical features of effective PD are defined as those that yield increases in teacher learning, thereby leading to a change in classroom practice and finally, improving student learning (Desimone, 2009; Twining et al., 2013; Guskey, 2002).

Increasingly the school is being viewed as a learning organisation centred on continuous, active and constructive PD for teachers and school leaders alike (Scheerens, 2010). Kennedy (2005) suggests that PD built on active communities of enquiry (based on partnerships between teachers, academics or other organisations) can provide the process, context and knowledge required for real and sustainable educational change. Teacher educators in the 21st century are encouraged to break down the traditional barriers that often exist between schools and universities to create a non-hierarchical model of sharing expertise and to build partnerships that promote collaboration and learning (Zeichner, 2010).

Desimone (2009) identifies the key characteristics of PD that are critical to improving teaching knowledge, skills and practice, and to increasing student achievement:

- **Content focus**: activities that focus on subject matter content and how students learn.
- **Active learning:** opportunities for teachers to engage in observing expert teachers or being observed; iterative feedback & (leading) discussion; reviewing student work.
- **Coherence**: the extent to which teacher learning is consistent with teachers' knowledge and beliefs, and what is being taught in the PD experience is consistent with reforms/national policies.
- **Duration**: span of time over which the PD programme is spread and the number of hours spent in the activity
- **Collective participation**: participation of teachers from the same school, year group, subject department etc., which leads to powerful interaction, collaboration and discourse.

In a comparison of approaches to PD in some of the world's highest achieving countries, as defined by international measures such as TIMSS and PISA, Lieberman and Pointer Mace (2010) identify a pattern of effective practices

including teachers working in communities that are explicitly focussed on improving practice, PD providers working locally *with* teachers as leaders, and supporting teachers to create their own professional knowledge. A systematic review of literature relating to teacher PD conducted by the UK Government Department for Education (DfE) reveals a substantial list of key features explicitly linked to improved learning outcomes for students:

- Observation of teaching
- Feedback to teachers
- The use of external expertise linked to school-based activities
- Scope for teachers to identify their own PD focus
- An emphasis on peer support
- Processes to encourage, extend and structure professional dialogue
- Processes for sustaining PD over time to enable teachers to embed practice in their classrooms (DfE, 2010)

Darling-Hammond and McLaughlin (2011) identify experiential learning as a common feature of PD that succeeds in improving teaching, specifically engaging teachers in concrete tasks of teaching, assessment and observation that illuminate the process of learning and development. Rooted in the work of Dewey, Piaget, Vygotsky and Hahn, experiential learning theory (ELT) is centred on the premise of learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984). ELT provides a holistic model of the learning process and is a multi-linear model of adult development, consistent with what is known about how people learn, grow and develop (Kolb, Boyatzis, & Mainemelis, 2011). As a result the approach has been applied to many studies as a framework for educational innovation (e.g. Murrell & Claxton, 1987).

It is suggested that an experiential approach to PD can motivate teachers to try new practices and make desired changes to the curriculum a practical reality (Darling-Hammond & McLaughlin, 2011; Guskey, 2002; Clarke & Hollingsworth, 2002). Guskey's (2002) Model of Teacher Change suggests that PD programmes must be designed based on the assumption that teachers' attitudes and beliefs will not change until they have the opportunity to implement new practices in the classroom and witness a change in student learning outcomes. Similarly, Clarke and Hollingsworth's (2002) Interconnected Model of Teacher Professional Growth suggests that change occurs through

two critical mediating processes - "reflection" and "enactment" - across four distinct non-linear domains: personal (teacher knowledge, beliefs and attitudes), practice (professional experimentation), consequence (salient outcomes), and external (sources of information, stimulus or support). This model recognises the complexity of teacher professional growth by capturing it as a continuing and inevitable process of learning, rooted in reflection and enactment in the classroom, with multiple growth opportunities and pathways between the inter-related domains.

However, as Blair (2016) notes, "simply inserting experiential activities into teaching without providing a consistent experiential pedagogical framework diminishes success for learners" (p.5). As a critical element of ELT, reflection on action is increasingly viewed as an effective aspect of teacher PD, whether as an individual tool for self-direction (Minott, 2010), or through collective professional discourse centred on the development of practice and understanding through shared experiences with colleagues (Lieberman, 1995; Little, 2003). According to Fullan (2001), engagement in conversation, collaboration and observation are necessary for effective changes to professional practice.

Despite a consensus in much of the literature on the key characteristics of effective PD related to teacher improvement (Twining et al., 2013), there are no clear guidelines regarding threshold levels required to elicit change in practice (Desimone, 2009). Further, there is a need for greater levels of research in relation to the ultimate intended impact of PD - student achievement (ibid). An inquiry-based approach to teacher PD has been shown to impact teachers' practice and improve instruction in order to positively impact student learning in the classroom (Ball and Cohen, 1999). Many of the challenges of PD are rooted in the fact that it tends to be fragmented, disconnected, and irrelevant to the real problems of daily classroom practice (Lieberman & Pointer Mace, 2010).

Effective teaching is dependent upon flexible access to rich and integrated knowledge from a range of domains including knowledge of student thinking and learning processes, knowledge of subject content and, more recently, knowledge of technology (Koehler, Mishra & Cain, 2013). Given the scope of this thesis, the focus of the following sections will narrow to specifically examine teacher PD for technology integration, including an exploration of the challenges and issues pertinent to ICT-focussed PD and a discussion of established models and conceptual frameworks to support teachers'

development of the knowledge and skills to effectively integrate technology into teaching and learning.

2.5.3 PD for technology integration

There is a growing body of research dedicated to the design of effective PD programmes to prepare and support teachers to meaningfully integrate ICT into their teaching and learning practices (e.g. Ertmer & Ottenbreit-Leftwich, 2010; Voogt et al., 2013; Twining et al., 2013; Kopcha, 2012). In the 21st century classroom, it may be argued that "effective teaching requires effective technology use" (Ertmer & Ottenbreit-Leftwich, 2010). In order to achieve high-level, effective use of technology that improves student learning outcomes, PD experiences must take into account how teachers' classroom practices are rooted in, and strongly influenced by, their pedagogical beliefs (Ertmer, 2005).

Teaching with technology is a complex, ill-structured process and thus requires innovative approaches to comprehending and accommodating teachers' professional learning needs (Koehler et al., 2013). Teachers need to be supported to develop an understanding of the tendencies, potentials, affordances, and constraints of a wide range of technological tools and digital applications, that are ever-changing, unpredictable and often isolated in nature (Koehler et al., 2013; Voogt, 2008). These challenges are discussed further in Section 2.5.5.

Given the complexities associated with effective teaching and learning with ICT, discussed in Section 2.3, PD for technology integration requires reform at multiple levels of education systems. The introduction of ICT should be viewed as an opportunity for developing "new goals, structures and roles" to support such reform (Twining et al., 2013, p.426). The 21st century learning movement is characterised by a trend towards new definitions of what it means to be an effective teacher, focussed on leveraging the affordances of ICT to facilitate student learning.

Teachers must be involved, either through teacher education programmes or PD efforts, in envisioning this new definition of effective teaching in the 21st century as it requires a paradigm shift in teacher knowledge, beliefs and culture (Ertmer & Ottenbreit-Leftwich, 2010). Effective teaching with technology is defined by its use in a learner-centred constructivist environment, as opposed to a traditional teacher-directed setting (ibid). It is suggested that in order to achieve meaningful change in classroom practice, teachers must acknowledge the role of ICT as a knowledge construction tool through collaborative activity,

the relevance of ICT to society and future employability, and an authentic problem-oriented approach to teaching and learning (Prestridge, 2012).

2.5.4 Issues relating to PD for technology integration

The challenges of teaching with technology are numerous and multifaceted, and while they are well understood across the literature, many of them remain unresolved. Section 2.3.3 presented an overview of the barriers to integrating ICT in teaching and learning by individual teachers, schools and education systems, all of which have an impact on the design and delivery of programmes of PD for using technology in the classroom. Teacher PD must include practical strategies and pedagogical models to help teachers to overcome critical issues and barriers to effective technology integration (Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010).

Twining et al. (2013) summarise the primary obstacles to effective PD for technology integration as a lack of consistent vision for what constitutes success; poor match between needs and provision; exclusion of significant voices from decision making; potential misalignment between policy, institutional culture and individual professional responsibility; and failure to successfully harmonise context, policy, practice and research. It is suggested that simply removing the primary barriers and highlighting the enablers is not sufficient for successful and transformative integration of ICT in school, but rather a myriad of complex factors at multiple levels (individual, school and system) must be addressed (Petko, 2012).

Whilst collaborative PD is strongly associated with improvements in teaching and learning, the traditional structure of schools means that most teachers work in isolation and are rarely given the opportunity in practice to witness or value the professional expertise of their colleagues (Twining et al., 2013), which is not conducive to encouraging teachers' efforts to integrate technology in learning (Koehler et al., 2013). The recent emergence of group-based learning approaches such as Communities of Practice (CoP) and Professional Learning Communities (PLC), are an attempt to overcome the isolated nature of teaching by promoting peer-supported professional growth (Twining et al., 2013). One example of a successful PLC was that developed by Rigelman and Rubin (2012) for a teacher education programme, which was shown to promote collaborative learning across a school-university partnership and to support the development of refined visions of what it means to be a teacher. Programmes of PD that succeed in breaking down "the insulation and isolation

of teachers" can generate some "exciting if also challenging possibilities" for innovation in schools (Hogan et al., 2007).

Along with the issues outlined above, the complex nature of the individual context of teachers, their pedagogical choices, beliefs and motivations makes technology integration in educational settings a challenging process (Hamilton, Rosenberg & Akcaoglu, 2016; Voogt, 2010). As already noted in Section 2.2, teachers' beliefs have a critical influence on the successful use and integration of ICT in the classroom, an issue that has implications for the design of PD experiences (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Voogt et al., 2013; Prestridge, 2012). Teachers may hold opposing beliefs about the importance of ICT - they may be convinced about the importance of its role in society, but have doubts about its usefulness for teaching and learning (Petko, 2012). Influences on teacher beliefs about ICT include technology in society and working life, teacher competency, access in schools/classrooms, the nature of the subject/task and associated pedagogies, the nature of how students learn, and the learning outcomes to be achieved (Prestridge, 2012).

There is a need to develop accurate insights into teachers' beliefs so as to gain a deeper understanding of the complexity involved in how they learn to use ICT effectively in the classroom (Levin & Wadmany, 2008). Additionally, there is a need to distinguish between teachers' ICT-specific and ICT non-specific beliefs (Petko, 2012). The intersection between teachers' belief about the role of ICT as a teaching tool and their established pedagogical beliefs may be described as either a 'collusion' or a 'collision', causing teachers to use ICT as an add-on to existing practice or as a tool that affects fundamental change in their classroom (Prestridge, 2012). Several studies have shown that there is a correlation between teachers' pedagogical orientation and the frequency and type of ICT use in classroom practice; however, it is important to recognise that many teachers have both an innovative and traditional pedagogical orientation (Voogt, 2010).

It is imperative that the design of PD programmes reflects an understanding and exploration of the relationship between teacher ICT competence, confidence and practice, which is important for the effective use of ICT in classrooms (Prestridge, 2012). Ertmer and Ottenbreit-Leftwich (2010) hold the radical view that the success of PD for technology integration is dependent upon a fundamental change in teachers' mind-sets to reach the belief that "teaching is not effective without the appropriate use of ICT resources to facilitate student learning" (p.255). The authors propose four variables of teacher change - knowledge and skills, self-efficacy, pedagogical beliefs and

subject/school culture - that have critical implications for the design of in-service PD programmes, leading to the following recommendations:

- Align experiences with existing pedagogical beliefs and knowledge
- Provide examples of other teachers' successes emphasising student outcomes
- Provide support for risk-taking and experimentation
- Expand the definition of "good teaching" to include technology integration (p.276).

Data show that facilitating "small changes in teachers' own contexts" is an "effective long-term strategy for impacting teacher practice in big ways" (p.277).

2.5.5 Models of effective PD for technology integration

Teachers that use ICT for teaching primarily do so by assimilating it into pre-existing pedagogical practices (Petko, 2012; Prestridge, 2012). In a small case study in the US of 18 elementary school teachers' perceptions of the barriers to technology integration and instructional practices with technology after two years of situated PD, teachers reported a high frequency of technology use for administrative tasks, communication with parents/students, or to prepare teaching materials (Kopcha, 2012). To address these issues there has been an increase, over the last decade, in the number of conceptual frameworks to guide teachers' use of technology in the classroom and to support them through a comprehensive process of change. Several studies recognise the importance of adequate investment in teacher preparation in the use of ICT (e.g. Ertmer & Ottenbreit-Leftwich, 2010; Twining et al., 2013), whilst others demonstrate that teachers' positive beliefs about the efficiency and effectiveness of ICT and the potential benefits in improving students' learning can lead to increased use in the classroom (Petko, 2012).

Levin and Wadmany (2008) describe the nature of change required for effective technology adoption as moving from technical, shallow engagement with technology through engagement with reflection on personal skills and capabilities, and finally to cognitive transformation (conceptual change or knowledge reconstruction), which can alter teachers' conceptions of teaching and learning. Situated PD has the potential to promote long-term changes in teachers' attitudes toward and practices with technology in the classroom by providing individualised professional learning and support in the authentic context of the classroom (Kopcha, 2012).

If the goal of technology integration is to have a transformative effect on education, models of PD must exemplify transformative learning (Twining et al., 2013). Within the scope of this research, three models of PD for technology integration in classrooms are selected for discussion:

- Technology, pedagogy and content knowledge (TPACK) (Mishra & Koehler, 2006; Koehler et al., 2013)
- Substitution, Augmentation, Modification, Redefinition (SAMR) (Puentedura, 2010)
- Teacher ICT Integration model (Donnelly et al., 2011)

The rationale for these selections, along with an explanation and summary of the key components of each model are presented in the following sections.

Technology, pedagogy and content knowledge (TPACK)

Many authors have extended Shulman's (1986, 1987) theory of pedagogical content knowledge (PCK) to describe the critical knowledge base required to effectively teach with technology, including information and communication technology (ICT)-related PCK (Angeli & Valanides, 2005; Angeli & Valanides, 2009) and technology-enhanced PCK (Niess 2005). Koehler and Mishra proposed the construct of TPCK (technology, pedagogy and content knowledge) - later renamed as TPACK - to emphasise the importance of considering the complex interactions between teachers' technological, pedagogical and content knowledge (Mishra & Koehler, 2006; Koehler & Mishra, 2009; Koehler et al., 2013). Since its first introduction in 2005, TPACK has spread rapidly across the fields of teacher education, PD and technology integration research.

The TPACK framework (see Figure 2-5) highlights the interactions between and across the components of teachers' knowledge, namely PCK (pedagogical content knowledge), TCK (technological content knowledge), TPK (technological pedagogical knowledge), and TPACK (technology, pedagogy, and content knowledge), and contends that teachers who wish to effectively integrate technology into their teaching need to be competent across all domains of interrelated knowledge. Applying the TPACK framework to teacher PD seeks to assist teachers to select specific technological applications that align with their instructional strategies and educational beliefs, and to engender the "types of flexible knowledge needed to successfully integrate technology use into teaching" (Koehler et al., 2013, p.13). Additionally, TPACK seeks to promote the development of improved techniques for

describing and measuring how technology-related professional knowledge is implemented in practice in the classroom (ibid).

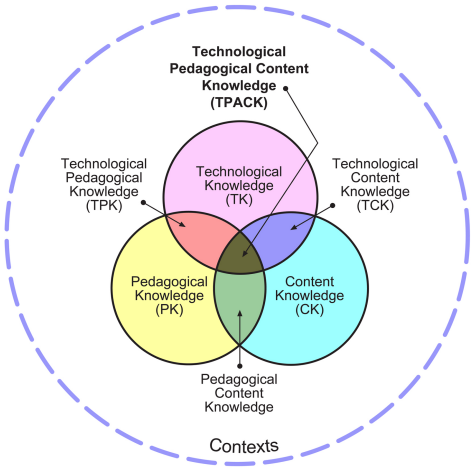

Figure 2-5 The TPACK framework (Koehler et al., 2013)

Whilst TPACK is generally accessible and intuitive to practitioners, from a theoretical perspective it is a complex concept that has caused much debate in the literature, as documented by Voogt et al. in their systematic review of literature on the topic published between 2005 and 2011. The authors suggest two important directions for further research: 1) investigate the complex relationship between TPACK, teacher practical knowledge and teacher beliefs, given the close association between teacher knowledge and beliefs; and 2) examine TPACK in specific subject domains so as to better assist teachers in using technology effectively to teach complex, subject-specific concepts (Voogt et al., 2013).

Substitution, Augmentation, Modification, Redefinition (SAMR)

Puentedura's (2010) Substitution, Augmentation, Modification and Redefinition (SAMR) model is described by Hamilton et al. (2016) as a four-level, taxonomy-based approach for selecting, using, and evaluating technology in K-12 settings. The framework, shown in Figure 2-6, was developed as a practical pathway for teachers to move from using technology as a way of merely enhancing learning to using it to completely transform the teaching and learning experience by allowing for significant task redesign or the creation of new tasks, previously inconceivable. Puentedura argues that it is at the higher levels of the SAMR framework that the true potential of technology for learning can be realised. SAMR is a practical framework that facilitates a connected, cross-curricular

approach to learning, promotes ways of knowing across subject areas and the means to integrate theoretical domains with applied practice (Puentedura, 2010).

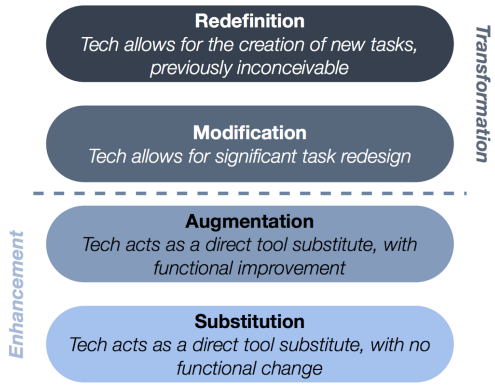

Figure 2-6 The SAMR model (Puentedura, 2010)

Despite its widespread use among practitioners there is a notable lack of academic research and theoretical explanations of the SAMR framework. It has been used in small-scale studies to evaluate the design and effectiveness of mobile learning activities (Hockly, 2013; Romrell, Kidder & Wood, 2014) and to measure the impact of technology use in libraries (Jacobs-Israel & Moorefield-Lang, 2013). A critical review of SAMR undertaken by Hamilton et al. (2016) highlights three main challenges: 1) the absence of context, 2) its rigid, hierarchical structure and 3) the focus on product over process. To address these challenges, the authors suggest that future use of the model should consider context as an implicit component, allow for more fluid movement between all levels of the model to account for the dynamic nature of teaching and learning with technology, and encourage teachers to focus on education as an integrated process (defined by learning outcomes and learning objectives) rather than as a series of stand-alone, independent, technology-driven products (ibid).

Teacher ICT Integration Model

Donnelly et al. (2011, 2013) developed a framework to describe four levels of integration of an ICT resource into the practice of Science teachers in post-primary schools in the Irish education system. Strongly grounded in the literature (including TPACK) and informed by research practice, this model of

ICT integration (see Figure 2-7) presents four stances of teacher ICT integration: the Contented Traditionalist, the Inadvertent User, the Selective Adopter and the Creative Adapter. These approaches are situated along an intersecting continuum of ICT use from student-centred/learning focussed at one end, to teacher-centred/assessment focussed at the other. Additionally, the framework captures the key factors that underpin the different levels of ICT integration, both in relation to teacher beliefs, PD design and the wider context of the school environment and education system.

The authors suggest that it serves as a useful framework for the design and development of new programmes of technology integration, and as a reflective tool for teachers who wish to self-evaluate their approach to technology integration (Donnelly et al., 2011). Further, there is evidence to suggest that teachers' positions are not stagnant and that alternative paths be made available to teachers to move between descriptions within the framework, with a view to transitioning over time to become a Creative Adapter (ibid). This framework has particular implications for the design of the programme of PD under investigation in this research, given its development to support the implementation of an ICT resource into the practice of Science teachers in post-primary schools in the Irish education system.

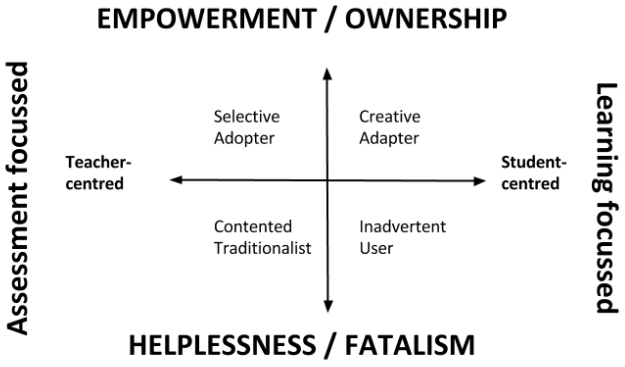

Figure 2-7 Teacher ICT Integration Model (Donnelly et al., 2011)

2.5.6 Evaluation of teacher PD

According to Desimone (2009) "examining the effects of PD is analogous to measuring the quality of teachers' learning experiences, the nature of teacher change, and the extent to which such change affects student learning" (p.188). Cochran-Smith (2005) suggests that multiple empirical approaches should be applied in the field of teacher education research, with better data collection

and analysis tools, consistent use of these tools across studies, and theory-driven work where researchers build on prior studies and accumulate knowledge in a particular area. Based on the core features of PD (presented in Sections 2.5.2 and 2.5.3), Figure 2-8 shows Desimone's (2009) proposed conceptual framework for studying the effects of PD on teachers and students, with increased teacher knowledge and skills and change in attitudes and beliefs leading to a change in instruction and, subsequently, improved student learning. The context of the PD experience, such as curriculum, policy or leadership, is both an important mediator and moderator of the outcomes for students and teachers alike. Critical decisions in the process of investigating teacher PD include when and how to apply data collection methods designed according to best practice (ibid).

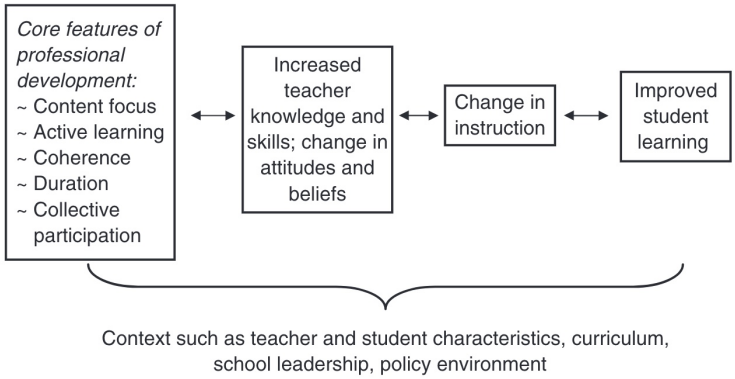

Figure 2-8 Proposed core conceptual framework (Desimone, 2009, p.185)

The implications of these issues for the design of the current study are discussed in greater detail in Chapter 4.

2.5.7 Summary

Desimone (2009) contends that quality programmes of inquiry into teacher professional learning and development are "one of the most critical targets of education reform" (p. 181). This section has explored some of the pertinent characteristics and critical features of PD identified in the literature, all of which are relevant to the design of PD for technology integration programmes. As already noted earlier in the chapter, the challenges of teaching with technology are numerous and multifaceted, and while they are well understood across the literature, many of them remain unresolved. Simply removing the barriers and highlighting the enablers is not sufficient for successful and transformative integration of ICT in schools, but instead requires the myriad of complex

factors at multiple levels (individual, school and system) to be addressed and accounted for in programmes of PD for technology integration (Petko, 2012).

If technology is to have a transformative effect on education, models of PD must exemplify transformative learning (Twining et al., 2013). A selection of three contrasting, but effective, models of PD for technology integration have been presented and the implications for the design of this study are discussed in greater detail in Chapter 4.

2.6 Discussion

It is evident from this review of the literature that while many of the challenges and issues relating to the three core concepts of technology in education, 21st century learning and teacher PD are well understood, they continue to be ignored by many jurisdictions, and thus remain unresolved. In the case of ICT, barriers should not be considered in isolation and as single-tier problems (Ertmer, 1999). Rather, multiple stakeholders and levels of an education system must engage in understanding the complex dependencies and tackling the root causes of barriers (Khalid & Buus, 2013; Twining et al;., 2013). In many ways, the barriers to integrating ICT in classrooms should be viewed as somewhat of an inevitability, and overcoming them should form a central component of school and system-wide programmes for technology-enhanced learning (Laferrière et al., 2013).

The success of technology-focussed initiatives lies not only in the *alignment* of ICT with education policy priorities, but more importantly in the *convergence* of educational technology with pedagogical practice, which leads to real integration and creates a foundation for disruptive transformation (Marshall & Anderson, 2008). In order to achieve scalable and sustainable impact of such ICT learning initiatives, it is critical to develop conceptual frameworks and concrete resources, so that solutions designed to overcome the challenges and barriers associated with using ICT can be more effectively integrated into the classroom, school and system (Prieto, Dlab et al., 2011). Teachers must be afforded the opportunity to engage in a dynamic, collaborative, practical and continuous process of PD over time so that the "multifarious and multidimensional" characteristics of their personal learning, cognitive views, feelings and behaviours can be addressed (Levin & Wadmany, 2008).

Conceptual frameworks are also a particularly important consideration in the context of the emergence of 21st century learning and skills as a key feature of global curricula (Hämäläinen and Vähäsantanen, 2011). Despite a level of agreement in the literature about the nature and importance of 21st century

skills in formal education, the sections above have described how their uptake in schools and classrooms is not guaranteed, owing to a number of prevailing challenges, including implementation, assessment, pedagogical practices and multiple diverse stakeholders.

It has been shown that innovative teaching supports the development of 21st century skills in students, yet such innovative teaching is scarce in practice and a "coherent and integrated set of conditions to support the adoption of innovative teaching" is lacking in most schools and nearly all education systems (Bernard & Langworthy, 2011, p.12). Teachers need to be given the opportunity to develop their own practice and understanding of 21st century skills, so that they can successfully embed them in the curriculum (Collins & Dolan, 2011). Additionally, students need to be afforded the chance to develop their metacognitive skills - they need to "learn how to learn" (McMurrow, 2006, p.329). This is particularly true for collaboration, where research has shown that a relational approach of firstly developing social and communication skills is necessary before advancing to effective teamwork in the classroom (Blatchford et al., 2003; Galton et al., 2009).

Thompson and Wiliam (2008) argue that effective, scalable models of teacher PD must adopt a "tight but loose formulation", whereby a number of central design principles identified at the outset are adhered to (the "tight" part), combined with a degree of flexibility to accommodate the "needs, resources, constraints, and particularities that occur in any school (the "loose part) (p.35). McMurrow (2006) advocates for the idea of 'movement' as one such central design principle, in order to break down the constraints of traditional school relationships and structures, and deeply ingrained beliefs held by multiple education stakeholders (students, teachers, principals, parents) in relation to teaching and learning. This 'movement' should occur between teachers, between students, between teachers and students, within physical spaces, between classrooms and schools, and between key stakeholders (ibid, p.333).

Another critical design principle that has emerged from this review of the literature is the notion of teachers as key agents of change (NCCA, 2009a, 2011c; Fullan and Langworthy, 2014; Schleicher, 2015) who become empowered when they are given the autonomy to become the authors of their own work (Hogan et al., 2007). By identifying "pivotal actions" that can be taken by key agents in a curriculum reform project, such as teachers or school leaders, barriers and tensions can be overturned to become the "driving forces for transformation" (Laferrière et al., 2013, p. 470).

2.7 Conclusion

This chapter has presented a review of the literature that informs, influences and shapes the direction and development of the study. Following a concept-centric approach (Webster & Watson, 2002; Levy & Ellis, 2006), the review sought to critically examine, analyse and synthesise a selected body of literature relating to education technology, 21st century learning and teacher PD. Despite the research accumulated in recent years, many questions regarding the effective use of information technologies and the implementation of pragmatic models of 21st century learning remain unanswered. Diverse approaches to pedagogy that challenge the prevailing practice of the traditional classroom are required in order to fully realise and exploit the potential of technology in education and a skills-based approach to teaching and learning.

While many teachers value 21st century pedagogies, teaching practice does not always reflect that belief (Schleicher, 2015). There is a need for quality programmes of inquiry into teacher professional learning and development (Desimone, 2009). This study seeks to document and critically evaluate the iterative design and implementation of a programme, over a four-year period (2010-14), to support and enable a cohort of teachers to use and adapt a particular model of 21st century learning – the Bridge21 learning model – to teach the formal curriculum in post-primary classrooms in Ireland. In the chapter that follows (Chapter 3), attention is given to the context of the research, by examining the three core concepts explored in this literature review - education technology, 21st century learning and teacher PD – through the lens of the particular setting of the study - post-primary schools in the Irish education system. Implications for the design of this study arising from this review of the literature are discussed in greater detail in Chapter 4.

3 Context

3.1 Introduction

The focus of this study is to document and critically evaluate the iterative design and implementation of a programme, over a four-year period (2010-14), to support teachers to utilise a particular model of 21st century learning - Bridge21 - in post-primary classrooms in Ireland. The thesis traces the progression of the learning model from its initial conception as an innovative outreach project delivered to post-primary students on a university campus, into a school-university partnership aimed at supporting teachers to design 21st century learning experiences to deliver the formal curriculum. The primary aims of the study are twofold, namely:

1. To ascertain whether the Bridge21 learning model can be used by a cohort of teachers within the confines of the formal school system and the impact it has on their students and classroom learning experiences.
2. To explore and define the elements of a conceptual framework to bring the Bridge21 learning model into post-primary schools, with particular focus on the approach to PD for teachers that was conceptualised, trialled and developed during the research.

Chapter 2 presented a review of the literature that informed, influenced and shaped the direction and development of the study. Adopting a concept-centric approach (Webster & Watson, 2002; Levy & Ellis, 2006), the key concepts of educational technology, 21st century learning and teacher PD were identified for examination, as they related most closely to the aims of the study and the elements of the learning model under investigation. This chapter sets the context of the research by examining these three key topics through the lens of the particular setting of the study - post-primary schools in the Irish education system.

The chapter begins by setting the context of the wider education system at the time the study was conducted. Section 3.2 presents a synopsis of the evolution of policy (from 1970 to 2015) relating to ICT in education in Ireland, in order to track the progress, or lack thereof, of 'top down' national policy initiatives in the years preceding the current study. This is followed in Section 3.3 by an overview of the education landscape relating to 21st century learning and skills at the time this research was undertaken. Related programmes of school reform, approaches to teacher PD and policy trends in relation to leading and supporting change in schools are also discussed. The chapter continues in Section 3.4 by narrowing the focus to the context of the Bridge21 programme,

with the goal of providing a detailed account of the background to the research, including a description of the key elements of the learning model, early research on its effectiveness and the conditions that influenced the logic and rationale for this study. The chapter concludes in Section 3.5 with a brief discussion of rationale for the study and the emergence of the research problem and objectives.

3.2 The Evolution of ICT in Education Policy in Ireland

The evolution of policy in Ireland relating to ICT in education has been described as a "persistent and endemic failure over more than three decades" to develop a vision and execute a strategy for "well-led, well-supported, ICT-rich educational opportunities for all" (Galvin, 2015, p. 236). Tracing the development of ICT usage in the post-primary school system in Ireland, McGarr (2009) identifies three distinct phases and highlights how ICT policy initiatives during that time, or lack thereof, influenced the prevailing use of ICT in schools. Computer use during the first stage (1970s - mid 1980s) was optional, exploratory and largely dependent on the resources available and the commitment of enthusiastic teachers - the "early technophiles" (McGarr, 2009, p. 1097). The second phase (mid 1980s - mid 1990s) saw the formalisation of ICT in schools, with its use becoming confined to discrete informatics subjects. The third phase was marked by the introduction of *Schools IT2000: A Policy Framework for the New Millennium* (DES, 1997) - the first large-scale attempt to integrate ICT into teaching and learning across the Irish education system (McGarr & O'Brien, 2007).

A number of evaluations and studies in the years following the establishment of the *Schools IT2000* initiative found relatively low levels of effective integration of ICT across the curriculum (O' Doherty, Gleeson, Moody, Johnston & McGarr, 2000; Glesson, O'Grady, McGarr & Johnston, 2001; Venezky & Davis, 2002; Mulkeen, 2003) and, more often than not, the predominant focus was on learning *about* technology rather than *with* it (McGarr, 2009). Additionally, it was found that school planning tended to centre on ICT infrastructure instead of meaningful approaches to teaching and learning using technology (DES Inspectorate, 2008). The issues and barriers encountered by teachers, particularly in the post-primary classroom, include the dominance of a high-stakes examination system, the lack of ongoing PD for teachers, and poor coordination and implementation of national policy (Gleeson, Johnston and McGarr, 2015). These barriers are similar to those found in the international literature (for example, Kopcha, 2012; Khalid and Buus, 2013), as discussed in

Chapter 2. In contrast, the flexible and broad curriculum at primary school level is viewed as more conducive to meaningful integration of ICT in teaching and learning (Conway & Brennan-Freeman, 2015).

By 2014, with no major developments in national policy relating to ICT in education for more than a decade - beyond the publication of some minor reports (for example, *ICT in schools: Inspectorate Evaluation Studies* (DES, 2008)) - there existed a "policy vacuum" (Gleeson et al., 2015, p.230). Perhaps coincidentally, this was also a time of grave economic recession in Ireland and funding cuts in education. There were calls for a coherent approach to policy making and implementation (ibid) and a clear vision for sustained, effective system-wide ICT usage (Galvin, 2015). However, some authors contend that this gap in policy development did not equate to complete inaction in relation to ICT in education, evidenced by the number of pilot projects and grassroots initiatives at that time (for example, FÍS Film Project[4] and the Diageo Liberties Learning Initiative[5]) and the rollout of broadband internet access, which set a new context for supporting technology-enhanced teaching and learning (Conway & Brennan Freeman, 2015). In summary, the continued use and development of ICT in schools during this phase was largely driven by the interest and enthusiasm of individual teachers and school leaders on the ground (Galvin, 2015).

It was against this backdrop that the implementation and data collection phases of the current study were undertaken from 2010-14. As discussed below, whilst there was a perceived 'policy vacuum' in relation to ICT in education, at the same time a major programme of reform was underway in post-primary schools, centred on a move towards 21st century learning, key skills and alternative approaches to assessment. In addition to the developments in ICT policy in the years preceding the study, or lack thereof, these 21st century reform efforts greatly shaped the context of the research and are discussed at length in 3.3.

The publication of the consultative paper *Building Towards a Learning Society: A National Digital Strategy for Schools* (Butler, Leahy, Shiel and Cosgrove, 2013) and the subsequent *Digital Strategy for Schools 2015-2020: Enhancing Teaching, Learning and Assessment* (DES, 2015) were welcome recent developments in Irish education ICT policy. An ambitious programme of new supports, new forms of innovation and new opportunities for integrating ICT into teaching, learning and assessment practices in schools is now firmly on the agenda.

[4] fisfilmproject.ie
[5] bitc.ie/csrcasestudies/diageo-ireland-the-diageo-liberties-learning-initiative/

3.3 21st Century Learning in Irish Education

3.3.1 Introduction

As discussed in Chapter 2, the implication of a transforming economy and society is that curriculum, assessment and teaching approaches must also undergo a process of change (Voogt & Pelgrum, 2005). Almost every country in the developed world has undertaken some type of school system reform during the past two decades, with teaching and learning at the forefront of many initiatives, rather than a focus on structural changes or supply of resources (Mourshed, Chijoke & Barber, 2010; NCCA, 2011b). Since the start of the 21st century, there has been a continuous debate about the structure and purpose of schooling in Ireland (NCCA, 2005; Jeffers, 2011; Collins & Dolan, 2011). However, previous reform programmes have fallen short of intended outcomes due to a mismatch between the re-designed curriculum and terminal examination, which frequently led to "a new curriculum being strangled by an old examination system" (NCCA, 2011b, p.5). The Irish education system, particularly at post-primary, is characterised by rigid structures and traditional subject-based rote-learning (Smyth, 2016) and the tradition of curriculum reform has primarily followed a 'top down' approach (Jeffers, 2011).

In recent times, the education system in Ireland has come under increasing criticism from educationalists, industry leaders and international corporate organisations. In particular, it is argued that the nature of assessment and the pivotal role of the Central Applications Office (CAO) points system[6] in post-primary schools means that teachers abandon creativity and innovation in favour of didactic teaching and rote-learning (Forfás, 2009, p. 67). Research has shown that when students transition from post-primary education, they lack the skills to learn independently, to be creative, to work with others, to solve problems and to think critically (Hyland, 2011; Smyth, Banks, & Calvert, 2011).

3.3.2 Holistic reform efforts at post-primary level

Since the turn of the 21st century, the post-primary school system in Ireland has been undergoing significant review, leading to a number of holistic 21st century learning reform initiatives. Senior Cycle (years 4-6 at post-primary) has been undergoing a significant phase of review in recent years, following research and consultation with a range of stakeholders. A number of areas have been prioritised for development, including 21st century skills, the revision of

[6] The Central Applications Office (CAO) processes applications for undergraduate courses in Irish Higher Education Institutions (HEIs). See cao.ie

existing subjects and the development of new curricula. A complete review of the Junior Cycle (years 1-3 at post-primary) was launched by the National Council for Curriculum and Assessment[7] (NCCA) in 2011, as a result of research evidence, public and political consensus and growing professional concern (NCCA, 2011b). A number of key areas were identified to be addressed via the reform process, namely: the inflexible, overcrowded, exam-focused nature of the curriculum, the poor transition between primary and post-primary, and a decline in literacy and numeracy standards as measured by PISA (OECD, 2010). The Junior Cycle reform agenda significantly framed the context of the current study and, hence, is selected here for in-depth discussion.

In order to address the critical issues identified by research and consultation, it was proposed that Junior Cycle students would become more responsible for generating, gathering and presenting evidence of their own learning, rather than placing an emphasis on traditional assessment of core subjects (NCCA, 2010a; NCCA, 2011b). Additionally, a greater emphasis on 21st century skills was proposed to deepen students' learning, to "act as a vehicle to smooth the transition from primary to post-primary school", and to equip them "to take up the challenges of further study in senior cycle and beyond" (NCCA, 2011b, p.19).

This proposed set of competencies, known as Key Skills (see Table 3-1, page 67), was grounded in national and international research and practice relating to 21st century learning, similar to that described in Chapter 2. A significant difference between the key skills and other international frameworks is that the use of ICT is not treated as a separate competency; rather it is integrated as an element of each of the key skills, for example *'Using ICT to confidently communicate'* and *'Using ICT to work with others'* (see Table 3-1).

[7] The NCCA advises the Minister for Education and Skills on curriculum and assessment from early childhood to the end of post-primary education in Ireland. See ncca.ie

Managing Myself	Staying Well	Communicating
Knowing myself Making personal decisions Setting and achieving personal goals Being flexible and being assertive Learning how to direct my own learning Using ICT to manage myself	Being healthy, physical and active Being social and safe Being spiritual Being confident Being positive about learning Using ICT safely and ethically	Listening and expressing myself Using language Using number Discussing and debating Communicating my learning Using ICT to confidently communicate
Being creative	**Working with others**	**Managing information and thinking**
Imagining Exploring options and alternatives Implementing ideas and taking action Changing and taking risks Learning creatively Being creative through ICT	Relating effectively and resolving conflict Co-operating Respecting difference Contributing Learning with others Using ICT to work with others	Being curious Gathering, recording, organising, and evaluating information Using information to solve problems and create new ideas Thinking creatively and critically Reflecting on and evaluating my learning Using ICT to access, manage and share knowledge

Table 3-1 Key Skills for the new Junior Cycle (NCCA, 2011b)

3.3.3 Research on education reform and teacher PD

There is a small, but growing body of literature on education reform in the Irish education system. Some of this research has illuminated the common failings of past education reform initiatives as firstly, the lack of continuity between curriculum design, implementation and assessment (Looney, 2001; Gleeson, 2009) and secondly, the "paucity" of PD, resources and "collaborative support structures at school, Department of Education and societal levels" (McMurrow, 2006, p333). Marshall and Anderson (2008) agree with this viewpoint, contending that the prevailing approach to change in Irish education has been to "tweak subject content" rather than undertake significant, systemic reform (p.465). Other work has highlighted the challenges of reform, including but not limited to enticing teachers away from the "comfort zone" of tried and trusted resources and methods, and students' assumptions of their passive role in learning, particularly at post-primary level (McMurrow, 2006, p.329). It is beyond the scope of this study to give a more detailed account of the historical trends from the literature on education reform in Ireland, however recent research in the areas of 21st century skills and teacher PD that are particularly relevant to the aims and objectives of the current study has been selected for discussion.

Research into the key skills has been primarily practitioner-led (by the NCCA in partnership with schools in the *Key Skills Network*[8]) and has developed in three distinct phases between 2008-10. Findings from an initial exploratory phase (2008) indicated that teaching became more learner-centred when teachers focussed on the key skills in their lesson planning and that teachers needed to be given opportunities to develop their own understanding and practice of the key skills (NCCA, 2008). The report from phase 2 of the research (2009) outlined a number of key considerations for supporting the process of change in schools, including the need for time to achieve change, leadership and support for change, and teachers as key agents of change (NCCA, 2009b). Additionally, the findings of the report had implications for PD, arguing that teachers need to become active members of professional learning communities and that PD should become "an integral part of the day-to-day practice in schools" (ibid, p. 22). Phase 3 of the research (2010) presented a series of 'stories' from schools who, in their role as learning sites, explored how key skills might be embedded in teaching within a whole school setting. Findings from this phase included the importance of local support, the value of external support, the value of reflection, the cyclical nature of PD, motivation of teachers and the importance of having a framework to support change in practice (NCCA, 2010b).

The *Teaching and Learning for the 21st century (TL21)* - a four-year research project (2003-07) at the National University of Ireland, Maynooth, with 15 post-primary schools in a small region in Ireland - bears many of the same features of the current study. The final report of the project identifies teacher PD as the single most important issue for national policy planning, if Ireland is to achieve its potential as a 21st century knowledge society (Hogan et al., 2007). It offers recommendations that can be applied by education practitioners embarking on programmes of reform in schools, including the following concepts:

- Teachers as authors of their own work
- Students as active learners
- PD as integral, rather than an 'add-on', to teacher's work
- Use of ICT as a tool, not a panacea

The TL21 project highlighted the importance of PD that is situated in schools and classroom, and the need for more teacher autonomy in deciding the subject content and the pedagogical approach most appropriate to the development of 21st century skills in students (Collins & Dolan, 2011).

[8] See juniorcycle.ie/Planning/Key-Skills

Butler and Leahy's (2015) research is centred on the design of a school-focussed, job-embedded, sustainable framework for PD in a single post-primary school in Ireland, conceived as part of a wider international project. The programme of PD is specifically designed to support teachers to move from a traditional instructional environment to one that embeds innovative use of digital technologies and other key elements of 21st century teaching and learning. Results show that the key features of the model of PD were that it was personal, on-site and contextual, just-in-time, and ongoing (Butler & Leahy, 2015, p.339). Data suggest that the professional learning programme was particularly effective because it was integrated into teachers' professional lives and communities within the school, and it was fully supported by the school leadership.

The above findings echo the work of Ertmer and Ottenbreit-Leftwich (2010), Dexter (2008), Fullan and Langworthy (2014), Darling-Hammond and McLaughlin (2011), Schleicher (2015) and others in the international literature, discussed in Chapter 2, in that there is widespread consensus that teachers are key agents of change and they must be provided with PD that equips them with both practical strategies and pedagogical models to bring transformational 21st century practices into their classroom. Given the context of the study described in this chapter, the results of the work of Butler and Leahy (2015) and Hogan et al. (2007) have particular implications for the design of the intervention (Chapter 4) and research methodology (Chapter 5).

3.3.4 Principles of reform

Central to many of the government-led reform efforts in Ireland over the past decade is the concept of schools, teachers and students as integral to the change process and that flexibility and creativity are critical factors in enabling innovation. This premise stems from a number of discussion papers that propose a range of principles and strategies for managing change in schools (NCCA, 2009a) and articulate big ideas about innovation in education (NCCA, 2011c). The Irish education system, at this time, was characterised by a shift in focus from the nature of innovations themselves to "the complex interaction between these and teacher's goals, needs and methods of teaching, the characteristics of learners and the school context" (ibid, p. 5).

To "achieve deep and continuing change in schools", the NCCA adopted a set of foundational principles and a set of strategies, including processes, roles and relationships across the education system (NCCA, 2009a, p. 10). It was intended that these foundational principles - divided into three categories:

Process of Change, Teachers at the Site of Change and *Policy-related dimensions of Change* (see Table 3-2) - would be taken into account by those in the Irish education system engaged in planning for change, those designing policy aimed at bringing about change, and those responsible for the process of carrying out change. Thus, they are an important consideration in the context and design of the current study, which sought to document and critically evaluate the iterative design and implementation of a programme of reform with teachers utilising a particular model of 21st century learning in post-primary classrooms in Ireland. Chapter 4 gives a detailed account of how these foundational principles informed the design of the intervention in this study. While the strategies describe "the conditions that are conducive to achieving deep and continuing change in schools" (ibid, p.10) , they fall short of providing practical, whole-school models of how the principles can be applied and operationalised in schools on a daily basis. This gap served as a motivating factor for the current study, as discussed in more detail in Chapter 5.

Process of Change	**Teachers at the Site of Change**	**Policy-related dimensions of Change**
- Achieve clarity on the intention and outcome of change - Change happens all the time - It takes time to achieve deep change - It takes investment to achieve deep change - Change involves leadership - Strategies for change must be agile - Think in terms of evolving & supporting more than changing - Realising change involves light and heat - Strategies for change must be designed for participation - Change should be characterised by quality	- Teachers as key agents of change - Teachers experience conflicting expectations and fragmentation - Change is personal and professional	- Appreciating the centrality of teachers & schools to the change process - Shared purpose among the other agents of change

Table 3-2 Principles for leading & supporting change (NCCA, 2009a)

The reform initiatives at post-primary are ongoing and at various stages of development, along with simultaneous changes being implemented in early childhood education and across the primary school curriculum. However, system-wide progress has been slow. In particular, the Junior Cycle reform programme has been significantly hampered by resistance from teacher union groups to many of the proposed new measures. Despite these obstacles, the trends in curriculum development, together with the direction of public policy in relation to ICT in education and previous research in the field (Hogan et al., 2007), created fertile ground for the introduction of new initiatives to promote 21st century learning in Irish classrooms. The particular model under investigation in this study - Bridge21 - is discussed in the following section.

3.4 Bridge21

3.4.1 Background

The social outreach programme, from which the Bridge21 learning model was developed, was founded in 2007 as a joint initiative of the Centre for Research in IT in Education in the researcher's university and an education-focussed NGO, Suas Educational Development[9]. Known then as 'Bridge2College', the first cohort of students were 15-16 year olds from schools that were part of the Department of Education's DEIS programme[10], were located in lower socioeconomic areas of Dublin and had low progression rates to higher education. These students were released from school, by arrangement with the principal, to attend week-long workshops (without their teachers) in a specially designed learning space on the university campus. The original aim of the programme was to positively engage young people from areas of social disadvantage and encourage them to improve their attitudes towards personal learning and education. The programme was designed to leverage the affordances of technology to empower the young people as creators and in control of their own learning, and emphasised teamwork, problem-solving and constructivist learning approaches.

From an initial pilot project with approximately 100 students, through to the establishment of an extensive outreach programme with an average of 800 students attending per year, the project was renamed as 'Bridge21' in 2010 to

[9] See suas.ie

[10] Delivering Equality of Opportunity in Schools (DEIS) is the policy instrument of the Department of Education and Skills to address educational disadvantage in Ireland. See www.education.ie/en/Schools-Colleges/Services/DEIS-Delivering-Equality-of-Opportunity-in-Schools-/DEIS.html

reflect the expansion of programmes and services both in the laboratory setting in the researcher's university and, increasingly, within the classrooms of local post-primary schools. In the first ten years of the project (2010-2017), more than 15,000 participants have experienced a Bridge21 programme, ranging from primary and secondary school students to postgraduate students and teachers, in a wide range of learning contexts. For example, the model has been used successfully to introduce computer programming to 16 year-olds and positively impact their perception of computer science (Tangney, Oldham et al. 2010; Byrne, O'Sullivan and Sullivan, 2017), to enhance student engagement in mathematics (Bray and Tangney, 2016), and as a 21st century teaching and learning approach to Computer Science education and teacher PD (Byrne, Fisher and Tangney, 2016).

3.4.2 The Bridge21 learning model

The Bridge21 learning model was designed to release the potential of technology-mediated learning, through a structured move away from individualised, teacher-led learning (Lawlor et al. 2010; Lawlor, 2016; Lawlor, Conneely, Oldham, Marshall & Tangney, in press). The pedagogical approach is rooted in social constructivism - particularly the work of Piaget (1937, 1962) and Vygotsky (1978) – owing to its rich support for an active peer-led learning process, without the teacher playing the most important role. Central to the rationale of the Bridge21 learning model is the potential of technology to support collaborative, project-oriented, skills-focussed learning, where the teacher can assume the role of facilitator to guide and support the learner in a student-led, intrinsically-motivated learning experience (Lawlor et al., 2016).

Figure 3-1 (p. 73) shows the central elements of the learning model, which may be summarised as follows:

1. **Technology-mediated**: The use of technology as an integral tool in the learning process.
2. **Project-based**: delivery of content through student-led, active, cross-curricular/thematic projects.
3. **Learning space**: A physical learning space designed and configured to support team-based learning.
4. **Teamwork**: A structured team-based pedagogy influenced by the Patrol System learning method of the World Organisation of the Scout Movement (WOSM).

5. **Mastery goal orientation**: A pedagogical approach which promotes an assimilation of skills, rather than a normative performance-based approach.
6. **Social learning protocols**: Promoting a social context of learning that emphasises trust, respect and personal responsibility for learning, leading to improved student motivation and engagement.
7. **Facilitator and/or Mentor(s)**: Adult support that seeks to guide, co-learn and mentor, with teachers orchestrating and scaffolding learning activities.
8. **Reflection**: Incorporation of team and individual reflection as a regular part of the learning process, to improve understanding and aid metacognition. (Lawlor, 2016)

Figure 3-1 The Bridge21 learning model (Lawlor, 2016)

Table 3-3 (p.74) provides a more detailed description of the key components of each element of the learning model.

Element	Components
Technology-mediated	Collaboration based on - technology as a tool - technology & resources sharing in the team
Project-based	- Scaffolded - Team oriented - Problem-based learning - SMARTER (Specific, Measurable, Attainable, Relevant, Time-bound, Engaging, Recordable)
Learning Space	- Designed to support the team - Team ownership of the space - Flexible - Presentation area - Stimulating environment (décor, furnishings etc.)
Building Teamwork	- Structured teams - Team stability - Team development - Tasks & roles - Team leaders
Mastery Goal Orientation	- Breaking the performance-ability connection - Valuing effort in the learning - Encouraging team & peer affirmation
Social Learning Protocols	A learning environment based on - Social informality - Student-led approach
Facilitator / Mentor	- Adult as a guide and support - Adult as co-learner
Reflection (Team & Individual)	- Team: Plan, Do, Review - Individual: 'Cave time'

Table 3-3 Key components of the elements of the Bridge21 model (adapted from Lawlor, 2016)

3.4.3 The learning model in practice – university laboratory setting

As already noted, Bridge21 was initially conceptualised as an outreach initiative of the researcher's university. The core participants were Transition Year students (an optional gap year for 15-16 year olds between the Junior and Senior Cycles in Irish post-primary education). The students were drawn from schools in areas of social disadvantage in Dublin and attended week-long workshops, during school time, delivered in a specially designed lab-school environment on the university campus. The typical workshop format was three and a half days (22 hours) in duration and included day-long projects that were approximately 5 hours duration, excluding breaks.

Students from different schools were put into teams of 4-5, following the protocols of Scouting Patrols by assigning a team 'pod' (described below) and nominating a team leader. The essential elements of team-based learning proposed by Michaelsen and Sweet (2008) were also adhered to, including that teams must be properly formed and managed, and that, in order to function as effectively as possible, teams should be as diverse as possible.

Projects and challenges were constructivist in nature. The tasks were designed so as to encourage students to solve problems, conduct research, explore various topics and collaboratively create multimedia artefacts (videos, blogs, podcasts, websites, games etc.). Examples of projects include:

- Make a 3-minute movie to introduce your team to the rest of the group.
- Create an advertisement campaign (including a 30 second radio ad, a 2 minute TV ad and billboard poster) to promote awareness of a social justice issue (such as homelessness).
- Make a computer game/animation.

A strict deadline was imposed on teams to deliver their work on time, and make presentations and demonstrate their learning to their peers and adult mentors. Learning activities had a clear scaffold which gave the teams deadlines and milestones to work towards, but also allowed them the freedom and flexibility to manage their own learning and shape their final work output. Creativity was promoted by not requiring one 'correct' answer, but encouraging teams to devise different solutions and means of presenting their work.

As noted above, students attended the workshops without their school teacher. A Bridge21 member of staff was the lead facilitator for a group of 25-30 students, usually with the assistance of adult mentors, whose role it was to support and guide the teams of learners, but not directly lead it. Time was allocated at the end of each day for students to reflect on their achievements, both in relation to the project content and output, and also how they had worked in their team, encouraging the development of students' meta-cognition.

The design and layout of the learning space were intended to support key elements of the learning model, specifically team-based and technology-mediated learning. One room consisted of moveable furniture and was a flexible space, whereas the second room contained fixed 'team pods', equipped with desktop computers, in which the students worked in groups of four to five. A preliminary design (aerial view) of the learning space and photographs

of the final décor and layout are shown in Figure 3-2, Figure 3-3 and Figure 3-4. In both rooms, the facilitator (lead teacher) and mentors were encouraged to work amongst the students as co-learners, with very little direct instruction from the 'top' of the room, as per the Victorian model of the classroom.

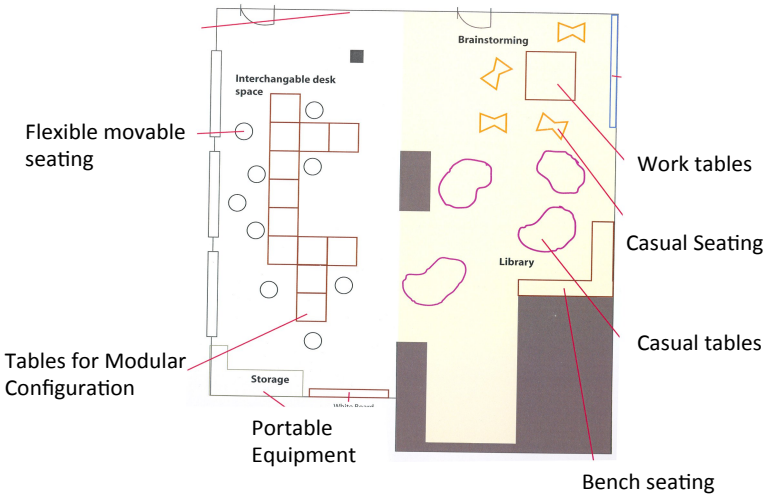

Figure 3-2 Preliminary design (aerial view) of the learning space

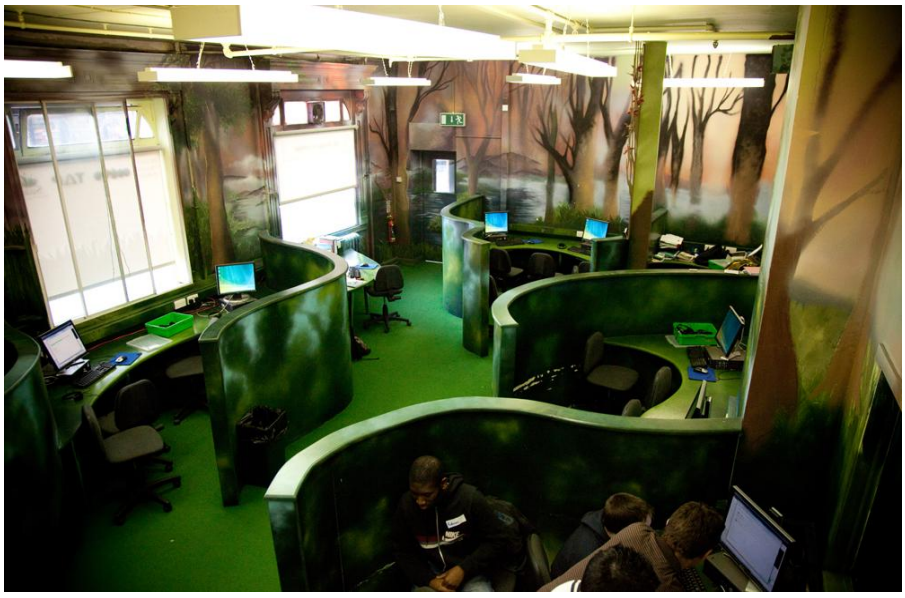

Figure 3-3 Design of Bridge21 laboratory classroom I

Figure 3-4 Design of Bridge21 laboratory classroom II

Findings from research on the effectiveness of the model in the laboratory setting indicate its potential as a vehicle for delivering effective 21st century learning activities to post-primary students (Lawlor et al., 2010; Tangney et al., 2010), to foster intrinsic student motivation (Lawlor et al., 2016) and to support peer teaching in technology-mediated collaborative workshops (Sullivan et al., 2015). These results suggest an opportunity to implement the learning model directly in the formal classroom, so as to release the potential of ICT, to leverage the power of collaborative learning and, ultimately, to change the pervading pedagogical practice in Irish post-primary classrooms to better suit the needs of 21st century learners.

3.5 Study Rationale

This chapter has set the context of the research by firstly examining the three key concepts from the literature review (educational technology, 21st century learning and teacher PD) through the lens of the Irish education system, in order to track the progress, or lack thereof, of 'top down' national policy initiatives in the years preceding the current study and to develop an acute awareness of the pertinent challenges and issues in the system at the time. Secondly, the context of the Bridge21 programme, including descriptions of the learning model and background research, was described so as to situate the study in the broader programme of work in the researcher's university and research group. This analysis of the context affirms the overall aim of the research which is to document and critically examine the progression of the learning model from its initial conception as an innovative outreach project

delivered to post-primary students on a university campus, into a school-university partnership at a time when the national policy agenda was shifting towards supporting schools and teachers to increase their provision of 21st century technology-mediated learning experiences to deliver the formal curriculum.

Given the context of the original development of the Bridge21 learning model in a laboratory classroom environment, there was a need to design a specific intervention for the partner schools, taking into account the wide range of options to implement the model in the formal classroom, along with a model of PD and support for teachers wishing to use or adapt the model to teach their particular subject. While it is clear, from the literature, that innovative teaching supports students' development of 21st century skills, it is scarce in practice and a "coherent and integrated set of conditions to support the adoption of innovative teaching" is lacking in most schools and nearly all education systems (Bernard & Langworthy, 2011, p.12). A specific goal of this research is to explore and understand the PD needs of teachers in post-primary schools in Ireland to enable them to design and deliver effective 21st century learning experiences using the Bridge21 model.

The research intends to align with trends in national policy regarding ICT in education and 21st century learning by investigating whether the Bridge21 model can provide a meaningful approach to teaching and learning using technology in post-primary classrooms in Ireland. The study sought to capture what Galvin (2015) describes as the interest and enthusiasm of individual teachers and school leaders on the ground who were willing to embrace change and were seeking practical models for technology integration and 21st century learning. It seeks to build on and extend the work of others in the field, such as Hogan et al. (2007), by identifying the PD needs of teachers and defining the key features of a robust model of PD to support the use of a technology-mediated, 21st century skills-oriented, team-based learning model in the post-primary classroom with a large cohort of schools. Figure 3-5 shows the timeline of the research intervention in the context of the significant policy developments relating to 21st century learning and education reform.

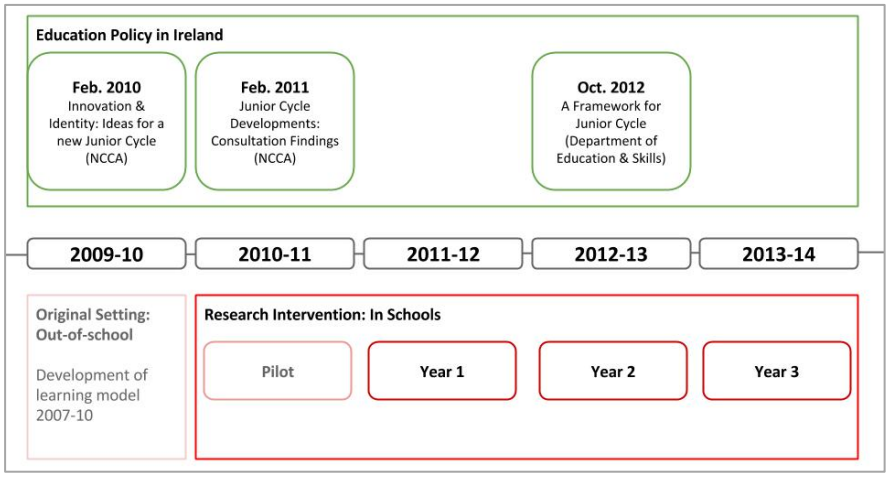

Figure 3-5 Research context & timeline

The review of literature presented in Chapter 2 and the detailed analysis of the context and setting for the study presented in this chapter informed the articulation of a set of key objectives of the research. To reiterate, the first set of objectives relate to the potential of the Bridge21 learning model as a pragmatic approach to 21st century learning in the formal classroom. Specifically, these objectives are:

- To gather evidence to illustrate students' and teachers' overall experiences and views regarding the use of Bridge21 in an authentic setting, i.e. the post-primary classroom.
- To determine specific ways in which the Bridge21 model can be effectively used to deliver the curriculum in the post-primary classroom.
- To identify whether the Bridge21 model facilitates teachers to increase their provision of 21st century learning experiences and the effect these experiences have on student skill development.

The second set of objectives focus on the evolution of the programme to support teachers to understand and adopt the learning model to teach the post-primary curriculum. Specifically, these objectives are:

- To identify the PD needs of teachers and define the key features of a robust model of PD and a school-university partnership to support the use of Bridge21 in the post-primary classroom.
- To build a repository of best practice learning activities that can be shared with the wider community of teachers and schools in the post-primary sector in Ireland.

These key objectives eventually led to the refinement of the research questions, stated in Chapter 5. That chapter will also discuss in detail how the context influenced the logic and rationale for the study, and how it informed the overall research framework, design and methods. The context had additional implications for the iterative design of the intervention, which will now be presented in Chapter 4.

4 Intervention Design

4.1 Introduction

In its original social outreach context, the objective of the Bridge21 learning model was to release the potential of technology to support collaborative, project-oriented learning, where the adult assumes the role of facilitator to guide and support learners. The aim of this study is to document and critically examine the progression of the Bridge21 learning model from its initial context in a laboratory classroom (the university outreach project), into an authentic setting (post-primary school classrooms) to deliver the formal curriculum. However, the transfer of research findings from specific conditions to various authentic learning situations is a complex process (Hämäläinen and Vähäsantanen, 2011).

The intervention described in this chapter aims to provide a framework for a school-university partnership centred on supporting teachers to use the Bridge21 model of technology-mediated 21st century team-based learning in the post-primary classroom in Ireland. As shown in Chapter 2, the successful application of such models in the setting of the formal classroom is dependent upon transformative programmes of PD that address a myriad of complex factors and barriers, including teacher beliefs, vision and the role of the teacher in a predominantly exam-focussed education system. Means (2010) contends that the design of authentic technology-supported interventions should be treated as a process of iteration and refinement, whereby those engaged in a collaborative partnership (for example, researchers and schools/teachers) move collectively through iterative cycles of implementation, monitoring, adapting and improvement.

As discussed in Chapter 3, this study, delivered over a four year period (2010-14), is set against the backdrop of a national programme of reform of lower post-primary education. The study explores the development of an intervention that was conceptualised at a time when policy leaders, school principals and teachers were seeking pragmatic models of 21st century learning that could be used in the classroom to improve student autonomy and engender key skills. The intervention was rooted in the Bridge21 learning model, which follows a particular approach to curriculum, technology, classroom design and pedagogy that requires a shift in focus from a narrow view of teacher-led delivery of subject content to a wider goal of empowering students as autonomous learners.

Building on the 'tight but loose' approach to teacher PD advocated by Thompson and Wiliam (2008), discussed in Chapter 2, consideration was given to central design principles that would shape the intervention centred on the progression of the Bridge21 model from a laboratory to an authentic classroom setting. The first design consideration (discussed in 4.2) focuses on the practical application of the learning model in the authentic setting of post-primary schools in Ireland. Such practical matters include the design of "change scenarios" (NCCA, 2009a) that articulate and exemplify a continuum of possibilities for how the participant schools and teachers could begin and continue to integrate the Bridge21 model into their daily practice. It was intended that these scenarios would give teachers and schools a degree of adaptability and flexibility in implementing the Bridge21 model in their classrooms (McMurrow, 2006; Thompson & Wiliam, 2008). The programme schedule for delivering the intervention and the provision of teacher resources are also described. The second design consideration relates to teacher PD. A set of design principles is presented in 4.3, underpinned by theoretical concepts from the literature, that formed the basis of the preliminary approach to teacher PD. Its iterative design throughout the two phases of the study is also briefly outlined. The chapter concludes in 4.4 with a summary of the design considerations and describes an initial conception of the overall school engagement framework.

4.2 Design Consideration 1: Practical Application of the Model

During the design phase of the intervention, consideration was given to a range of matters relating to the overall practicalities of the university-school partnership. These issues included the design of school-based scenarios to describe options for the meaningful integration of the model in schools, the mapping of an annual programme schedule to quantify and plan the level of engagement and participation required by schools, and the creation of a preliminary set of teacher resources and support materials to aid teachers in the design and delivery of Bridge21 learning experiences in the post-primary classroom. Each are discussed in the sections that follow.

4.2.1 School-based scenarios

The development of a series of "change scenarios", in collaboration with education partners and schools, provides a practical means of outlining and exemplifying a continuum of possibilities for how schools and teachers can

engage in the process of change (NCCA, 2009a). For the purposes of the current intervention, it was necessary to design a number of scenarios to describe a range of ways in which the Bridge21 learning model might be applied and used in the participant post-primary schools. It was intended that that each of the scenarios would facilitate varying degrees of change to schools' timetables and the way classes and subjects were organised and taught.

The development of the scenarios is informed by Voogt and Pelgrum's (2005) analysis of ICT-related curriculum change yielding three patterns: *Single-subject Curricular Focus, Thematic Curricular Focus*, and *School-wide Curricular Focus*. Each pattern is characterised in terms of focus (academic subjects, cross-curricular, or school-wide) and the perceived added value of ICT in the curriculum, either to improve how existing content is taught, to facilitate the learning of new goals, or to facilitate a new vision of teaching and learning. Based on this analysis, three scenarios for the use of the Bridge21 model in the post-primary classroom were developed in this study (Conneely et al., 2012). The change scenarios are described in the sections below.

(1) Single Subject

In this scenario, individual teachers adapt or use the Bridge21 learning model in a single subject within the regular timetable (generally a 40-minute single class period, up to a maximum of an 80 minute double period). This approach is designed to present the least number of logistical challenges to schools and cause minimum disruption to the regular timetable. It gives teachers the opportunity to explore and become familiar with the elements of the Bridge21 learning model within the comfort-zone of their own subject area and typical class duration. This scenario requires teachers to use the Bridge21 learning model in at least one of their regular classes every week. It is designed to allow teachers to build on the foundation skills in teamwork that their students develop during the induction course (in Phase 1 of the PD model, as described in 4.3.5) by presenting them with more challenging subject-focused content to learn.

(2) Integrated Curriculum

In this scenario, a 2-3 hour block of consecutive classes on the school timetable is allocated for the purposes of an integrated curricular-focussed activity. This is achieved by amalgamating one period of the weekly allocation of 2-3 subject areas. Teachers who are timetabled during this block are given the opportunity

to design (with the support of the researcher or Bridge21 programme staff) and implement cross-curricular, team-based, technology-mediated projects. The 2-3 hour time slot facilitates sustained student engagement and collaboration on a project. The learning objectives in the integrated curriculum module include multiple subject areas and the Junior Cycle key skills. Projects vary in length from a single 2-3 hour project, to a project completed over a half/full term during a regular weekly allocation of a block of classes.

(3) Thematic Curriculum

In this scenario, a thematic, project-based learning approach is implemented by several teachers across numerous subjects, within the existing timetable. This scenario is designed to facilitate thematic, cross-curricular, team-based projects while minimising disruption to the timetable. In practice, subject teachers focus on an agreed theme during specified day(s)/week(s) and students engage in a project utilizing learning from the different subject areas. The learning objectives in the thematic modules can include multiple subject areas and the Junior Cycle key skills.

The three change scenarios described above follow an explicit developmental sequence and presented a continuum of possibilities to participant schools and teachers. This design provided a means for schools that began with a small change at the beginning of the year to progress to a more ambitious approach towards the latter stages of the year. The nature of the school-university partnership was such that each participant school made an individual selection regarding their preferred approach, based on the needs of its teachers and students.

4.2.2 Preliminary programme schedule

Based on the three change scenarios, a programme schedule was designed to guide the delivery of the intervention in practice in schools. A proposed schedule, totalling approximately 50 hours of workshop delivery and support services for each school, was presented to principals before the beginning of the academic year. This design feature recognised the role of the school principals in fostering a culture of collaboration and risk-taking and creating the conditions to encourage teachers' initiative and to develop students' potential – identified by Fullan and Langworthy (2014) as key drivers in the transformation of teaching and learning in schools. Given the wide range of needs of individual schools, teachers and students, the overall time commitment for the

programme was subject to discussion, agreement and ongoing review between school management, the researcher and Bridge21 programme staff.

Activities were implemented onsite in schools and at the Bridge21 laboratory classroom in the researcher's university, as shown in Table 4-1, which presents a detailed overview of the key elements of the programme schedule. This schedule was designed to offer a range of activities as part of the intervention, informed by the core elements of the preliminary model of PD, which will be discussed in 4.3.5. An important principle of the design of the programme schedule was a degree of flexibility to allow each activity to be tailored to suit the individual needs or constraints of the participant schools.

Table 4-1 (see p.86) shows that the division of time in the programme schedule was weighed in favour of student workshops, teacher workshops and active, ongoing support for teachers as they trialled and developed their use of the Bridge21 learning model in the post-primary classroom. **Student Workshop 1** was delivered by the researcher or a member of the Bridge21 staff, with teachers in an observational role. Students were introduced to the Bridge21 learning model in the unique setting of the laboratory classroom on the university campus. This workshop was designed to provide students with an opportunity to learn and develop their skills of *how* to work and learn as part of a team during specifically designed technology-mediated, project-based activities (Girvan et al., 2016). This was followed by **Teacher Workshop 1**, a cross-curricular technology-mediated team-based experience, similar to the initial student workshop, of approximately 3 hours duration. This allowed teachers to experience the model first-hand before exploring initial ideas of how it might be applicable in their school and – with the school principal – identifying common goals for the year.

Student Workshop 2 was designed as a developmental activity for students, to allow them to reflect on and further develop their teamwork and leadership skills, particularly in the context of curriculum-based projects. **Teacher Workshop 2** followed a similar format to the initial one and afforded teachers the opportunity to engage in a structured reflection of classroom practice and identify aspects of the Bridge21 learning model that required additional support or greater understanding, knowledge and experience.

Activity	Details	Participants	Date	Duration	Location
Leadership engagement	Meeting with school leadership team to discuss change scenarios, agree programme schedule & set goals.	Principal (& Dep. Principal)	August / September	0.25 day	Bridge21 or In-school
Student Workshop 1	Induction Course for students – training in teamwork skills; Teachers as observers	Students (25-50) Teachers (1-5)	August / September	1-2 days	Bridge21
Teacher Workshop 1	Introductory PD course for teachers	Teachers (All staff or small group)	August / September	0.5 day	Bridge21 or In-school
Student Workshop 2	Development course for students – teamwork skills; leadership development; curriculum-based projects	Students (25-50) Teachers (1-5)	October / November	1 day	Bridge21 or In-school
Teacher Workshop 2	Developmental PD course for teachers: review & evaluation of classroom practice	Small groups of teachers (5-12)	March / April	0.5 – 1 day	Bridge21 or In-school
Active teacher support	Classroom observation; 1:1 review with teachers	Small groups of teachers (5-12)	Ongoing Oct - April	2 days (total time during year)	In school
End of year event	Closeout event for principals & teachers from all schools to meet, share best practice, discuss common challenges etc.	Principals (& Dep. Principals) from all schools Teachers from all schools	May/ June	1 day	Bridge21 (or other location on the university campus)
Leadership engagement	Meeting with school leadership team to review & discuss progress/ challenges etc.	Principal (& Dep. Principal)	May / June	0.25 day	Bridge21 or In-school

Table 4-1 Elements of school programme schedule (Conneely et al., 2012)

An ongoing period of **active teacher support** followed both sets of workshops for students and teachers, to ensure that sufficient time was allocated to tackle issues and challenges surfaced by teachers and/or students. This support was delivered via structured one-to-one and group-based reviews and reflections on learning activities, and classroom observation. To support the development of a fledgling community of practitioners, an **end of year event** was included as part of the programme schedule. Teachers were invited to present examples of learning activities, projects and student work output. This event also allowed time for teachers to share and discuss experiences, challenges and insights with teachers from other schools. Additionally, teachers collaborated on plans for the future and discussed how participation in the intervention aligned with the national education reform (ibid).

4.2.3 Preliminary teacher resources

The quality of team interaction during collaborative tasks is highly dependent on a teacher's approach to planning lessons, scaffolding learning tasks and activities and the overall structure of lessons in order to allow time for reflection, briefing and debriefing (Blatchford et al., 2006). Thus, an important consideration in the design of the intervention was the provision of planning materials, best practice documents and other resources to guide teachers in the development and implementation of Bridge21 learning activities in their classrooms. An initial set of project planning documentation and activity ideas were provided for the exploratory phase of the research, based on the author's experience of the application of the Bridge21 learning model in the classroom laboratory setting in the years preceding the research, as described in Chapter 3. For examples of these, see Appendix 4.1. The development of teacher resources was an iterative process, continuously reviewed and refined throughout the two phases of research. Teachers from across the network of participant schools also had the opportunity to meet and discuss their ideas, and share resources and best practice materials at events hosted by the Bridge21 programme team during the school year.

4.3 Design Consideration 2: Design Principles for Teacher PD

The review of literature presented in Chapter 2 and the detailed examination of the research context in Chapter 3 provided a theoretical underpinning for the development of a set of design principles, which evolved into a model of PD to support teachers to use the Bridge21 model in the post-primary classroom in

Ireland. The approach to PD aims to address some of the challenges and issues relating to effective professional practice identified in the literature and to embed some of the key factors that affect teacher innovative behaviour, particularly in relation to the effective use of ICT in the classroom. Figure 4-1 shows that the process of developing the model of PD throughout this research project was an iterative one.

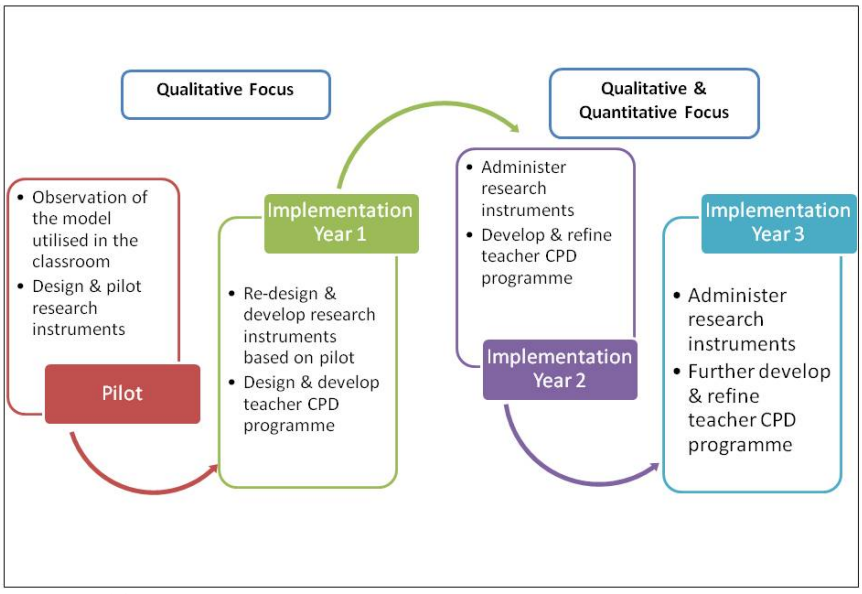

Figure 4-1 Timeline of development of PD model

Five design principles that guided the development of a preliminary design of the PD model are described in the sections that follow. The preliminary model that emerged (presented in 4.3.5) was used during the exploratory phase of the research and was reviewed and further refined during the explanatory phase, based on analysis of data and ongoing review of the literature.

4.3.1 Experiential learning

As shown in Chapter 2, an experiential approach to PD can motivate teachers to try new practices and make desired changes to the curriculum by engaging in concrete, active tasks (including observation and reflection) that illuminate the process of learning and development (Darling-Hammond & McLaughlin, 2011). Teachers need to be given opportunities to develop and reflect on their own understanding and practice of 21st century skills, before they can plan and deliver 21st century learning activities for their students (NCCA, 2008; 2010; Collins & Dolan, 2011). Additionally, a cyclical approach to PD centred on the concept of teachers as learners provides a framework for translating intended changes to the curriculum into reality in practice (NCCA 2010b; Darling-Hammond & McLaughlin, 2011). Programmes of PD for technology

integration that include hands-on learning in cooperative teams followed by discussion and reflection of learning practices can demonstrate to teachers the feasibility and usefulness of such learning experiences in the classroom (Levin & Wadmany, 2008).

Experiential learning aligns with many of the elements of the Bridge21 learning model and its application in practice in the classroom laboratory setting, as described in Chapter 3. Thus, a programme of PD rooted in experiential learning would provide a consistent pedagogical framework (Blair, 2016) for teachers' own professional learning experiences and those of their students in the classroom. This approach aligns with Putnam and Borko's (2000) proposed features of effective teacher learning, which include the view that teachers must be treated as active, professional learners who are exposed to the same learning experiences as their students. Thus the first design principle is:

- The PD approach should be **experiential-oriented** to provide teachers with an opportunity to actively engage, analyse and reflect on practical and contextually relevant Bridge21 learning experiences.

4.3.2 A relational approach

Despite the potential of collaborative learning as a 21st century skill, many studies have shown that in reality, high-level, productive collaboration in the authentic setting of the classroom is relatively rare (Hämäläinen, 2011; Kollar & Fischer, 2010) and is challenging to create (Dillenbourg & Jermann, 2010; Vass & Littleton, 2009). Students cannot be put into teams and expected to know how to work effectively together - they need to be guided in how to interact to accomplish creative collaboration and learning (Hämäläinen & Vähäsantanen, 2011). Blatchford et al. (2003) and Galton et al. (2009) advocate for a relational approach to collaborative learning, whereby skills are developed over time in a developmental sequence. Students firstly develop social and communication skills before advancing to effective teamwork skills, that are task-related, substantial and sustained in order to encourage an active involvement in learning by all team members (Blatchford et al., 2005). Given the structured team-based pedagogy of the Bridge21 learning model, influenced by the WOSM's Patrol System method, and its particular application in practice in the classroom laboratory setting, as described in Chapter 3, it is necessary to give students the opportunity to firstly experience the model and develop their collaborative learning skills in an experimental non-curricular setting before encountering a curriculum-focussed technology-mediated, team-based lesson in the authentic setting of the classroom. This is particularly important as research

showed that of those students who participated in the Bridge21 programme in the years before the current intervention, few had any experience of collaborative learning either in or out of school (Lawlor et al., 2010; Lawlor, 2016).

Many teachers hold the belief that children are unable to learn from one another (Lewis & Cowie, 1993) and that there is potential for increased conflict amongst students when engaged in group discussions (Cowie, Smith, Boulton & Laver, 1994). Equally, teachers may wholeheartedly accept new definitions of effective teaching with technology, but they may be unable to implement these ideals without seeing concrete examples of what it looks like in practice (Ertmer & Ottenbreit-Leftwich, 2010). Positive changes in student outcomes is a motivating factor for teachers to change their own practice (Guskey, 2002; Clarke & Hollingsworth, 2002). Further, when teachers witness the impact of technology on their students' learning they are motivated to experiment with additional technologies in their teaching (Ottenbreit-Leftwich, 2007). PD that is focussed on helping teachers to understand how student-centered practices, supported by technology, affect student learning outcomes has the potential to affect substantial changes in knowledge, beliefs, and culture (Ertmer & Ottenbreit-Leftwich, 2010). Thus, a relational approach gives teachers the opportunity to observe their students learning in the Bridge21 model, to understand their skills level and to establish a starting point from which they can then support them to develop new and/or deeper understandings upon their return to the classroom (Rigelman & Ruben, 2012).

Considering all of the above, the second design principle emerges as:

- The PD model should adhere to a **relational approach** by explicitly including a developmental sequence of student learning that aims to:
    i. engender the development of students' collaboration and teamwork skills
    ii. afford teachers the opportunity to observe and understand their students learning in the Bridge21 model.

4.3.3 Role of the teacher

A key element of the Bridge21 learning model is the facilitator and/or team of mentors who guide and scaffold student's learning and frequently adopt the role of co-learner. This approach resonates with much of the literature on orchestration, which involves practices such as scaffolding, supporting and structuring students' shared knowledge construction processes (Craft, 2008; Dillenbourg et al., 2009; Fischer & Dillenbourg, 2006; Sawyer, 2006b;

Scardamalia & Bereiter, 2006; Wells & Arauz, 2006), as discussed in Chapter 2. Hämäläinen and Vähäsantanen's (2011) description of the teacher's role in orchestrating creativity and collaborative learning includes the following key steps:

1. to lead the learning process towards a specific outcome;
2. to ensure an open and flexible learning environment for collaboration and creativity;
3. to support and monitor the learning process during the group work based on contextual needs;
4. to be a fellow collaborator, joining the students in the collaboration process; and
5. to enhance the collaboration processes, including channelling and focusing learning processes, instead of providing correct answers.

These actions and behaviours bear many resemblances to the role of the facilitator as a key component of the Bridge21 learning model as applied in the classroom laboratory setting, described in Chapter 3.

Orchestration is a challenging process that requires a significant shift in teacher's roles from direct instructor to facilitator and guide of student's learning. An additional challenge is to coordinate the demands of an often inflexible, overcrowded curriculum, their own theory-based knowledge and the contextual and practical necessities of the school and wider education system (ibid). The literature highlights the need to develop conceptual frameworks, practical guidance and reliable models to provide meaningful support for teachers in developing their role as facilitator in the context of technology-mediated learning activities (Roschelle et al., 2013; Prieto et al., 2015). Such conceptual tools have the potential to help teachers to effectively support ICT learning activities and thus should feature in programmes of PD (Prieto et al., 2011). Thus, the third design principle is:

- The PD approach should focus on evolving the **role of the teacher** from direct instructor towards facilitation and orchestration of student learning.

A key concept identified in the literature is the role of teachers as agents of change (NCCA, 2009a; Schleicher, 2015). Many education reform initiatives are being driven and sustained primarily by the interest, enthusiasm and commitment of individual teachers who embrace change and adopt models for technology integration and 21st century learning (Fullan, 2014; Galvin, 2015). As Fullan states, educational change is dependent on "what teachers do and

think – it's as simple and as complex as that" (2007, p.129). Rigelman and Ruben's (2013) proposed model of PD empowers teachers as change agents by helping them to firstly recognise and articulate their vision of practice and, following that, to seek and/or develop collaborative relationships (with colleagues, school leadership etc.) who could support them as they worked to achieve their vision. This approach is in line with Ertmer & Ottenbreit-Leftwich's (2010) view that teachers must be involved in the process of visioning a new approach to effective technology integration in schools, either through teacher participatory efforts or through teacher education and PD efforts. Petko et al. (2015) take this a step further to show that the success of any technology innovation in schools is dependent upon a combined top-down and bottom-up approach, where district initiatives, school leadership and teacher participation go hand in hand.

When considered against the overall aim of the research, the above points give rise to the fourth design principle:

- The PD model should follow a process of participatory innovation, encouraging **teachers as agents of change**.

4.3.4 Constructivist pedagogy

The review of literature in Chapter 2 highlights that learner-centred constructivist pedagogical approaches are regarded as particularly suitable for supporting the acquisition of 21st century skills (Voogt & Roblin, 2012; Voogt et al., 2013) and for facilitating effective, creative and innovative use of ICT in the classroom (Voogt, 2010; Petko, 2012; Ertmer et al., 2007). A teacher's pedagogical capacity in the 21st century is determined by their expertise in constructivist teaching strategies (Voogt and Pelgrum, 2005) that they can draw upon to form learning partnerships with students whereby they discover, create and master content together (Fullan & Langworthy, 2014). One of the essential features of effective teacher professional learning to support the integration of technology in the classroom is a social-constructivist approach whereby teachers engage as active learners who construct their own understanding and awareness of personal challenges, beliefs, needs and capabilities to cope with the changes required (Putnam & Borko, 2000) These findings resonate with Levin and Wadmany (2008) who suggest that PD experiences should adhere to personal and social constructivist-based learning principles, even if this requires a slower pace of change and more diversified professional learning experiences for teachers.

These findings, together with the socially constructivist theoretical underpinning of the elements of the Bridge21 learning model, form the basis of the fifth and final design principle:

- The PD approach should adopt and promote a **constructivist pedagogy** to engage teachers in constructing their own understanding and knowledge of how to use the Bridge21 learning model in a unique and meaningful way.

4.3.5 Preliminary PD design

The five design principles described above were used to guide the preliminary design of a programme of PD to transfer the Bridge21 model from its original use in the context of a laboratory classroom setting (the university outreach project) to its use by teachers in an authentic setting (post-primary school classrooms). To summarise, the design principles state that the PD approach should:

1. Be **experiential-oriented** to provide teachers with an opportunity to actively engage, analyse and reflect on practical and contextually relevant Bridge21 learning experiences.
2. Adhere to a **relational approach** by explicitly including a developmental sequence of student learning that aims to:
   i. engender the development of students' collaboration and teamwork skills
   ii. afford teachers the opportunity to observe and understand their students learning in the Bridge21 model.
3. Focus on evolving the **role of the teacher** from direct instructor towards facilitation and orchestration of student learning.
4. Follow a process of participatory innovation, encouraging **teachers as agents of change**.
5. Adopt and promote a **constructivist pedagogy** to engage teachers in constructing their own understanding and knowledge of the Bridge21 learning model in a unique and meaningful way.

Figure 4-2 below shows the preliminary design as a developmental model that is cyclic, based on four key steps that encapsulate the design principles: Experience, Develop, Evaluation and Transform (Conneely et al., 2012). This approach is similar to that suggested by Levin and Wadmany (2008), wherein an initial experience for teachers and students leads to a phase of development, with new classroom practice and the creation of new learning artefacts using the Bridge21 model. Teachers then move to an evaluation stage, reflecting on

their own practice, student learning outcomes and engaging in dialogue with colleagues. The cyclical nature of the model aims to promote sustained teacher engagement as change agents and affect the depth of teacher's learning, their cognitive views, and feelings, and their behaviours within the overall change dimensions (Levin & Wadmany, 2008, p.254). The elements of this preliminary model, informed by the design principles, seek to exemplify transformative learning (Twining et al., 2013) by positioning the development of teacher's understanding and use of the Bridge21 learning model in the authentic setting of post-primary classrooms as having the potential to ultimately transform practice.

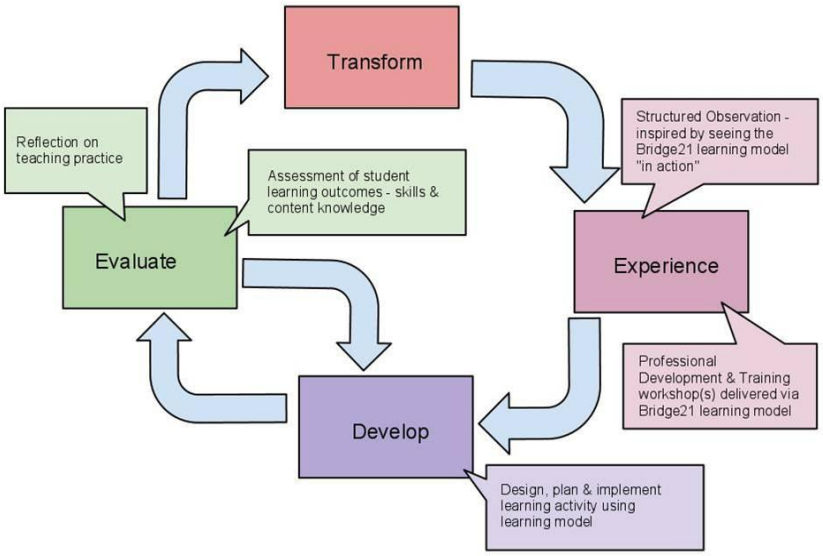

Figure 4-2 Preliminary design of PD model (Conneely et al., 2012)

The process of developing the model of PD throughout this research project was an iterative one. The preliminary design described here formed the basis of the exploratory phase of the research and was reviewed and further refined during the explanatory phase. Chapter 6 presents the analysis of data and discusses the results that informed further iterations of the PD approach. The final version of the PD model led to the development of an overall conceptual framework – presented as a primary contribution of the research – is discussed in Chapters 7 and 8.

4.4 Summary

The key design considerations that shape the intervention under exploration in this study relate firstly to the practical means of supporting the progression of the Bridge21 learning model from a laboratory classroom into the authentic

setting of post-primary schools in Ireland, and secondly to teacher PD. Three school-based scenarios were developed, guided by Voogt and Pelgrum's (2005) analysis of ICT-related curriculum change and the NCCA's (2009a) foundational principles of change. These scenarios followed an explicit developmental sequence and presented a continuum of possibilities to participant schools and teachers as to how the Bridge21 learning model can be used in practice in the classroom. Additionally, a programme schedule was designed in order to set expectations regarding the depth of engagement and participation by schools, and a preliminary set of teacher resources and support materials.

Based on the literature review (Chapter 2) and research context analysis (Chapter 3), including the defining features of the Bridge21 learning model and its particular initial use in a laboratory classroom, five design principles were proposed to guide the preliminary design of a model of PD to support teachers to use the learning model to teach the formal curriculum in post-primary classrooms in Ireland. The PD experience that evolved (see Figure 4-2) is a cyclic, developmental model, based on four key steps that encapsulated the design principles. It adheres to the approach suggested by Levin and Wadmany (2008), whereby PD is a dynamic process that affects teachers' learning, cognitive views, feelings and behaviours through "multifarious and multidimensional" elements. The preliminary PD model and the elements of the programme schedule (Table 4-1) bear many resemblances to the key features of Butler and Leahy's (2015) model of PD for a technology intervention in one post-primary school in Ireland, in that it seeks to be personal and interactive for teachers, delivered on-site and just-in-time, is ongoing, and is firmly situated in the wider context of the education system.

The process of developing the model of PD throughout this research project was an iterative one. The preliminary design described here formed the basis of the exploratory phase of the research and was reviewed and further refined during the explanatory phase. Table 4-2 below presents a summary of the intervention design described in this chapter. It shows how the key elements of the intervention design are guided by Desimone's (2009) critical features of PD – *Content focus, Active learning, Coherence, Duration, Collective participation* – and align with many of the foundational principles of change proposed by the NCCA (2009a) to be taken into account by those in the Irish education system engaged in planning for change and responsible for the process of carrying out change.

Critical features of PD	Element of intervention design	Principles of change*
Content focus	Relational approach: workshops that focus on how students learn during Bridge21 activities, in particular teamwork	Think in terms of evolving & supporting more than changing[1] Strategies for change must be agile[1] Appreciating the centrality of teachers & schools to the change process[3]
	Development of school-based scenarios	
	Development of resources & planning materials for teachers	
Active learning	Experiential learning: teachers actively engage in, analyse and reflect on practical and contextually relevant Bridge21 learning experiences	Strategies for change must be agile[1] Change should be characterised by quality[1] Teachers as key agents of change[2] Change is personal and professional[2]
	Observation of Bridge21 staff delivering student workshops	
	Social constructivist-centred learning in student & teacher workshops	
	Regular (approx. 1-2 per term) discussions with Bridge21 staff to review lessons, student work & learning outcomes & reflect on teacher experiences	
Coherence	Situated in the context of Junior Cycle reform and key skills	Achieve clarity on the intention and outcome of change[1] Change involves leadership[1]
	Regular engagement (twice yearly) with school leadership	
Duration	Programme engagement spans over full academic year	It takes time to achieve deep change[1] Change should be characterised by quality[1]
	Most activities/workshops 0.5-1 day duration	
Collective participation	Minimum number of teachers from the same school required to participate	Strategies for change must be designed for participation[1] Teachers as key agents of change[2] Appreciating the centrality of teachers & schools to the change process[3] Shared purpose among the other agents of change[3]
	End-of-year closeout event for principals & teachers from all schools to promote cross-school interaction and collaborative discourse	

*__Principles of change categories__: [1]Process of Change, [2]Teachers at the Site of Change, [3]Policy-related dimensions of Change

Table 4-2 Intervention design elements (adapted from Desimone, 2009 & NCCA, 2009a)

5 Methodology

5.1 Introduction

This study is centred on the documentation and critical evaluation of the iterative design, development and implementation of a programme to support teachers to use a technology-mediated team-based model of 21st century learning in post-primary classrooms in Ireland. Given the fluid and iterative nature of the social outreach programme from which the study originated, a pragmatic philosophy was adopted at the outset of the research. The overarching aim of the study was to contribute to the understanding of how the Bridge21 learning model could be transferred from an outreach context into the authentic setting of the post-primary classroom. To this end, a number of key objectives were presented in Chapter 1. The first set of objectives relate to the potential of the Bridge21 learning model as a pragmatic approach to 21st century learning in the formal classroom. Specifically, these objectives are:

- To gather evidence to illustrate students' and teachers' overall experiences and views regarding the use of Bridge21 in an authentic setting, i.e. the post-primary classroom.
- To determine specific ways in which the Bridge21 model can be effectively used to deliver the curriculum in the post-primary classroom.
- To identify whether the Bridge21 model facilitates teachers to increase their provision of 21st century learning experiences and the effect these experiences have on student skill development.

The second set of objectives focus on the evolution of the programme to support teachers to understand and adopt the learning model to teach the post-primary curriculum. Specifically, these objectives are:

- To identify the PD needs of teachers and define the key features of a robust model of PD and a school-university partnership to support the use of Bridge21 in the post-primary classroom.
- To build a repository of best practice learning activities that can be shared with the wider community of teachers and schools in the post-primary sector in Ireland.

It was intended that the research would establish whether the learning model and schools programme would have the potential to "migrate from our experimental classroom to average classrooms operated by and for average

students and teachers, supported by realistic technological and personal support" (Brown, 1992, p.143).

This chapter begins by discussing the logic of the inquiry so as to establish how the context (discussed in Chapter 3), and the researchers' prior activities and experiences influenced the focus of the study and the overall research framework. The epistemology, theoretical perspective and positionality of the researcher are explained. In the sections that follow, the research approach, the design process and the methods utilised for data collection and analysis, including a review of the ethical considerations and measures, are outlined. Finally, validity and reliability of the data will be discussed.

5.2 Logic of the Inquiry

The logic and rationale for this study are grounded in the researcher's participation, as both an educator and a researcher, in the Bridge21 programme, as described in Chapter 3. As a co-founder of the programme and collaborator in the development of the learning model in the years preceding the current study, the researcher gained a body of knowledge, insight and practical experience of using the model in a school laboratory setting that served as the catalyst for the school intervention under investigation here. The author's prior experience and knowledge is evidenced by numerous contributions to journal publications, conference presentations and reports in the years preceding the current study (for example, Tangney et al., 2010; Lawlor et al., 2010; Conneely et al., 2012; Conneely et al., 2015).

As outlined in Chapter 3, findings from research on the effectiveness of the Bridge21 model in the laboratory setting indicated its potential as a vehicle for delivering effective 21st century learning activities to post-primary students (Lawlor et al., 2010; Tangney et al., 2010), to foster intrinsic student motivation (Lawlor et al., 2016) and to support peer teaching in technology-mediated collaborative workshops (Sullivan et al., 2015). These results suggested an opportunity to implement the learning model directly in the formal classroom, so as to leverage the potential of technology, to foster collaborative learning practices and, ultimately, to change the pervading approach to pedagogy in Irish post-primary classrooms to better suit the needs of 21st century learners. However, given the context of its original development in a laboratory classroom environment, there was a need to design a specific intervention (described in Chapter 4), through examining a range of approaches to implementing the model in the formal classroom, along with developing a

model of PD and support for teachers wishing to use or adapt the model to teach their particular subject in post-primary schools in Ireland.

While it is clear, from the literature, that innovative teaching supports students' development of 21st century skills, it is scarce in practice and a "coherent and integrated set of conditions to support the adoption of innovative teaching" is lacking in most schools and nearly all education systems (Bernard & Langworthy, 2011, p.12). In considering the design of a study to implement the Bridge21 model in post-primary schools in Ireland, there was a need to explore and understand in detail the PD needs of the participant teachers to enable them to design and deliver effective 21st century learning experiences. This study is influenced by, and indeed mirrors, approaches and best practices from the literature on technology education, 21st century learning, and teacher PD as discussed in Chapter 2 (for example, Ertmer and Ottenbreit-Leftwich, 2010; Dexter, 2008; Fullan and Langworthy, 2014; Darling-Hammond & McLaughlin, 2011; Schleicher, 2015). It also draws on the small body of literature on educational policy and school reform in Ireland (for example, Hogan et al., 2007).

The external context of the Irish education system greatly influenced the rationale and logic for this study. The study was set against the backdrop of a national programme of reform of lower post-primary education (Years 1 - 3), as described in Chapter 3. Hence it was a time when school leaders and teachers were seeking a pragmatic model of 21st century learning that could be used in the classroom and serve as a framework for technology integration and a move away from rote learning towards improved student autonomy and development of 21st century skills. Whilst there were small pockets of innovation across the country, fuelled by the interest and enthusiasm of individual teachers and school leaders on the ground (Galvin, 2015), in general there has been a dearth of systematic pragmatic approaches to 21st century classroom practice in the context of Irish post-primary education over the past decade and little research to establish the impact and value of such approaches. This also served as a motivating factor for the researcher. The research logic model is summarised in Figure 5-1.

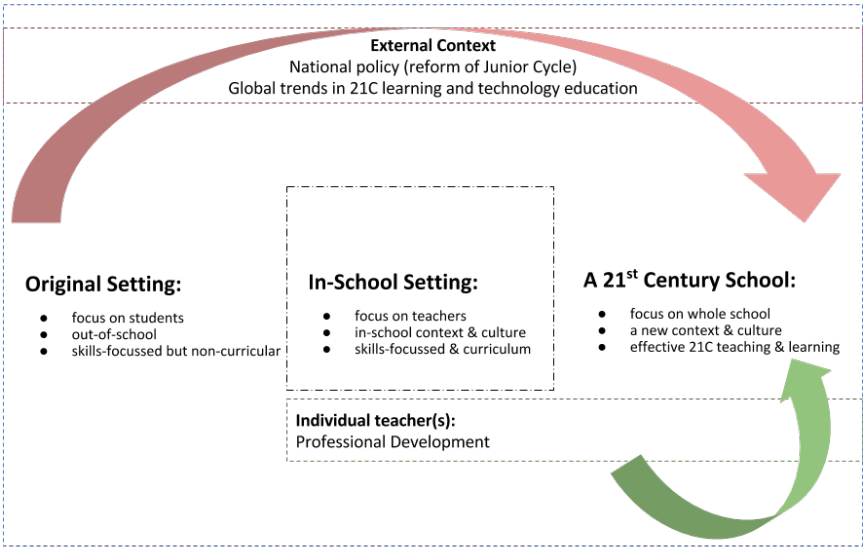

Figure 5-1 Research logic model

5.3 Research Framework

The following sections outline the research approach undertaken in the study and attempt to situate it in an overall research paradigm. The research approach is largely based on Creswell's (2014) framework for research that details the intersection of three key components: philosophy/worldview, design and research method(s). Creswell states that "in planning a study, researchers need to think through the philosophical worldview assumptions that they bring to the study, the research design that is related to this worldview, and the specific methods or procedures of research that translate the approach into practice" (Creswell, 2014, p.5). The research framework also considers the work of Crotty (1998), who suggests four key aspects that inform a choice of approach: *epistemology*, *theoretical perspective*, *methodology* and *method*, and Guba and Lincoln (1994), who proposed a classification of four key elements in deciding philosophical and methodological positions in research, namely: *ontology* (what is real?), *epistemology* (how do we know?), *axiology* (what is valuable?) and *methodology* (how do we find out?).

Greene (2007) highlighted the importance of recognising and being aware of a researcher's mental model, defined as "a complex, multifaceted lens through which a social inquirer perceives and makes sense of the social world" (p.13). Johnson and Onwuegbuzie (2004) refer to a research paradigm as a set of beliefs that "include, but are not limited to, ontological beliefs, epistemological beliefs, axiological beliefs, aesthetic beliefs, and methodological beliefs. In short, [...] a research paradigm refers to a research culture" (p.24). The process

of selecting a research paradigm is an "acknowledgement of the researcher's belief systems and of the impact a researcher can have on the object of research" (Grogan & Simmons, 2007, p. 37). In designing the overall approach of this study, the researcher engaged in a process of reflexivity and thus was cognisant of the degree to which personal assumptions, values, experiences, knowledge and beliefs, and those of the community of researchers associated with the programme under exploration, would frame, guide and impact the design of the inquiry, choice of methods, data analysis, results and conclusions (Cohen, Manion and Morrison, 2013). As Creswell and Miller (2000) state, the "inseparableness of the researcher and the process of inquiry" must be acknowledged (p.129). Multiple strategies were undertaken to maintain a degree of objectivity in the research and will be discussed later in the chapter (see 5.10). Additionally, the researcher's positionality as part of the overall research process is addressed in 0.

The research framework is displayed in Figure 5-2 to show the interaction of each of the components that combined to influence the overall approach undertaken in the study. This framework is explained in more detail in the sections that follow: 5.4 describes the researcher's epistemology, followed by an outline of the design considerations in 5.5; the research questions are articulated in 5.6 and the specific methods chosen are described in 5.7.

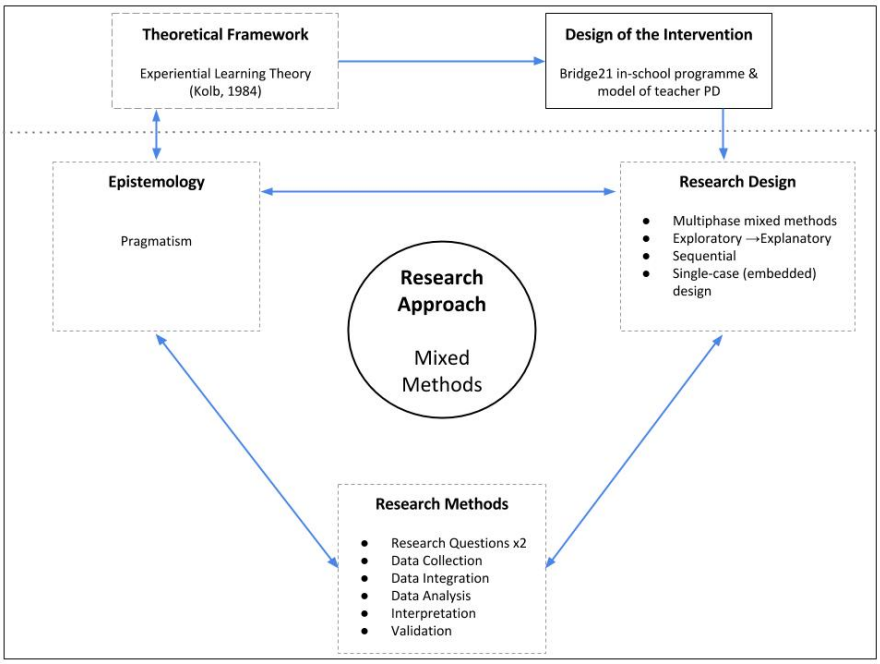

Figure 5-2 Research Framework (Creswell, 2014 & Crotty, 1998)

5.4 Epistemology

Having considered a range of epistemological schools of thought (including idealism, rationalism and constructivism), pragmatism was identified as aligning most closely to the aims and objectives of the study, as it is essentially a practical rather than ideological epistemology – as Denscombe (2010) states, it is "practice-driven" (p.280). Pragmatism is concerned with actions and consequences, focussing on how knowledge or experience is applied in a particular situation. The pragmatic worldview is founded in the writings of early exponents Peirce, James, Mead and Dewey, who were constructionist and critical (Crotty, 1998), and more recently in the work of Murphy, Patton and Rorty (Creswell, 2014). Pragmatism encompasses a very broad and inclusive ontological approach, whereby knowledge is viewed as being "both constructed and based on the reality of the world we experience and live in" (Johnson & Onwuegbuzie, 2004, p.18). Pragmatism offers a critical philosophical basis for research that focuses on a problem and uses all approaches and measures available to understand and derive knowledge about it (Tashakkori & Teddlie, 2010; Patton, 2015).

Pragmatism displays a number of common characteristics, summarised as the efficacy of practical application providing "a standard for the determination of truth in the case of statements, rightness in the case of actions, and value in the case of appraisals" (Rescher, 1995, p.710). Johnson and Onwuegbuzie (2004) provide a comprehensive typology of the general characteristics of pragmatism that were used to guide this study, including:

- Places high regard for the reality of and influence of the inner world of human experience in action.
- Human inquiry is viewed as being analogous to experimental and scientific inquiry. We all try out things to see what works, what solves problems, and what helps us to survive.
- Endorses a strong and practical empiricism as the path to decide what works.
- Views current truth, meaning and knowledge as tentative and changing over time.
- Prefers action to philosophising (in a sense it is an anti-philosophy).
- Takes an explicitly value-oriented approach to research that is derived from cultural values.
- Endorses practical theory.
- The researcher (and research community) constantly tries to improve upon past understandings in a way that fits and works in the world in

> which he or she operates. The present is always a new starting point. (Johnson & Onwuegbuzie, 2004, p. 18)

Given the fluid and ever-changing nature of the intervention under exploration in this study, pragmatism offers a strong philosophical underpinning for the research, as it allows for exploring and developing a nuanced understanding of participants' experiences. As an action-oriented, practical epistemology, pragmatism afforded the researcher the opportunity to focus on the research problem and to draw on both qualitative and quantitative measures to derive a solution and the most effective application - in other words, what works best for the research participants and setting (Patton, 2015).

In proposing a pragmatic epistemology for this study, the shortcomings of the philosophical approach were considered, including the suggestion that pragmatism may promote incremental change rather than more fundamental, structural or revolutionary change; the assertion that what is meant by usefulness or workability can be vague unless explicitly addressed by a researcher; and the contention that pragmatic theories of truth have difficulty dealing with the cases of useful but non-true beliefs and non-useful but true beliefs (Johnson & Onwuegbuzie, 2004). Due consideration was given to these shortcomings in the research design and in the specific methods chosen to translate the overall approach into practice, as discussed in the sections that follow. The researcher further addressed these limitations by re-considering the philosophical assumptions of pragmatism at the data analysis, interpretation and validation stages of the study.

Pragmatism tends to be widely associated with mixed methods research, defined as the combination or integration of qualitative and quantitative research and data (Creswell, 2014). Johnson and Onwuegbuzie (2004) argue that mixed methods research should use a method and philosophy that attempt to synthesise the insights provided by both qualitative and quantitative research into a practical solution from which researchers can advance knowledge and answer important research questions. The following section will discuss the field of mixed methods research in more detail, before outlining the rationale for the specific mixed method model utilised in this study.

5.5 Research Design

5.5.1 Mixed methods

The field of mixed methods research is increasingly recognised by many researchers as one of the three major research paradigms (qualitative and

quantitative being the other two) (Creswell & Plano Clark, 2011; Tashakkori & Teddlie, 2010; Johnson, Onwuegbuzie & Turner, 2007). Cohen et al. (2013) refrain from hailing it as a new paradigm, yet still highlight the importance of "combining methods wherever necessary and relevant in planning and doing research" (p.26). Also known as integrating, synthesis, quantitative and qualitative methods, multimethod or mixed methodology, the term mixed methods is generally used today (Tashakkori & Teddlie, 2010). The origins of mixed methods lie in the triangulation of data sources to eradicate weaknesses and to seek convergence across methods in a study (Creswell, 2014). The key features of mixed methods research are summarised by Denscombe (2010) as:

1. The use of qualitative and quantitative approaches within a single research project.
2. An explicit focus on the link between approaches.
3. An emphasis on practical approaches to research problems (pragmatism) (p.138).

Johnson et al.'s (2007) comprehensive review of the recent history of mixed methods research includes a list of nineteen definitions of qualitative- and quantitative-dominant mixed methods research, along with a list of several outstanding issues that require further investigation as the field advances. Following detailed content analysis and discussion, the authors propose the following definition of mixed methods as "the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration." (Johnson et al., 2007, p.123). The authors contend that mixed methods research recognises the importance of traditional quantitative and qualitative research but offers a robust third paradigm option that, with an informed design process, will provide the most informative, complete, balanced, and useful research results. The paper concludes with the assertion that mixed methods research should be used "when the nexus of contingencies in a situation, in relation to one's research question(s), suggests that mixed methods research is likely to provide superior research findings and outcomes" (ibid, p.129).

Numerous typologies exist to guide the design process in a mixed methods study (e.g. Leech & Onwuegbuzie 2009; Teddlie & Tashakkori 2009; Creswell et al. 2003; Maxwell & Loomis 2003). It is suggested that the logic of mixed methods research is such that when designing a study, qualitative and quantitative methods, approaches, ideas and concepts should be combined in a

strategic manner that produces "complementary strengths and nonoverlapping weaknesses" (Johnson et al., 2007, p.127). A strong mixed methods design is characterised by a strong mixed methods research question, often broken down into separate sub questions which converge into a combined integrated answer (Tashakkori & Creswell, 2007). The research questions for this mixed methods study are presented in 5.6

The rationale for selecting a mixed methods design for the current study was informed by Denscombe's (2010) review of published mixed methods studies to identify common purposes and stems from the pragmatic epistemic values of the researcher in seeking to compare different perspectives drawn from a combination of methods and data to provide a "full and complete picture" (Denscombe, 2010, p.141) of the intervention under exploration. Additionally, the collection and integration of both qualitative and quantitative methods facilitated a comprehensive understanding of the impact of the multiple phases of the intervention over time and the evolving needs of the participant teachers and students. Finally, this approach allowed the researcher to compensate for the strengths and weaknesses that are inherent in single-methods approaches (for example, single-observer) by using a balanced combination of methods.

The specific applications of the mixed methods design in the research process are discussed in greater detail in 5.7. Within the overarching mixed methods design, three alternative research methodologies were examined to ascertain their suitability for the current study, namely Case Study, Action Research and Design-Based Research. Each one is discussed in turn in the sections below.

5.5.2 Case study

A case study is a distinct form of empirical enquiry with a long distinguished history across many disciplines (Creswell, 2013). A case study is defined as "a specific instance that is frequently designed to illustrate a more general principle" (Nisbet & Watt, 1984, p.72). Case studies are an appropriate means to explain, describe, illustrate and enlighten (Yin, 2014), and establish cause and effect (Cohen et al., 2013) of real-world phenomena under investigation.

Yin (2014) proposes a twofold definition of the case study as a research method, covering both its scope and features. A case study is "an empirical inquiry that investigates a contemporary phenomenon (the 'case') in depth and within its real-world context" (Yin, 2014). Given that it is often difficult to separate phenomenon from context, particularly in often-complex real-world contexts, several distinguishing features are common in case study research (Yin, 2014; Creswell, 2013), namely:

- The 'case' is clearly defined and is bounded by specific parameters of place, time, events or processes.
- There is a clear statement of intent for the study.
- Multiple sources of information are collected and evidence is triangulated so as to develop an in-depth understanding and rich description of the case.
- Data analysis can be guided by theoretical propositions or descriptive frameworks, which allow the researcher to identify themes, issues or situations specific to the case.
- Results and conclusions of the study are based on the overall meaning or assertions (Stake, 1995) derived from the 'case'.

There are several weaknesses and challenges to be addressed when following the case study method. Traditional concerns include a lack of rigorous, systematic procedures, an inability to generalise from case study findings and an unmanageable level of effort and span of time to conduct (Yin, 2014). However, there are demonstrated measures and well-documented approaches to case study research to assist the researcher in addressing these concerns. Additionally, measures of validity and reliability, including construct validity, internal and external validity, concurrent validity and avoidance of bias are critical in presenting case study research (Cohen et al., 2013, p.295). These measures will be discussed later in the chapter (see 5.10).

5.5.3 Action research

Action research is considered a powerful research tool for change and improvement to practice and can be used to explore a variety of areas within the field of education, including teaching methods, learning strategies and continuing PD of teachers (Cohen et al., 2013). Somekh and Zeichner (2009) suggest that action research "embodies a collision of terms" whereby research knowledge is generated and, simultaneously, social action is undertaken, thus challenging "the normative values of two distinct ways of being – that of the scholar and the activist" (p. 5). As a methodology, action research is designed to bridge the gap between research and practice and is regarded as offering "rigour, authenticity and voice" (Somekh, 1995, p. 361).

Kurt Lewin is often credited with inventing the term action research. His significant work in the field set forth a vision of improving social formations by involving participants directly in a cyclical process of research, defined by four main stages: *plan, act, observe* and *reflect* (Lewin, 1946). Cohen, Manion and Morrison (2013) build on this framework to define action research as a cycle of

identifying a problem, planning an intervention, implementing the intervention and evaluating the outcome (p.361). Action research is widely conceptualised as a cycle or spiral (Elliott 1991, 2007; Dick 2002; McNiff & Whitehead, 2011; Carr, 2006; Rosendahl & Rönnerman, 2006) where the results are intended to be applied directly to the research context in order to improve practice.

It is evident that, in educational settings, there are many different orientations, approaches to, and understandings of action research (Bradshaw, Gallastegi, Shohel and Younie, 2014). In recent decades, there has been an increased focus on teacher professional learning and development through action research, documented in the work of Elliot (1991, 2007) and others. Yet there is often little scope to support the cyclical nature of action research, with few participants succeeding to complete more than one iteration of plan, do, review, reflect (Bradshaw et al., 2014).

Specific principles of action research include authentic participation, collaboration and the requirement of participants to examine their own experiences objectively (Denscombe, 2014). The four key characteristics of action research are identified as:

1. Practical
2. Change is integral to the process
3. Cyclical process
4. Practitioner participation (ibid)

Kemmis and McTaggart (2003) highlight collaboration as a significant principle of action research, particularly in education settings where the relationship between teachers and others, for example staff involved in a school-university partnership, is critical to the research.

While the researcher was required to spend significant portions of time in partner schools delivering workshops, engaging with and supporting students, teachers and principals, whilst also directing the systematic collection of data in order to answer the research questions, action research was ultimately considered to not be an appropriate approach for this study. This was primarily due to the fact that the cyclical nature of action research did not suit the innovative, iterative and fluid nature of the programme under investigation.

5.5.4 Design-based research

Design-based research (DBR) is a new research methodology that is being used increasingly in educational settings, particularly in primary and post-primary contexts and for technology-focussed interventions (Anderson & Shattuck,

2012). It is accepted as "an important methodology for understanding how, when and why educational innovations work in practice" (The Design-Based Research Collective, 2003, p.5). DBR projects are generally iterative in nature, innovative and theory-oriented but result in a clear, effective application and/or solution to real-world problems in practical educational contexts (Cobb et al., 2003).

Following an empirical analysis of recent literature on DBR, Anderson and Shattuck (2012) define the key features of the methodology as follows:

- Situated in a real education context
- Focusses on the design and testing of a significant intervention
- Uses mixed methods
- Involves multiple iterations
- Involves a collaborative partnership between researchers and practitioners
- Evolution of design principles
- Practical impact on practice

The extended and iterative nature of the intervention under exploration in this study was well suited to DBR. Additionally, the collaborative partnership between the researcher and practitioners working in a real education context aligned with a number of the key features outlined above. Having considered three alternative methodologies, the research design deemed most appropriate to the current study is now discussed.

5.5.5 Summary of research design

Multiphase mixed methods design is identified by Creswell (2014) as an advanced approach generally applied to cases of programme intervention. Thus, it emerged as an appropriate research method for this study. This design allowed the researcher to develop robust measurement instruments by collecting and analysing data during an initial (exploratory) phase, and then administering instruments (a teacher questionnaire and interviews with school principals) in the second (explanatory) phase to build on the earlier analysis. A multiphase mixed methods design also structured the exploratory phase in such a way that the analyses informed the iteration and development of the intervention over time, in particular the model of PD.

Having considered the merits of case studies in Section 5.5.2, it was decided to treat each phase of the research as an embedded single-case design, comprising several units of analysis to bind the case by specific points in time. The context of the Irish post-primary education system was the same in each phase of the

research, with the first case identified as '*exploration of the learning model*' and the second case as '*use and experience of the model in schools*'. The exploratory phase comprised two embedded units: Pilot and Year 1 of the intervention. In the explanatory phase there were three embedded units: Years 2 and 3 and Post-intervention. A summary of the Case Study design is shown in Figure 5-3.

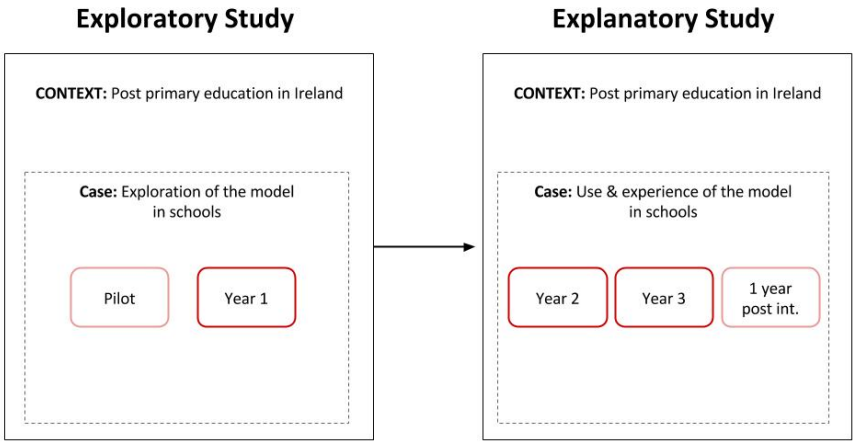

Figure 5-3 Embedded single-case design (adapted from Yin, 2014)

Within the overarching structure of mixed methods, the study also adheres to a design-based research methodology. Several of the characteristics of DBR, outlined in Section 4.5.4, are directly relevant to the study. It was situated in a real educational context and focussed on designing an intervention to address a challenge in a local context, with which the researcher was very familiar. DBR also aligns with the pragmatic nature of the study, as the scope and detail of the intervention evolved through multiple iterations over an extended period of four years (Pilot and Years 1-3). A collaborative partnership between the researcher and participant schools, teachers and students was developed from the outset and maintained for the duration of the study. One of the overarching aims of the study was to develop practical design principles, including a model of PD, to contribute to the understanding of how the Bridge21 learning model could be transferred from an outreach context into the post-primary classroom setting. Further, it was intended that at the end of the study, the learning model and schools programme would have the potential to "migrate from our experimental classroom to average classrooms operated by and for average students and teachers, supported by realistic technological and personal support" (Brown, 1992, p.143). The DBR approach proposed in this research is similar to Looi and Toh's (2013) longitudinal study in Singaporean primary schools to support teachers in orchestrating science learning activities using

mobile technologies. Their study followed a DBR iterative process from which a conceptual framework emerged to enable flexible learning in mobile learning primary school classrooms in Singapore.

Finally, in considering the continuum of qualitative-quantitative research proposed by Johnson et al. (2007, p.124), this mixed methods study may be defined as qualitative dominant overall (QUAL, as per the shorthand notation developed by Morse, 1991). During both phases of the study, a concurrent nested strategy was adopted over time, with a qualitative dominant (QUAL +quan) approach during the exploratory phase, followed by a QUAN +QUAL process during the explanatory phase. Data yielding from qualitative and quantitative methods were integrated and analysed during both phases, followed by a final interpretation of the entire analyses and presentation of overall results. The research design is summarised in Figure 5-4. The effective strategies for integrating qualitative and quantitative data at different stages of the research process, along with validity procedures, are discussed in later sections of this chapter.

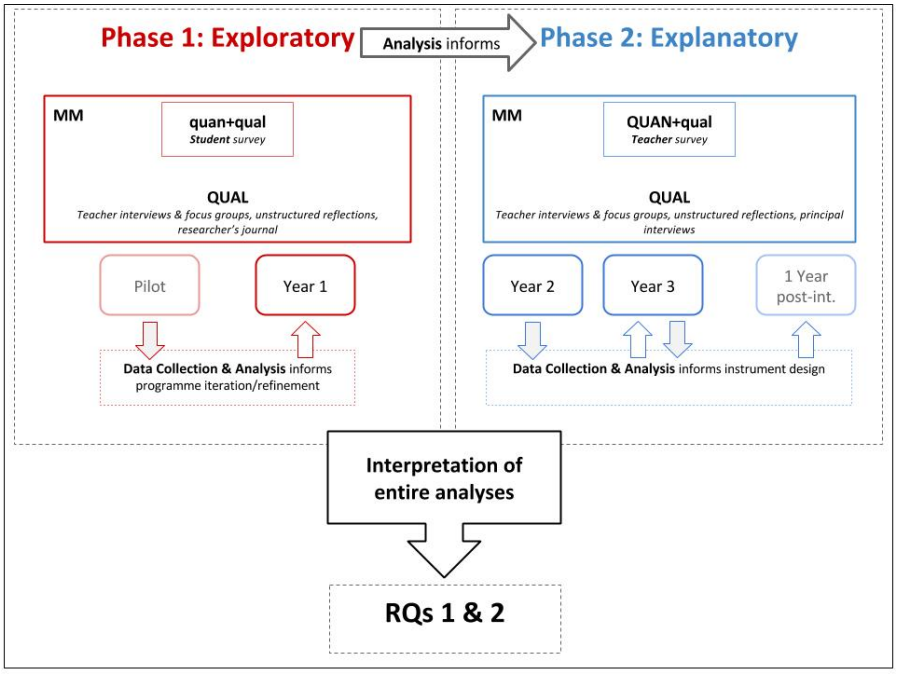

Figure 5-4 Research design (adapted from Creswell, 2014, p.221)

5.6 Research Questions

The focus of this study is to document and critically evaluate the iterative design and implementation of a programme, over a four-year period (2010-14),

to support teachers to utilise a particular model of 21st century learning in post-primary classrooms in Ireland. As outlined in Chapter 3, this study is situated in the context of the Bridge21 programme 2010-14, implemented as part of a school-university partnership with a number of post-primary schools in Ireland. This programme, and the participant schools, is the lens through which the research questions are examined within an overall framework of a multiphase fully integrated mixed methods design.

Several studies on mixed methods research design discuss the need for a mixed methods research question (Creswell 2014; Creswell & Plano Clark, 2011; Tashakkori & Creswell, 2007). Creswell suggests that including a mixed methods question highlights the significance of integrating both qualitative and quantitative strands of the inquiry (Creswell, 2014). In the case of the concurrent nested strategy of this mixed methods study, the research questions are designed to address both the 'what' and the 'how'. Qualitative and quantitative data are collected simultaneously during two phases of the research and the data are merged in the final interpretation of the entire analysis to answer the research questions (see Figure 5-4).

In order to address the aims and objectives of the study described earlier, two primary research questions were identified. To reiterate, the first question (**RQ1**) seeks to explore whether the Bridge21 learning model has the potential to be transferred from its original use in the context of a laboratory classroom setting (the university outreach project) into the authentic setting of post-primary schools in Ireland. The question is divided into two parts:

> **RQ1(a)**: What are the primary factors that affect the use of the Bridge21 learning model in the post-primary classroom?
>
> **RQ1(b)**: How does participation in such learning experiences affect the development of students' 21st century skills?

The second question (**RQ2**) focuses on developing a conceptual framework for a school-university partnership to support teachers to adopt a 21st century learning approach to the post-primary curriculum using the Bridge21 model. The two parts of this question are as follows:

> **RQ2(a)**: What are the key elements of a school-university partnership framework designed to support teachers to use the Bridge21 model of technology-mediated team-based learning in the post-primary classroom?
>
> **RQ2(b)**: How do the defining features of the framework, including the approach to PD, facilitate teachers to use this model to teach the

curriculum and to increase their provision of 21st century learning experiences for their students?

As noted above, the research questions were explored simultaneously through both phases of the study and the final interpretation of the entire analysis of data formed the basis for the presentation of overall results in Chapters 7 and 8.

5.7 Research Methods

5.7.1 Introduction

This section details the specific research methods employed in this study. Some methods were predetermined at the outset, but others emerged through the multiphase mixed methods design. By employing qualitative and quantitative methods through a blend of exploratory and explanatory research, the researcher sought to address a wide range of questions (the "how, why, what, who, when and how many") relating to the programme under investigation (Denscombe, 2010, p.150). A mixed methods approach generally involves strategies of inquiry that comprise collecting data either simultaneously or sequentially to best understand the research problem (Creswell, 2005). Figure 5-4 above shows that the collection of data occurs in two sequential phases, which enables access to detailed quantitative and qualitative data over time in order to frame and address the research questions.

Qualitative and quantitative methods were interlinked across the study in a number of different ways. Firstly, the results of the exploratory phase were used to inform the development of measures administered in the explanatory phase. These results were synthesised in a final set of findings, which were interpreted by the researcher to provide answers to the research questions and overall conclusions to the study. Secondly, rich, contextual data collected through qualitative methods (including interviews, observations and other documents) were complemented by the quantitative measures included in the student and teacher questionnaires, with the combined analysis providing a detailed and practical insight into the use of the Bridge21 learning model in the authentic setting of the post-primary classroom in Ireland. Thirdly, qualitative and quantitative results were constantly compared during the data analysis phase to ascertain any differences or similarities in the two types of data, or to use qualitative data to "shed a lot of useful light on a simple statistic" (Cohen et al., 2013, p.25). Finally, background information collected in the teacher questionnaire was used as the basis for selecting a small sample of school

principals to participate in a final set of interviews post-intervention. By these means, there was a clear and explicit focus on the link between qualitative and quantitative approaches in order to produce "superior research findings and outcomes" (Johnson et al., 2007, p.129).

Design Phase	Method	Data type	Purpose	Level
1 & 2	Qualitative interviews with teachers	QUAL	To provide rich and contextualised data from a sample of participants on their perspectives of the intervention and to inform the design of a questionnaire instrument.	Teacher Classroom School
1	Student questionnaire (pre, post)	quan+ qual	To provide qualitative and quantitative data from a sample of student participants to describe student experiences of the intervention and measure perceived differences in 21st century skill ability.	Student Classroom
1	Teacher & student reflections	qual	To provide additional rich and contextualised data from a sample of participants on their perspectives of the intervention via structured & unstructured reflections.	School Classroom Teacher Student
1 & 2	Qualitative documents	qual	To provide additional data on teachers' and students' experiences of the intervention via written reflections and observations recorded in the researcher's journal.	School Classroom Teacher Student
2	Teacher questionnaire	QUAN+ QUAL	To provide qualitative and quantitative data (from open- and closed-ended questions based on Phase 1 analysis) from a sample of participants to describe teacher experiences of the Bridge21 programme.	Teacher Classroom School
2	Semi-structured interviews with principals	QUAL	To provide richer and more contextualised data from a small sample of participant school principals.	Classroom School

Table 5-1 Summary of Research Methods

Table 5-1 above summarises the methods for each phase of the study, providing detail on the purpose and level for each one, along with the type of data collected (using the shorthand notation developed by Morse, 1991). The sampling plan for each method is discussed in 5.8.1.

In summary, this study may be described as a fully integrated mixed design, whereby mixed methods were used iteratively at each and all stages and levels of the research (Teddlie & Tashakkori, 2009). It is important to adopt a systemic, ecological or holistic approach to research centred on investigating the use of technology in schools or the nature of teachers' change processes (Zhao & Frank, 2003). Thus, given the nature of the intervention under exploration, data were collected at multiple levels, including school, classroom, teacher and student. The following sections here describe in detail the design procedure for each instrument, including pilot activity and refinement processes undertaken.

5.7.2 Instrument design

The research methods utilised in this study include qualitative interviews, questionnaires, qualitative observation and qualitative documents (including researcher journal and structured and unstructured participant reflections). The background research that informed the design and administration of each one are discussed in turn in the sections below.

Interviews (QUAL)

The research interview is defined as "a two-person conversation initiated by the interviewer for the specific purposes of obtaining research-relevant information, and focussed [...] on content specified by research objectives of systematic description, prediction, or explanation" (Cannell & Kahn, 1968). Yin (2014) contends that qualitative interviews are one of the most important sources of data in a case study design. Interviews may be structured, unstructured/open, or semi-structured (Cohen et al., 2013). Semi-structured interviews, containing a specified set of open-ended questions, are used to elicit the views and experiences of research participants, with an emphasis on understanding the factors that facilitate and hinder the quality, or otherwise, of an intervention (Johnston et al., 2014).

During both phases of this study, face-to-face interviews were conducted with a sample of participant teachers, both in individual and in small focus group (approximately 3-4 participants) format. During the exploratory phases, the

interviews sought firstly to provide rich and contextualised data from a sample of participants to explore the impact of the intervention; secondly to advise the researcher on ongoing iterations and development of the programme design; and finally, to inform the design of the teacher questionnaire to be administered in the explanatory phase. Appendix 5.1 contains the semi-structured interview protocol used with teachers in Phases 1 and 2. During the explanatory phase of the research, an additional set of semi-structured interviews was conducted with a small sample of principals from schools that had participated in a minimum of three years of the Bridge21 programme. This enabled an in-depth exploration of the key findings from the teacher questionnaire and provided insight into unexpected themes surfaced by the results. Interviews with school principals were intended to provide richer and more contextualised information on the questionnaire data from a leadership and whole school perspective. The interview protocol used with principals is in Appendix 5.4. During both phases, all interviews were digitally recorded and transcribed (by a professional) for later analysis.

Several authors point to the limitations of interviews, including biased responses due to the presence of the researcher, the effect of an unnatural setting and the provision of indirect information filtered through the views of interviewees (Creswell, 2014; Cohen et al., 2013). Efforts were made to minimise these drawbacks by conducting the interviews on the school premises, preferably in a teacher's classroom and by explicitly encouraging participants, from the outset, to be honest and unbiased in their responses.

Student Questionnaire (quan+qual)

This study follows a similar approach to that of Soebari and Aldridge (2015) who explored students' perceptions of a learning environment to evaluate the effectiveness of a teacher PD programme and to understand changes in teachers' practices. Questionnaire was the preferred method for collecting data from students during the exploratory phase of the study, as it allowed the researcher to identify attributes of the larger population from a random sample group (Fowler, 2009). The aims of the student questionnaire were threefold:

1. To explore students' views on their learning in school generally
2. To explore students' views on their experiences of the intervention specifically, and
3. To measure perceived differences in 21st century skill ability.

Potential change in students' experiences and views during the intervention were measured through employing a one-group pre–post questionnaire design, administered at time 1 and time 2 during the exploratory phase, to a sample of the target class group of the intervention (first year in post-primary schools). Data were collected via group administration of a paper-based version of the questionnaire during the school day and collated for later analysis.

The design of the questionnaire was led by the researcher, in collaboration with colleagues affiliated with the intervention under exploration. A mapping of the Bridge21 learning model to the key skills (proposed as part of the national reform programme discussed in Chapter 3) was undertaken and 11 sub-skills were selected for investigation (see Table 5-2). A mixture of scaled Likert-scale items and open-response probes were presented in the questionnaire, with a range of items focusing on each of the sub-skills to increase the validity and reliability of responses. The post questionnaire contained additional questions to retrospectively probes students' experiences with and views on the intervention itself (Johnston et al., 2014).

A pilot undertaken with a purposive sample of first year post-primary students (n=30) from schools not participating in the intervention was used to test the format, language, wording and length of the questionnaire, and to determine whether or not it was appropriate for the target sample for the study (Cohen et al., 2013). This field-test resulted in amendments to the order and wording of questions, provision of additional definitions/terminology and edits to the format to include more colour and images/icons in the final version of the instrument. Appendix 5.2 contains the complete pre and post questionnaires.

Key Skill	**Being Creative**	**Working with Others**	**Managing Information & Thinking**
Sub-skill	Exploring options & alternatives Implementing ideas & taking action Learning creatively	Co-operating Contributing Learning with others Using IT to work with others	Gathering, recording, organising & evaluating information Using information to solve problems & create new tasks Thinking creatively & critically Reflecting on & evaluating my learning

Table 5-2 Student questionnaire - key skills (from NCCA, 2011b)

Observation (qual)

The advantages of qualitative observation, as detailed by Creswell (2014) include recording information as it occurs during a first-hand experience with a participant or group of participants, often allowing for unusual aspects of an activity or behaviour to be noticed. Furthermore, observation can be useful in exploring topics that may be uncomfortable for participants to discuss. In the case of this study, the researcher conducted classroom observations and school visits several times during each year of the study (average 3 times per school per year). Although these visits were part of the overall programme schedule (described in 4.2.2 above), they tended to be informal in nature and typically included a meeting with the school leader and/or participant teachers and an unstructured observation of a classroom activity (of approximately 40-60 minutes duration). The researcher aimed to develop a strong rapport and working relationship with the majority of participants, over time, so that observations would increasingly yield rich and contextualised information.

The use of qualitative observation as a method in the overall design afforded the researcher the opportunity to record the activities, behaviours and viewpoints of students, teachers and principals at a particular school (research site). Due to the often informal and practical nature of most school visits, the role of the researcher varied between complete observer and participant as observer (where the observation was secondary to the participant role). The observations also allowed the researcher to ascertain first-hand the level of engagement with the intervention and to surface issues or challenges that may not have arisen through other interactions (e.g. project meetings held on the university campus).

Other Documents (qual)

Qualitative documents are an unobtrusive source of information, giving the researcher access at a time convenient to them (Creswell, 2014). During this study teachers' and students' written reflections of their direct experiences of the intervention were collected. These qualitative documents enabled the researcher to gain an insight into the reality of the participants in the intervention, giving voice to their unique perspectives and experiences in their own words and language.

A research journal was used to document the personal learning journey of the researcher throughout the process. Reflections and memos in the journal (n=76) give an insight into the researchers' logic and thought processes at

particular stages of the study. The evolution of key aspects of the design of the intervention, in particular the programme of PD support for teachers, can clearly be traced via journal entries. A sample of notes and reflections from the researcher's journal and an extract from the log of entries are provided in Appendix 5.5.

The drawback of qualitative documents such as those utilised in this study is that not all participants provide equally rich, descriptive and articulate reflections. Additionally, some of the research journal entries were incomplete. However, as discussed in 5.10, by using qualitative documents as one of several methods of data collection in a multi-phase mixed methods design, the validity of the data is strengthened.

Teacher Questionnaire (QUAN+QUAL)

As detailed in Figure 5-4, data analysis and findings from the exploratory phase of the study were used to inform the design of a questionnaire administered to teachers during the explanatory phase. The content and structure of the questions were informed by several sources. Findings from the exploratory phase, particularly the case study research of Conneely et al. (2012) and Johnston et al.'s (2014) investigation of enacting a 21st century skills-based curriculum in post-primary education, indicate a number of key themes that warranted deeper exploration. Using these themes as a guide, a search for existing instruments in the literature, containing scales validated by prior research, yielded two large-scale international studies in the field of 21st century learning and ICT. These were:-

1. **EU Survey of Schools: ICT in Education** (Wastiau, Blamire et al., 2013)
    - commissioned by the European Union (EU) in 2011
    - one of a series of benchmarking activities comparing national progress towards the EU 2020 goals.
    - specifically designed to address the dearth of reliable comparative data and indicators to support evidence-based politics relating to technology in schools (Wastiau et al, 2013).
2. **Innovative Teaching & Learning (ITL) Global Research Project 2010-12** (Fullan, 2011; Shear, Means et al, 2009)
    - design and research based on several leading multinational studies including:
        - the Second Information Technology in Education Study (Law, Pelgrum & Plomp, 2006),

- the Programme for International Student Assessment (OECD, 2006),
- frameworks for 21st century learning (UNESCO 2011; Partnership for 21st Century Skills, 2006, 2011; ISTE 2007, 2008)
- research on constructs related to teaching practices that lead to positive student outcomes (Shear et al., 2010).

Scales from both sources were either modified to fit the focus of the study or discarded due to the fact that they were measuring factors beyond the scope of the study.

The questionnaire was firstly piloted with the researcher's colleagues, peers and non-participant teachers (n=12) to test the format, question type, wording, content and timing of the questionnaire (Cohen et al., 2013). This field-test resulted in amendments to the order and wording of questions and minor edits to the format. The final design was a 60-item questionnaire, comprising a mixture of scaled Likert items and open-response probes, covering five main sections as follows:

1. Background/Participant profile information
2. Using Bridge21 in teaching
3. ICT Access & Use
4. Leadership & Professional Culture
5. Professional Development

It was necessary to balance the ideals of questionnaire design, including measures of internal consistency and comprehensive coverage of all issues and topics relating to the programme, with the demotivating factor of participants having to respond to a very lengthy and time-consuming set of questions (Cohen et al., 2013).

The questionnaire was made available to participants online (administered via Survey Monkey[11]). Communication was sent via email to the full population of teachers (n=160) that had been involved in the intervention at any time between 2010 and 2014. Teachers were invited to complete the questionnaire, with the aim of understanding their engagement with the intervention over the previous three years. A second communication (also via email) was sent six weeks later, with a final reminder email a further two weeks later, after which the questionnaire was closed. The prolonged time frame was due to the fact

[11] SurveyMonkey is an online survey development cloud-based software. See surveymonkey.com

that the questionnaire was administered at the end of the academic year, hence the decision to leave it open throughout the summer holidays so as to give the option of completing it to as many participants as possible. The complete questionnaire is available in Appendix 5.3.

5.8 The Research Process

This section will firstly identify the sites and individuals participating in the study, before outlining the sampling plan pertaining to each method described in 5.7. The positionality of the researcher is also discussed.

5.8.1 Participant profiles and sampling

In the context of this qualitative dominant mixed methods study, the participants and sites were purposefully selected in order to "best help the researcher understand the problem and the research questions" (Creswell, 2014, p.189). The multiphase mixed methods design facilitated a focussed combination of quantitative and qualitative research methods that yielded a rich, contextualised description of schools, individual teachers, and students, allowing for an in-depth exploration of issues across all schools. The four aspects for describing sites and participants, as identified by Miles and Huberman (1994), serve as an additional framework for this study, as follows:

- **the setting**: the schools where the research takes place
- **the actors**: the teachers and students who are observed, interviewed and surveyed
- **the events**: the Bridge21 learning activities for students and the programme of PD for teachers, and
- **the process**: the Bridge21 learning model and evolving model of PD.

Five schools participated in the initial pilot study, with an additional three joining in Year 1, totalling eight schools. More schools joined the programme in subsequent years leading to twelve in Year 2 and sixteen in Year 3 (see total participant numbers in Table 5-3). The schools represented a diverse range of locations and socio-economic areas (including a number of DEIS schools), were of varying sizes and gender-type, were all English-medium language and included both fee paying and non-fee-paying schools. Several of the schools already had a strong rapport with the researcher due to the fact that they had been participants on the earlier out-of-school intervention since 2007 (see Chapter 3). Hence there was already a well-established and positive working relationship between school management and staff and the programme research team. Appendix 5.6 provides a summary of the school profiles.

As described in Chapter 3, the timing of the research was significant as it coincided with the programme of national reform in lower post-primary education. This programme included the establishment of a new Junior Cycle Network (JCN), led by the NCCA - a group of 49 post-primary schools nationwide who applied and were selected to initiate change within their own schools and subsequently share their experiences, ideas and resources with others in the initiative. The current research followed a similar approach of creating a pool of 'early adopters' (Rogers, 1995) in the Pilot Phase and in Year 1. These students, teachers and principals were then considered to be a learning community, acting as role models and reference points for the 'early majority' who engaged in Years 2 and 3 of the study. It is important to note that some of the Bridge21 participant schools were selected to be members of the JCN, which had implications for the design of the intervention and data analysis.

Year	**2010-11 Pilot**	**2011-12 Year 1**	**2012-13 Year 2**	**2013-14 Year 3**
Setting: Schools	5	8	12	16
Actors (Participants):				
Teachers	20	35	97	160
Students	100	330	546	600

Table 5-3 Setting & actor numbers (by year)

Teachers' participation in the programme was voluntary. Following initial meetings and agreement from the school principal, the research team facilitated a whole staff seminar at the beginning of the year. From this, teachers were asked to volunteer to participate in the programme. The minimum requirement for participation in the programme was one teacher per school, with a maximum of twelve, from a range of subject areas. In most schools an average of five teachers were involved and they worked collaboratively to provide peer-support to one another throughout the academic year (Conneely et al., 2012).

In the early years, the programme focused on first year post-primary classes and their teachers. The minimum requirement for participation in the programme was one class per school; however, in some schools as many as four classes were involved (this was at the discretion of the school principal). In some schools, as the project progressed during the year and teachers became more

confident and comfortable with the learning model, the use extended to second, fourth (Transition) and fifth year classes.

During the initial phase of the research, an opportunistic sample of schools, individual teachers, and students was selected as the lens through which to explore the initial quan+QUAL research methods and data. Opportunistic sampling was considered most appropriate for the preliminary stage of the study as it allowed the researcher a degree of flexibility to explore and reflect on initial results emerging from the intervention. A purposive sampling strategy was used during the explanatory phase to select a nominated sample of principals from schools who had participated in a minimum of three years of the programme for interview, following the analysis of the teacher questionnaire. Table 5-4 presents an overview of the sampling plan for each research method, including the number of participants (*n*) and the year(s) it was administered.

Design Phase(s)	**Method**	**Sampling Guideline**	***n***	**Year(s)**
1	Student questionnaire (pre, post)	Random sample of 1st Year students from all participant schools	134	Year 1
1 & 2	Qualitative interviews with teachers	Purposive sample of teachers from all participant schools	40	Pilot Years 1-3
1	Teacher & student reflections	Structured & unstructured reflections & memos gathered from a sample of teachers and students	58	Pilot Year 1
1 & 2	Researcher's journal: memos & observations	Notes, memos & reflections captured by the researcher	76	Pilot Years 1-3
2	Teacher questionnaire	Sample of teachers from all participant schools	55	Year 3
2	Semi-structured interviews with principals	Small sample of principals from schools who had participated in min. 3 years of the programme	3	1 year post-intervention

Table 5-4 Research methods sampling plan

5.8.2 Research positionality

As discussed above, the logic and rationale for this study were grounded in the researcher's participation, as both an educator and a researcher, in the Bridge21 programme. This is termed by some authors as 'backyard' research (Glesne & Peshkin, 1992). More accurately, this project may be described as 'insider research' as it is being "conducted within a social group, organisation or culture of which the researcher is also a member" (Greene, 2014, p.1). Loxley and Seery (2008) characterise insider research as that which is undertaken by members of the same group who share characteristics (cultural, biological, occupational, etc.). There has been a notable increase in scholars of insider research in recent years, particularly in the field of education research (Greene, 2014). Chavez (2008) draws a distinction between total insiders - those researchers who share multiple identities or profound experiences with the research participants - and partial insiders - those who share a single identity (or a few identities) with a degree of separation or detachment from the community. Further, Chavez (2008) highlights the complexity of positionality due to the shifting, fluid nature of a researcher's multiple identities through interactions with participants or during particular stages or experiences in an intervention.

This study is positioned as insider research, due to the context and particular characteristics of the work. First, the researcher holds a depth of knowledge and understanding about the Bridge21 programme, based on a range of practical experiences and research publications in the years preceding the current work. Additionally, at the time the research was undertaken the researcher was a member of the management team and had built a strong sense of identity both with colleagues in the university and with teachers and principals in the partner schools. On the one hand there are advantages to be found in the closeness afforded by the insider positionality of this study, but on the other hand it can complicate and severely impede the "implementation and completion of the research" (Chavez, 2008, p. 490).

Having insider status has the potential to result in bias towards certain themes, the active pursuit of evidence to support personal viewpoints or the creation of favourable or unfavourable conclusions about the sites or participants (Creswell, 2014). Others contend that the familiarity of insider researchers with their participants and proximity to interventions can lead to more nuanced insights from the data (Chavez, 2008). Drawing on Chavez's (2008) synopsis of the methodological advantages and complications of insider research, under the key headings of positionality, access, and data collection, interpretation and

representation, multiple strategies for validation were employed to ensure that quality and accuracy of data were maintained throughout the study and to mitigate against any potential bias in interpreting the data. These are discussed at length in 5.10. Furthermore, measures were taken to ensure that data were not compromised in any way nor that participation in the intervention placed any of the participants at risk (Creswell, 2014).

5.9 Data Analysis

Qualitative and quantitative methods of data analysis were employed during the two phases of this multiphase mixed methods study. Particular techniques were selected and applied to describe, explain and interpret the data in order to answer the research questions. Yin (2014) suggests four key principles in order to ensure a high quality is achieved and maintained in case study research, regardless of the chosen strategy for analysis. In order to achieve a high quality analysis, this study sought to attend to all the evidence collected, to consider all plausible alternative interpretations of the data, to address the most significant aspects of the study and to draw on the prior, expert knowledge of the researcher (Yin, 2014, p.168).

The process of analysing data during both phases of the study followed the key stages suggested by Creswell and Plano Clarke (2011):

1. Data preparation
2. Initial exploration of the data
3. Analysis of the data
4. Presentation and display of the data
5. Validation of the data

As this multiphase mixed methods study is defined as qualitative dominant overall, consideration was given to the range of different ways in which qualitative data can be organised and presented, for example by issue/theme, by instrument or by case study (Cohen et al., 2013).

The specific approaches and analysis methods utilised for qualitative data are described in 5.9.1, including a synopsis of the computer-assisted qualitative data analysis employed. Section 5.9.2 presents an overview of the analysis of quantitative data. Validation of data is treated separately in 5.10.

5.9.1 Qualitative data analysis

Qualitative data analysis involves organising, accounting for and explaining the data (ibid). It is often an iterative process, characterised by the merging of

analysis, interpretation and data collection processes (Gibbs, 2008). As qualitative data may derive from multiple, diverse sources, there is a broad range of approaches to qualitative data analysis and it is evident that there are many differences in terms of purpose, focus, treatment of data and context.

Table 5-5 shows Denscombe's (2010) comparison of five key approaches to qualitative data analysis across the following key criteria: *Purpose of analysis Significance of data Focus of attention Units of analysis* and *Treatment of data* (p.280). Using these criteria as a reference, 'Content analysis' is considered an appropriate method for this study, due to its alignment with the overall purpose of the research and the nature of the research questions. The content analysis undertaken is explained further in the following section.

	Content Analysis	**Grounded Theory**	**Discourse Analysis**	**Conversation Analysis**	**Narrative Analysis**
Purpose of analysis	Look for hidden message	Develop concepts or theory	Show how power is exercised through language	Reveal underlying rules/structure of interaction	Depict constructions of personal identity
Significance of data	Frequency of occurrence	Derived meaning	Implied meaning	Displayed meaning	Implied meaning
Focus of attention	Surface content	Meaning of content	Content in context	Structure of content	Structure or meaning of content
Units of analysis	Words, phrases	Sentences, paragraphs	Paragraphs, whole documents	Blocks of text/talk	Whole story/text
Treatment of data	Measured (frequency, position)	Coded (constant comparative analysis method)	Related (to wider social structures)	Deconstructed	Deciphered (to find symbolic significance)

Table 5-5 Comparison of qualitative data analysis approaches (adapted from Denscombe, 2010, p.280)

Content Analysis

Content analysis provides a means of "quantifying the contents of a text" by using a clear method that is ideally replicable by other researchers (Denscombe, 2010, p.283). Zhang and Wildemuth (2009) draw a distinction between quantitative and qualitative content analysis, the latter being a more sophisticated analysis of meaning, pattern and connections in the data, rather than a basic count of the number of times a unit of analysis occurs. Hsieh and Shannon (2005) define qualitative content analysis as a research method for "the subjective interpretation of the content of text data through the systematic

classification process of coding and identifying themes or patterns" (Hsieh & Shannon, 2005, p.1278). The key features of the process of qualitative content analysis are that it reduces data, it is systematic and it is flexible (Schreier, 2014).

Hsieh and Shannon (2005) describe three types of content analysis: conventional, directed and summative. The key features and differences between each type may be summarised as follows:

- *Conventional*: beginning with observation, codes are derived from the data and are defined during data analysis.
- *Directed*: codes are derived from a theory or relevant research findings and are defined before and during data analysis.
- *Summative*: a number of keywords are derived from the interests of the researcher or the literature review and are identified before and during data analysis.

The success of content analysis depends greatly on the coding process (ibid). There are a number of different approaches to the coding process, including: *open* (a new label assigned to describe/categorise a piece of text), *analytic* (more explanatory/interpretive than descriptive), *axial* (category label for a group of codes) and *selective* (identifying the core category in a text) (Cohen et al., 2013; Seale, 1999). Thematic analysis is an additional coding strategy whereby qualitative data are segmented, categorised, summarised, and reconstructed in such a way that the significant or most interesting concepts in the data are captured (Given, 2008). Braun and Clarke (2006) define two levels of thematic analysis:

- *Semantic:* themes identified "within the explicit or surface meanings of the data and the analyst is not looking for anything beyond what a participant has said or what has been written"
- *Latent:* themes which begin "to identify or examine the underlying ideas, assumptions, and conceptualisations – and ideologies - that are theorised as shaping or informing the semantic content of the data" (p.84).

As shown in Table 5-1 above, qualitative data were collected through a range of methods during both phases of the study: interviews, questionnaires, observations and other documents. Different types of content analysis and coding processes were employed in each phase of the research. Conventional content analysis was used during the exploratory phase of the research. An open coding process was adopted to make sense of the qualitative data, to

explore patterns and to identify emergent themes for closer examination during the second, explanatory phase of the research. A directed content analysis strategy was applied to qualitative data collected during the explanatory phase. The Bridge21 learning model and definitions of the key components (Lawlor et al, 2016) were used to define a coding matrix for responses to open-ended questions in the teacher questionnaire. Findings from the teacher questionnaire and analysis of qualitative data in the exploratory phase were used to develop a coding matrix to analyse the interviews with a small sample of principals from schools who had participated in a minimum of three years of the programme. As the analysis proceeded, additional codes were developed, and the initial coding schemes were revised and refined. Analytic and thematic coding processes were undertaken in the explanatory phase of the research. Braun and Clarke's (2006) framework was used to guide the thematic coding process, with six key phases as follows:

1. Become familiar with the data.
2. Generate initial codes.
3. Search for themes.
4. Review themes.
5. Define themes.
6. Write-up.

Although the framework is set out as a six-step process, it is not necessarily linear. This facilitated movement back and forth between phases to yield a descriptive analysis and rich interpretation of the data. This approach to thematic coding allowed for common meanings to emerge in relation to critical aspects of the research, such as the context, conditions and actions of, or interactions between, key agents in the study, for example between teachers and students, principals and teachers, or the school and the researcher (/university).

Computer Assisted qualitative data analysis

Computer-assisted qualitative data analysis software (CAQDAS) packages are designed to ensure qualitative data are organised, stored, coded and retrieved in an appropriate fashion (Denscombe, 2010; Yin, 2014). Such software packages have become more diverse and highly functional in recent years (Yin, 2014) and are considered a reliable and useful tool in the analysis of qualitative data. The use of CAQDAS is viewed as being of benefit to, rather than transforming, analytic practice (Fielding, Lee & Lee, 1998), in that its essential function is not to actually perform data analysis, but rather to facilitate and assist the coding

process by enabling the researcher create code indexes and categories and to use memos, hypertext systems and selective retrieval (Cohen et al., 2013). The researcher must employ their analytic skills to interpret the CAQDAS outputs and search for any significant meaning, look for connections and reveal patterns in the data (Cohen et al., 2013; Yin, 2014; Denscombe, 2010).

The primary justifications for using CAQDAS in the current study were firstly, to facilitate data management and secondly, to extend the capabilities of the qualitative research process (Fielding et al., 1998). The NVivo software package was selected, owing to its common use in the field of education research and its wide range of features as summarised by Cohen et al. (2013, p.544). NVivo is used to support qualitative data analysis during both phases of this study, in the following ways:

- To import, store and manage large volumes of data from various sources across multiple phases
- To support conventional and directed content analysis of text through the software's coding functions (codes, nodes, tree nodes etc.)
- To sort, collate and retrieve selective texts from the overall data set
- To add memos and comments to text files during the coding process.

Descriptions of the content analysis and coding processes, along with examples of coding schema, are presented in Chapter 6.

5.9.2 Quantitative data analysis

Quantitative data analysis is a powerful research form that is often associated with large-scale projects but can equally serve small-scale investigations, such as case studies (Cohen et al., 2013). Descriptive statistics were used in this multiphase mixed methods study as a "straightforward, yet rigorous" way of organising quantitative data, summarising findings, presenting evidence, describing the profile of participants and exploring connections between the data (correlations and other associations) (Denscombe, 2010, p.241). For the most part, this study relied on descriptive statistics to provide a detailed report of what had been found in the data. Inferential statistics were used to a lesser extent, due to the small sample size, but provided some measures from which tentative conjectures could be suggested (Cohen et al., 2013).

Quantitative data analysis is generally performed using software packages to apply statistical formulae and perform computations (ibid). As the most widely used software package in the social sciences, SPSS was used in this study to process the quantitative data.

As shown in Table 5-1, quantitative data were collected during both phases of the study using the methods of a student pre/post questionnaire in the exploratory phase, and a teacher questionnaire in the explanatory phase. For both questionnaires, all responses were collated and analysed using SPSS. Descriptive and inferential statistical tests were carried out on data from the student questionnaire, including measures of central tendency and paired sample t-tests. A similar set of tests were carried out on data from the teacher questionnaire, including paired sample t-tests, Cohen's d calculations and Pearson's correlation tests. All of the above tests were based on the assumptions summarised by Cohen et al. (2013, p.703).

5.10 Trustworthiness of the Study

The trustworthiness and credibility of research are generally assessed based on four key criteria: validity, reliability, transferability, and objectivity (Denscombe, 2010). The logic of mixed methods research suggests "designing studies to diverge, where needed, and converge, where needed, in a way that results in overall or total design viability and usefulness".(Johnson et al., 2007, p.128). Yin (2014) describes several tactics to be used throughout a research process in order to address the key issues of design in case study research, namely: construct validity, internal validity, external validity and reliability.

It is difficult to completely guarantee the credibility of qualitative-led research, in particular, owing to the fact that it is impossible to exactly replicate social settings and that researchers, with their personal beliefs, past experiences, assumptions and values, tend to be intimately involved in the collection and analysis of qualitative data (Denscombe, 2010, p.298). A researcher's bias can never be completely separated from the research process, particularly in the case of insider research (Chavez, 2008) and DBR (Anderson & Shattuck, 2012). As Creswell and Miller (2000) state, the "inseparableness of the researcher and the process of inquiry" must be acknowledged (p.129). Nevertheless, efforts were made to strengthen the trustworthiness of this study as discussed in the following sections.

5.10.1 Validity

Validity refers to the extent to which the data collected are accurate and appropriate, and have been produced, checked and treated according to good practice (Cohen et al., 2013; Denscombe, 2010). It is an important requirement for both quantitative and qualitative research (Cohen et al., 2013). The logic of mixed methods research suggests that "data should be collected that will

provide all of the information that is potentially relevant to the purpose(s) of the study" (Johnson et al., 2007, p. 127). However, assessing the validity of findings in mixed methods research is particularly complex because it "involves combining complementary strengths and nonoverlapping weaknesses of quantitative and qualitative research" (Onwuegbuzie & Johnson, 2006, p.49). Common problems of validity that arise in mixed methods research have implications for this study. They include: representation (using largely or only text), legitimation (ensuring that results are dependable, credible, transferable, trustworthy etc.) and integration (using and combining quantitative and qualitative methods each with their own canons of validity) (ibid, p.54).

Several measures of validity are inherent in the overall design of this research. As it is a fully integrated mixed methods design there were multiple points of data integration and methodological triangulation. A total of four methods of data collection (see Table 5-1 above) were used at multiple levels in order to critically examine the intervention from multiple standpoints. The use of multiple sources of evidence is a relevant tactic to increase construct validity when doing case study research (Yin, 2014). During the multiphase research process, both qualitative and quantitative data were collected and analysed, so as to explain the richness and complexity of the intervention and to draw conclusions to the research (Cohen et al., 2013). Additionally, as already noted above, the weakness in one research method was compensated by the strengths of the other approaches in order to give a balanced approach to data collection and analysis (Onwuegbuzie & Johnson, 2006). Further, efforts were made to select an appropriate methodology for answering the research questions and to select and design appropriate instruments for gathering the type of data required (ibid, p.198). Finally, the formation of research questions in the design phase, together with a strong theoretical underpinning, increases the external validity of the research (Yin, 2014).

Whilst it must be acknowledged that some aspects of the current study are at risk of being invalid (some qualitative data are self-reported and/or observed behaviours, changes, practices etc.), these issues are minimised by the steps outlined above. Thus there is a reasonable degree of confidence that the data collected are accurate and appropriate.

5.10.2 Reliability

Reliability may be defined as the "dependability, consistency and replicability" of research "over time, over instruments and over groups of respondents" (Cohen et al., 2013). Reliability ensures an explicit account of the methods,

analysis, decision-making, procedures and lines of enquiry that lead to the outcomes and conclusions of the research (Denscombe, 2010). The objective of reliability is not on replicating the results of one case study by doing another; rather it is providing a detailed account of the procedures followed so that a later investigator would arrive at the same findings and conclusions (Yin, 2014). The use of documentation can increase the reliability of a study. For example, the development of a good coding scheme is central to trustworthiness in research using content analysis (Folger, Hewes, & Poole, 1984). A coding scheme includes the process and rules of data analysis that are systematic, logical and scientific (Hsieh & Shannon, 2005).

Three primary measures were taken to address issues of reliability in this study. Firstly, this chapter gives an explicit account of the logic of the inquiry, the overall research approach, the design process and the methods utilised for data collection and analysis. Secondly, a process of qualitative content analysis, that was systematic and flexible, was adopted (Schreier, 2014). The process was systematic in that it was guided by the research questions rather than by the researcher's assumptions and expectations. Additionally, it was guided by coding schemes. A degree of flexibility was built into the process by using different types of content analysis (conventional and directed) and coding processes, as described above. This facilitated the generation of coding schemes that were both concept-driven and data-driven, so that the analysis lead to a valid and reliable description of the data and material collected during the study (ibid). Thirdly, CAQDAS was used to facilitate data management and to extend the capabilities of the content analysis process (Fielding & Lee, 1998).

5.10.3 Transferability

Transferability is the term used by Lincoln and Guba (1985) to describe the extent to which findings arising from a particular research instance are generalisable and may be transferred to other instances, regardless of sample size. It is argued that generalisability is a term that holds little meaning for most qualitative researchers (Glesne & Peshkin, 1992). For case study research, *statistical generalisation*, whereby an inference is made about a population based on analysis of data from a sample of that population, is less relevant than *analytic generalisation*, wherein findings either corroborate, modify reject or otherwise advance theoretical concepts from the literature, or propose new concepts that arise upon completion of a case study (Yin, 2014). Case study research should be positioned as an opportunity to "shed empirical light about some theoretical concepts or principles" (ibid, p.40).

The quantitative data in this multiphase mixed methods study were viewed as auxiliary to the overall qualitative-dominant approach. As such, the aim was to derive analytic generalisations from the results and findings that contributed to the development of a framework for a school-university partnership centred on supporting teachers to use the Bridge21 model of technology-mediated 21st century team-based learning in the post-primary classroom in Ireland. The research methodology described in this chapter, particularly the conditions of the embedded single-case design with several units of analysis and the purposive sampling strategy, ensured that adequate information was gathered to present an in-depth picture of the intervention (Creswell, 2013). This process gives a degree of confidence for making inferences about the relevance and applicability of the findings to other teachers, schools, research projects, organisations etc. (Denscombe, 2014). The specific generalisations are discussed in Chapter 8.

5.10.4 Objectivity

Objectivity in qualitative research has been described as a myth (Corbin & Strauss, 2008). The challenges of objectivity in predominantly qualitative research are rooted in the inherent involvement of the researcher's 'self' in the interpretation of data (Denscombe, 2014; Corbin & Strauss, 2008). In the case of DBR, researchers themselves (with their biases, insights, and deep understanding of the context) are often the best research tool (Anderson & Shattuck, 2012). Objectivity is also difficult to achieve in insider research due to the high level of subjective involvement with and closeness to the research setting and/or participants (Greene, 2014; Chavez, 2008). In this way, researchers are regarded not as a limitation but as a critical resource in the research process (Denscombe 2014) – their involvement adds "as much as it detracts from the research validity" (Anderson & Shattuck, 2012, p.18).

As discussed earlier in this chapter and in Chapter 3, the logic and rationale for this study were grounded in the researcher's participation, as both an educator and a researcher, in the Bridge21 programme. Whilst the influence of the researcher's identity, beliefs and values on the design, implementation and analysis of the current study must be acknowledged, efforts were made to avoid any compromise to the data. A reflexive account of the researcher's role has been provided in 0, to explore ways in which personal experiences and values may have influenced this study (Denscombe, 2014). It must be acknowledged, however, that these aspects of self had an important role to play in the process of finding meaning and significance in the data and developing a sensitivity to emerging issues and themes from the point of view of the participants (Corbin

& Strauss, 2008). Additional measures taken to address issues of objectivity include actively investigating data that did not fit the analysis or that contradicted the general trend, and checking for rival explanations (Denscombe, 2014).

5.11 Ethics

There is an expectation that social researchers approach their work in an ethical manner (Denscombe, 2010). The complexities of research methods in educational settings and their ethical consequences are inextricably linked. These complexities are often among the least anticipated by researchers, particularly in relation to the evaluation of developments or large-scale programmes (Cohen et al., 2013). The recent increase in related literature and extensive research is indicative of the growing awareness and importance of ethical considerations and regulations in research (ibid). Before a study can be undertaken in many research institutions today, it needs to be "scrutinised by a committee of suitably qualified experts to ensure that the design of the research includes appropriate measures to protect the interests of the people and groups covered by the research" (Denscombe, 2010, p. 329).

The research methods employed in this study have been submitted to, reviewed and approved by the Research Ethics Committee of the School of Computer Science and Statistics at Trinity College Dublin. The researcher contributed information pertaining to this study as part of an overall application for ethical approval that was submitted by the researcher's supervisor for the entire Bridge21 project and its related research areas.

As stated above, during the initial phase of the research, an opportunistic sample of schools, individual teachers, and students was selected as the lens through which to explore the initial research methods and data. Approval at the school level was sought from the Principal and the Board of Management. Teachers took part in the study on a voluntary basis and gave written consent to participate. Students also took part on a voluntary basis and written consent was obtained from both a parent/guardian and the student themselves to participate in the specific data collection activities. The consent forms and other research ethics documentation are provided in Appendix 5.7.

In summary, these measures ensured that the study was conducted according to the key principles of social research ethics (Denscombe, 2010), including protecting the interests of the participants, ensuring participation of participants is voluntary and based on informed consent, and operating with honesty and integrity throughout the process.

5.12 Summary

This study is centred on the documentation and critical evaluation of the iterative design, development and implementation of a programme to support teachers to use a technology-mediated team-based model of 21st century learning in the post-primary classroom over an extended period of four years. This chapter describes the mixed methods approach undertaken, encompassing two phases of research and underpinned by a pragmatic philosophy, within an overall methodology of design-based research. The multiphase mixed methods design allowed the researcher to collect and analyse data during an initial (exploratory) phase, the results of which informed the second (explanatory) phase. Each phase of the research was treated as an embedded single-case design, comprising several units of analysis to bind the case by specific points in time.

Data were collected at multiple levels during the two phases of the research, including the classroom, school principal, teacher, and student, using a range of qualitative and quantitative methods. The quantitative methods are viewed as auxiliary in the predominantly qualitative study. Multiple strategies were employed to ensure the trustworthiness of the study. Data were collected, integrated and analysed during both phases, followed by a final interpretation of the entire analyses to answer **RQ1** and **RQ2** and to present overall findings and results. The analysis, findings and conclusions are discussed in the chapters that follow.

6 Data Analysis and Results

6.1 Introduction

This study is centred on the documentation and critical evaluation of the iterative design, development and implementation of a programme, delivered over an extended period of four years, to support teachers to use a technology-mediated team-based model of 21st century learning in the post-primary classroom. The iterative design of the intervention is described in Chapter 4. Chapter 5 described the mixed methods approach, encompassing two phases of research (exploratory and explanatory), underpinned by a pragmatic philosophy within an overall methodology of design-based research. This chapter presents an account of the data analysis process for both phases of the research and describes the key results.

Two primary research questions underpin the study. The first question (**RQ1**) seeks to explore whether the Bridge21 learning model has the potential to be transferred from its original use in the context of a laboratory classroom setting (the university outreach project) into the authentic setting of post-primary schools in Ireland. The question is divided into two parts:

> **RQ1(a)**: What are the primary factors that affect the use of the Bridge21 learning model in the post-primary classroom?
>
> **RQ1(b)**: How does participation in such learning experiences affect the development of students' 21st century skills?

The second question (**RQ2**) focuses on developing a conceptual framework for a school-university partnership aimed at supporting teachers to adopt a 21st century learning approach to the post-primary curriculum using the Bridge21 model. The two parts of this question are as follows:

> **RQ2(a)**: What are the key elements of a school-university partnership framework designed to support teachers to use the Bridge21 model of technology-mediated team-based learning in the post-primary classroom?
>
> **RQ2(b)**: How do the defining features of the framework, including the approach to PD, facilitate teachers to use this model to teach the curriculum and to increase their provision of 21st century learning experiences for their students?

The research questions were explored simultaneously throughout both phases of the study. The mixed methods design facilitated the collection and analysis of qualitative and quantitative data at multiple levels during an initial

(exploratory) phase, the results of which informed the second (explanatory) phase. These analyses will be followed by a final interpretation of the findings to answer **RQ1** and **RQ2** and to present overall results and conclusions (in Chapters 7 and 8).

The two phases of the study are used to structure this chapter. Firstly, an account of the research aims, context, data analysis and key results of the Exploratory Phase is presented in Section 6.2. The same headings are used in Section 6.3 to provide a description of the Explanatory phase. The chapter concludes in Section 6.4 with summary of the key results and findings from both phases, to be discussed in greater depth in Chapter 7.

6.2 Exploratory Phase

The exploratory phase of this study sought to investigate whether the Bridge21 learning model had the potential to be transferred from its original use in the context of a laboratory classroom setting (the university outreach project) into the authentic setting of post-primary schools in Ireland. Chapter 4 described the intervention design, which included three school-based scenarios for integrating the Bridge21 model, a draft set of teacher resources, a detailed programme schedule and the preliminary model of PD. Data gathered from an initial pilot (2010-11) and launch of a formal programme in Year 1 (2011-12) formed the basis of this initial stage of the research.

This section begins by describing the aims (Section 6.2.1) and setting the context of the exploratory phase (Section 6.2.2). Thereafter, the collection and analysis of data are described in Section 6.2.3 (Qualitative) and Section 6.2.4 (Quantitative). The emergent themes from the qualitative data analysis are combined with the quantitative data and presented in Section 6.2.5 as overall results of the exploratory phase. The main findings are grouped under three key headings: students, teachers, and programme design, including how the programme is operationalised and refinement of the PD model. The section concludes in Section 6.2.6 with a summary of this phase and sets the context for the next phase of research.

6.2.1 Exploratory aims

The preliminary model of PD, school-based scenarios and draft teacher resources, presented in Chapter 4, formed the basis of an exploratory programme of engagement with schools to begin to trial the extension of the Bridge21 learning model beyond its use in the context of a university-based outreach intervention. A programme schedule, totalling approximately 50 hours

of workshop delivery and support services, guided the delivery of the intervention in each of the first wave of 8 schools. The aims of the exploratory phase were to:

1. Explore ways in which the learning model could be used and/or adapted to deliver curriculum content in the post-primary classroom.
2. Gather evidence to illustrate students' and teachers' experiences and views regarding the use of the model in an authentic setting.
3. Identify whether the learning model could support the development and acquisition of 21st century skills in students.
4. Identify teachers' PD needs and refine the model of PD.
5. Develop a repository of best practice learning activities and resources that could be used in the second (explanatory) phase of research.
6. Generate and refine questions for the next stage of research.

Within the above aims, there is a particular focus on **RQ1** and its associated parts, which seek to explore whether the Bridge21 learning model has the potential to be transferred from its original use in the context of a laboratory classroom setting (the university outreach project) into the authentic setting of post-primary schools in Ireland. Data gathered during an initial pilot (2010-11) informed the launch of a formal programme in Year 1 (2011-12). Further detail on the context of this phase of the research is provided below.

6.2.2 Context

During the 2010 -11 school year, a pilot programme was developed to explore and trial the extension of the Bridge21 learning model beyond its original conception in a university laboratory classroom setting. This development occurred against the backdrop of policy developments in relation to ICT education and 21st century skills, and recent findings emerging from the field of research on education reform in Ireland (NCCA 2008; 2009b; 2010a; Hogan et al., 2007). Five schools, with a total of 20 teachers and 100 students, participated in initial trials to explore how the Bridge21 model (or elements thereof) could be used to deliver the curriculum in the post-primary classroom. Results of this pilot informed the launch of a formal programme in the following year (2011-12) with an extended group of eight partner schools, involving a total number of 35 teachers and 330 students. A detailed account of the school profiles was provided in Chapter 5 (see Section 5.8.1).

Teacher participation in the programme was voluntary. Following initial meetings and agreement from the school principal, the Bridge21 team were invited to facilitate a whole staff seminar at the beginning of the year to present

an overview of the learning model and the goals of the programme. From this, teachers were invited to volunteer to participate in the programme. The minimum requirement for participation in the programme was 1 teacher per school, with a maximum of 12. All subject areas were welcome to participate in the programme. In most schools, an average of 5 teachers were involved. Students of the participating teachers who were in 1st Year classes were the target group of learners, in order to position the research in the context of the wider education system reform programme. All teachers participated in a minimum number of 2 professional learning activities and workshops throughout the academic year, based on the preliminary model of PD described in Chapter 4. The programme schedule was used to guide and sustain interaction and engagement between the schools (teachers, principals and students) and Bridge21 programme staff throughout the academic year.

The timing of the launch of Year 1 of the programme is significant as it coincided with the establishment of the JCN by the NCCA - a group of 49 post-primary schools from across Ireland who applied and were selected to initiate change within their schools at Junior Cycle and subsequently share their experiences, ideas and resources with others in the initiative. This study followed a similar approach to the NCCA of creating a pool of 'early adopters' (Rogers, 1995) - students, teachers, principals and learning communities who would be role models and reference points for an expansion of the study to the 'early majority' in the explanatory phase (Years 2 and 3). It is important to note that some of the Bridge21 participant schools were also members of the JCN. This had implications for the research context, data analysis and results. Although there were some commonalities between the two programmes, there was a greater depth of engagement in the Bridge21 programme schedule for partner schools (as described in Section 4.2.2) and the NCCA JCN programme was lacking in practical models and approaches to teaching and learning in the post-primary classroom.

These two years of the programme (Pilot & Year 1) form the exploratory phase of the research. Figure 6-1 summarises the design and methods of this phase. Within an overall framework of a multiphase fully integrated mixed methods design, the exploratory phase is qualitative dominant (QUAL+quan). An opportunistic sample of schools, teachers, and students who participated in the Pilot and Year 1 was the lens through which QUAL+quan data gathered through multiple methods were explored. This sampling design allowed the researcher a degree of flexibility to explore and reflect on initial results emerging from the intervention. The collection and analysis of data from the

sample of participants are now described, firstly qualitative data (Section 6.2.3), followed by quantitative data (Section 6.2.4).

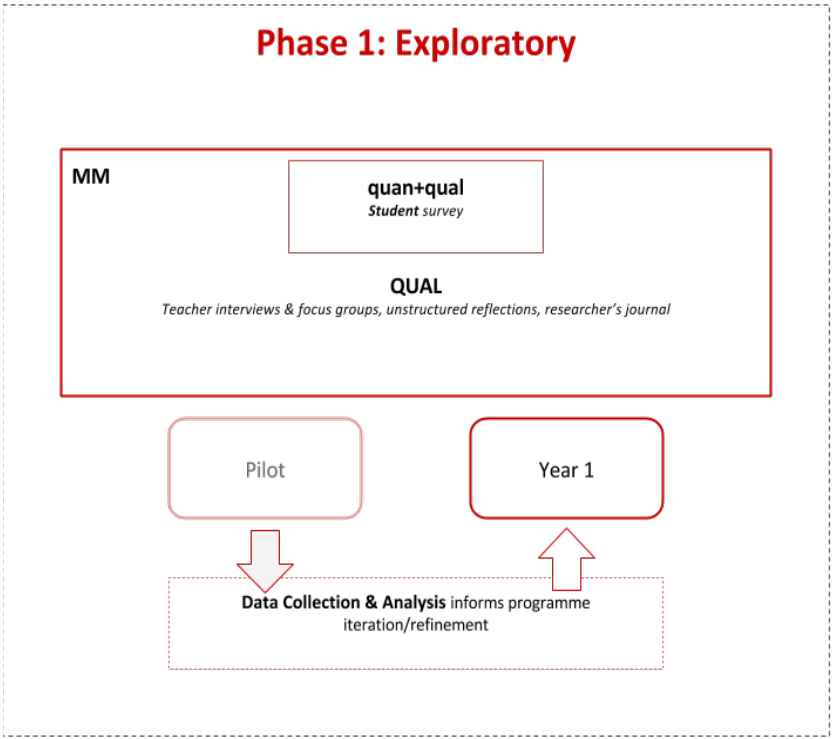

Figure 6-1 Exploratory Phase Design

6.2.3 Qualitative data collection and analysis

As discussed in Chapter 5, the methods utilised to collect data include questionnaires, interviews, observations and other qualitative documents including written reflections and the researcher's journal. These methods yielded qualitative data that were analysed to address the specific aims of the exploratory case study stated above.

Teacher experiences and views of the programme were captured through individual and focus group interviews conducted either at the end of a Bridge21 learning activity or at the end of the academic year. A total of 5 interviews were conducted involving 15 teachers (via a combination of individual and focus group interviews). Data were also gleaned from unstructured reflections and observations written by a sample of teachers (n = 6).

A pre-post questionnaire was designed during the pilot year, loosely based on the questionnaire design utilised in the laboratory classroom setting to capture data on students' overall experiences and learning outcomes (Lawlor et al., 2010; Tangney et al., 2010). Analysis of responses (n = 34) was used to reiterate

and refine a pre-post questionnaire that was administered to a total of 134 students from an opportunistic sampling of 2 schools during Year 1. Comments and responses to open-ended questions in these questionnaires yielded qualitative data and insights into students' overall experiences and views of the programme. Separately, unstructured student reflections (n = 53) also yielded qualitative data in respect of students' direct experiences of the Bridge21 model and views of the programme.

Throughout the Pilot and Year 1 of the programme, the researcher kept a log of school visits, classroom observations, informal meetings with teachers, and reflections on the iterative development of the programme via a research journal. A total of 46 log entries (Pilot: n = 26; Year 1 n = 20) were recorded during this phase of the research. These notes and reflections provide an additional source of qualitative data for analysis.

Table 6-1 (see p.140) shows the four primary qualitative data collection methods used during the exploratory phase and the corresponding numbers of responses (n) from participants. The process of analysing these data was an iterative one, whereby the analysis, interpretation and data collection processes were merged throughout the exploratory phase (Gibbs, 2008). Content analysis is a sophisticated approach to eliciting meaning, patterns and connections in data (Zhang and Wildemuth, 2009). As discussed in Chapter 5, conventional content analysis is an exploratory technique and is thus suited to the aims of this phase of the research. Beginning with open-ended observation, codes were derived from the data and were refined during data analysis process (Hsieh and Shannon, 2005). An open coding process facilitated the researcher in making sense of the qualitative data, exploring patterns and identifying emergent themes for closer examination during the second, explanatory phase of the research.

Method	**Respondents**	***n***
Interview	Teachers (group, individual)	15
Pre-post questionnaire	Individual students	134
Unstructured reflections	Students Teachers	53 6
Research Journal entries	Researcher	46

Table 6-1 Exploratory phase - summary of qualitative data

As described in Chapter 5, the qualitative data analysis software package Nvivo10 was used to support the data analysis process. Qualitative data from the multiple methods outlined in Table 6-1 were imported into NVivo and the software's coding functions were used to conduct conventional content analysis. The open coding process was formalised by the development of a coding scheme, shown in Table 6-2 (see p.142). For each code, a definition and list of key words are provided. The development of a transparent coding scheme helps strengthen the trustworthiness of the content analysis process (Folger et al., 1984).

6.2.4 Quantitative data collection and analysis

Quantitative data gathered from students during the exploratory phase of the research were treated as auxiliary to the qualitative data (which is predominantly teacher-focussed) in order to facilitate further exploration of emergent themes. A pre-post questionnaire (described in 5.7.2, p.114), administered to a total of 134 students from 2 schools at the mid and end points of Year 1, contained scales relating to three key skills, which were identified for focussed study based on analysis of data from the Pilot year and a comparative analysis of the elements of the Bridge21 model and the proposed key skills of Junior Cycle (NCCA, 2011b) (described in Section 5.7.2). Within these three key skill areas, a total of eleven elements of the skills were explicitly examined in the pre-post questionnaire with students. Each skill was examined through multiple questions to increase validity and reliability of results, and the pre-post design facilitated measurement of potential changes in student experiences and views over time (Johnston et al., 2015; Conneely et al., 2013).

The complete pre-post questionnaire is provided in Appendix 5.2. Student responses were collated and analysed using SPSS. Paired sample t-tests and Cohen's d calculations were undertaken to examine differences and effect sizes in students' responses across questionnaire items designed to measure particular elements of each of the key skills. Table 6-3 (p.144) shows a summary of the effect sizes and differences for the key skills.

Category	Description	Codes	*n*
PD experience & design	*Data relating to the overall design and experience of the PD model and school-university programme of engagement*	Consistent approach; courage; Peer learning; need; support; inter-school collaboration; teacher as learner; teacher motivation; vision	33
Learning activity design	*Data relating to the process of designing Bridge21 learning activities in the classroom.*	Challenge of assessment; implementation experience (neg); learning process; learning product/outcome; learning space design; lack of structure; planning; out of school (pos.); project-based (pos. & neg.);	42
Learning outcomes	*Data relating to the learning outcomes from Bridge21 learning activities and the impact on students*	21C skills; curricular links; learning outcomes (neg.); attendance (pos.); peer assessment; creativity; sustained use of the model	44
Overall experience	*Data relating to teachers' and students' overall experiences of the programme and Bridge21 learning model*	Learning model (pos.); student enjoyment; teacher enjoyment;	20
Role of the teacher	*Data relating to the role of the teacher when using Bridge21 in the post-primary classroom*	Trust; peer teaching; student-teacher relationship; teacher: (lack of) control; teacher perception of student ability;	47
School culture	*Data relating to the impact of existing school culture on the use of Bridge21 in the post-primary classroom*	Attitude to change; fear of change; teacher leadership; noise = negative;	16
School organisation	*Data relating to the impact of school organisation on the use of Bridge21 in the post-primary classroom*	Timetable; Teacher preparation time;	17
Student engagement	*Data relating to overall student engagement in learning via the Bridge21 model (perspective of teachers and students)*	Behaviour (pos.); Behaviour (neg.); class dynamic; student-student relationship; student attitude to the model; student autonomy; student perception;	53
Teamwork	*Data relating to teacher and student perception of teamwork as a core component of the Bridge21 model.*	Teamwork (pos.); Teamwork (neg.); student training; challenge; ability; team selection; team roles; curriculum (pos.)	88
Technology	*Data relating to teacher and student perception of technology as a core component of the Bridge21 model.*	Technology (pos.); Technology (neg.); Lack of resources; motivation; student attitude (pos.); teacher fear of technology; technology as a distraction	26
The system	*Data relating to the impact of the wider education system on the use of Bridge21 in the post-primary classroom*	Comparison to traditional teaching/learning; context; education system (neg.); pressure of syllabus	26

Table 6-2 Exploratory Phase qualitative coding scheme

As shown in Table 6-3 (see p.144), a significant statistical difference was found for six elements across the three key skills: *'Exploring options and alternatives', 'Implementing ideas and taking action', 'Co-operating', 'Using ICT to work with others',*

'Using information to solve problems and create new ideas' and *'Thinking creatively and critically'*. A Cohen's d calculation for each one yielded modest effect sizes. For example, a paired sample t-test of the mean difference pre-post across questionnaire items measuring the variable '*Using ICT to work with others*' resulted in a *t* of 2.6 at a significance level of .001, which may be considered statistically significant. A Cohen's d calculation yielded an effect size of 0.31, which may be considered a moderate effect size. Although the effect sizes are moderate, this is considered notable in educational research of this kind in naturalistic settings (Cohen, 1988; Elliot & Sammons, 2004; Lipsey et al., 2012). Of the 11 elements of the key skills examined in the pre-post questionnaire, five show no statistically significant evidence of difference in means or gain as measured by the statistical tests. The results highlight an unexpected negative difference in means in relation to '*Learning creatively*'; however, this is not found to be significant. No or minimal differences are observed in relation to four other variables (*'Contributing'; 'Learning with others'; 'Gathering, recording, organising and evaluating information'; 'Reflecting on and evaluating my learning'*).

Further analysis shows that students report an increase in frequency of team-based learning activities, with a statistical difference of .292 on a 5-point scale ($t = 2.315$, $df = 112$, $p < 0.05$). Student responses also indicate their belief that working collaboratively with other students helped them learn (average increase of .431, $t = 2.315$, $df = 112$, $p < 0$ .05) and that they learned from working as part of a team (average increase of .414, $t = 3.067$, $df = 110$, $p < 0.05$). These data indicate positive changes in both the quantity and impact of team-based learning as an integral component of the Bridge21 programme in their schools. Finally, descriptive tests show that there was a reported increase in the frequency of ICT use in classes as a result of the school's engagement in the Bridge21 programme. The mean response of students to the question '*I used ICT to help me work with others on a task*' in the pre-questionnaire was 1.78, indicating on average that ICT was used 1-2 times per month. Responses in the post-questionnaire suggest mean usage of 2.12, or 1-2 times per week ($t = 2.163$, $df = 101$, $p < 0.05$).

Key Skill	Element	Mean Difference	SD	t-value	Effect size *r*
Being Creative	**Exploring options and alternatives**	0.27	0.87	3.40	**0.32**
	Implementing ideas and taking action	0.14	0.56	2.90	**0.26**
	Learning creatively	-0.06	0.48	-1.43	0.13
Working with Others	**Co-operating**	0.22	1.10	2.16	**0.23**
	Contributing	0.04	0.58	0.67	0.06
	Learning with others	0.12	0.93	1.40	0.15
	Using ICT to work with others	0.34	1.32	2.60	**0.31**
Managing Information and Thinking	Gathering, recording, organising & evaluating information	0.12	0.82	1.68	0.17
	Using information to solve problems and create new ideas	0.11	0.61	2.02	**0.21**
	Thinking creatively and critically	0.12	0.51	2.63	**0.24**
	Reflecting on and evaluating my learning	0.00	0.57	0.67	0.02
Calculations based on participant responses $n = 134$					

Table 6-3 Differences & effect sizes in student key skills (Johnston et al., 2015; Conneely et al., 2013)

6.2.5 Results of exploratory phase

Findings – Programme Design

All schools opted initially for the **single subject scenario**, as it presented the least number of logistical challenges, caused minimum disruption to the regular timetable and most closely aligned to teachers' existing practices and the prevailing school culture (Zhao et al., 2002). The merits of this approach were that it also gave teachers the opportunity to explore and develop confidence using the components of the Bridge21 model within the comfort-zone of their own subject area and within a familiar time frame. Examples of how teachers adopted the Bridge21 model (or components of it) in their subjects, within the regular timetable are outlined in Table 6-4. The examples incorporate a wide range of subject areas from all participant schools in the exploratory phase, reflecting a diverse group of participant teachers.

These examples show that within their subjects many teachers made use of a range of technologies to encourage resource and material sharing amongst students and to support on-going collaboration between students, particularly in project-oriented tasks. Furthermore, teachers made use of the technologies to give students autonomy over their work and assignments and to encourage peer feedback.

Task	Details	Subjects
Research, create & share a study document for your peers	Each team is given a different part of a chapter to research, both in their textbooks and on the internet. They are required to write up notes, find images & collaborate together to create a document online (using Google Docs). This is then shared and presented to the other teams.	Geography; Science; History; Home Economics; R.E.;
Write a character study/thematic blog post	Each team is allocated a different character or theme from a play/novel/short story. They have to write a blog post which captures the key points of that character/theme & share with the rest of the class. The task ends with final presentations to other teams.	English; Irish
5-minute movie	Teams are challenged with the task of writing a script, acting, filming & producing a 5-minute version of a play/novel/short story. Can also be done as an animation. The task ends with a final screening of all the movies	English; Foreign Languages
Design a Festival Poster	Each team is asked to choose an annual holiday/festival. They then conduct research and compile a list of vocabulary & other information. They then choose how they want to represent it in visual format to communicate the meaning & spirit of the particular festival (i.e. a poster or other piece of artwork). The task ends with final presentations to other teams & peer feedback.	Irish; Foreign Languages
Promotional video for local business	Each team is asked to choose a business in their local area. They conduct background research using their textbooks & the internet. They compile questions & set up meetings/interviews in preparation for a field trip/site visit, during which they capture video footage, photographs & collect additional information. Use all data to create a 3min video to promote the business, which is presented to other teams.	Business Studies; Geography

Table 6-4 Examples of activities designed by teachers - single subject scenario (Conneely et al., 2012)

Only one of the eight schools from Year 1 opted for the **integrated curriculum scenario**. Having built up a term's worth of experience using elements of the Bridge21 learning model in their individual subjects, a group of teachers in School E came together to design, create and implement a cross-

curricular project, integrating the subjects of Geography, Art, Home Economics and Physical Education. This scenario required a significant commitment from both the teachers themselves in preparation work and planning time, and also from the school principal to re-design a 4-hour block of the timetable on Wednesdays to allow the project to be implemented. An overview of the project is detailed in Table 6-5.

Project Title:	The Changing Landscape of Our Local Area
Description of task	Students were given a specific topic to explore under the headings of past, present & future (e.g. fashion, food, architecture, pastimes etc.) They were required to research and create the following to tell the story of how their topic had evolved from the past into the present & a prediction of how it might change in the future: ● A visual display (e.g. a model, role-play or demonstration, a poster) ● A 3-minute video ● A PowerPoint presentation ● An information factsheet
Subjects	Geography, Art, Home Economics & Physical Education
Time Allocated	Project implementation: 4 hrs @ week over 6 weeks Planning: 1 hr meeting @ week over 4 weeks before project Review & evaluation: 1 hr meeting @ week during project & 2 hour meeting after project
Format	Week 1: Introduction to project, team formation, initial brainstorming & planning activities Week 2: Field trip - visit to local area & Science Gallery, TCD Week 3: Research & review of information collected on field trip Week 4: First draft of factsheet, presentation & video content Week 5: Second drafts & presentation preparation Week 6: Presentations & showcase of work

Table 6-5 Bridge21 activity - integrated curriculum scenario (designed by teachers in School E)

Whilst only one school opted for the fully integrated curriculum scenario as outlined in Chapter 5, it should be noted that other variations of this scenario emerged during the exploratory phase. In all schools, there was evidence of groups of teachers conducting cross-curricular projects with 1st Year classes

without making changes to the regular timetable. For example, in School F the Music and Irish teachers worked together to design a team-based project that involved writing, composing and recording Irish language songs for 'Seachtain na Gaeilge[12]'. Teams were also given the added challenge of scripting a short movie to accompany their song. This project was implemented within the confines of normal 40-minute class scheduling. A further variation on the integrated curriculum module occurred in School C. The learning activity involved a group of teachers who came together to develop a 7-week cross-curricular project, which was implemented within the confines of normal 40-minute class scheduling. Details of this project and the assessment criteria are shown in Appendix 6.2.

Only one of the eight schools from the 2011-12 programme opted for the **thematic curriculum scenario**. Staff identified 4 weeks in the year, where the timetable would be suspended and students would engage in thematic weeklong projects, culminating in a presentation/public showcase. Examples of themes and project details are in Appendix 6.2. It should be noted that, in other schools, without making changes to the regular timetable and class schedule suggested above, groups of teachers managed to implement immersive, thematic projects. For example, in School A, a group of teachers designed a 2-week project centred on the theme of the 100th anniversary of the Titanic (inspired by a literacy competition as part of the Junior Cycle School Programme[13]). Week 1 was spent in school, where teachers integrated the theme into their subject areas, as per the regular timetable. The subjects included History, Geography, Art, Maths, Home Economics and English. Week 2 was spent at the Bridge21 learning centre, where students had an opportunity to choose a particular area of interest to them and engage in an immersive project, using the knowledge they had gained via their subjects the previous week. The student work output from this creative, active project included short films, physical models, creative writing (short stories, journal entries and "letters home" from various characters) and a statistical analysis of the passenger numbers on the boat.

Approximately half of the schools that began with the single subject change scenario at the beginning of the year progressed to integrated curriculum and/or thematic modules towards the latter stages of the year. This suggests

[12] Seachtain na Gaeilge is the most popular celebration of our native Irish language and culture in Ireland and many other countries every year. See snag.ie

[13] The Junior Certificate School Programme targets lower secondary students in Ireland who are identified as being at risk of early school leaving, perhaps without completing lower secondary education.

that the use of the Bridge21 model in the classroom encouraged teachers and principals to examine and reflect on the type of learning experiences they wanted their students to experience and the learning outcomes (both subject content and key skills) they wanted their students to achieve.

Findings – Student experiences

96% of student questionnaire respondents described the Bridge21 approach to learning as excellent or good, which suggests an overall positive experience with the programme. When asked, in the post-questionnaire, to describe in their own words a class that they enjoyed in the past month, responses indicate that interaction with peers and the teaching method were key factors in why students enjoyed a particular class, as evidenced by the sample quotes below:

> *"I enjoyed science class because we worked in groups and made plays to show off what we knew about cells ... I liked it because it was a fun way of finding out what I know"*
>
> *"I enjoyed my English [class] ... I enjoyed working as a team the most"*
>
> *"The second day involved more teamwork which was great … it involved a lot of teamwork and planning but it was so much fun and so much learning"*
>
> *"A class I enjoyed during the month is maths. In this particular class we worked on chance. Normally I wouldn't particularly like learning about chance. But, in this class we worked in pairs, recording what coloured discs we pulled out of a bag. I really enjoyed this class because I got to work with my friends."*

These responses, collected via the post-questionnaire, suggest that Bridge21 was viewed by students as an engaging way of learning and are in direct contrast to comments captured in the pre-questionnaire relating to students' reasons for disliking school, such as: *"Sitting listening to teacher go on and on and on"* and *"No interactive learning"*. Similarly, a pre-questionnaire comment that "*I don't like sitting at a desk for the whole class*" contrasts with post-intervention responses that "*we interacted with everyone*" and learning "*about loads of new things in a fun way*". These contrasting views illustrate the extent to which participation in Bridge21 learning activities seemed to alter students' perspectives on school, with the frequency of words such as 'exciting', 'fun' and 'learning' suggest increased levels of motivation to engage positively with school and their own development. The results are similar to those reported by Lawlor et al. (2016) and Lawlor (2016) which suggest that participation in workshops in the

laboratory classroom setting have a positive impact on student's perceptions of learning and their intrinsic motivation.

The statistical interpretations presented above were consolidated by conventional content analysis of qualitative data yielding from student responses to open-ended questions regarding the development of key skills. Comments such as *"I use the brainstorm activity when I don't know what to do", "I completed a task in different ways"* and being *"open to other ideas"* are consistent with the quantitative results relating to the variable '*Exploring options and alternatives*' presented above. The data suggest an increased awareness amongst participant students that skills learned through participating in an activity or solving a problem could be transferred to subsequent activities or problems. Given the emphasis on cross-curricular and project-based learning in the Bridge21 model, this is an important finding.

Analysis of responses to the open-ended question asking students to report the three skills they had learned during the Bridge21 programme reveals that '*Working with others'* was the most frequently reported key skill (n = 102, 76% of respondents). Student responses include: *"Working in groups with more independence than a normal class"* and *"We helped each other"* and *"[....] not being by myself"*. The data suggest that through engagement with Bridge21 students developed key elements of the *'Working with others'* skill. For example, comments coded as the '*Co-operating'* element include: *"I learned how to cooperate with my team"* and *"It helped me learn to cooperate with others"*. Comments coded as the *'Contributing'* element suggest that the structured team-based approach of the Bridge21 model allowed students to be active, participatory learners who contributed to their teams and benefited from the contributions of their peers. For example:

> *"Everyone's ideas are better than one"*
>
> *"It helped me have more ideas when constructing a task"*
>
> *"It involved a lot of teamwork and planning, but it was so much fun and so much learning"*.

The high frequency of responses coded as '*Working with others'* suggests that students perceive teamwork to be a key element of the Bridge21 learning model.

Content analysis shows that several other key skills were strongly referenced by students in qualitative comments (with a frequency of 20 or more), such as '*Reflecting on and evaluating my learning*' (n = 33), and '*Co-operating*' (n = 25). Other skills that were strongly referenced by students included some that were not

explicitly examined in the questionnaire, including: '*Being creative through ICT*' (*n* = 20) and *'Imagining'* (*n* = 22).

Beyond the core elements of the key skills that were investigated in the pre-post questionnaire, student comments highlight that other elements, such as '*Relating effectively and resolving conflict'* and *'Respecting difference'* were developed through engagement with Bridge21. For example:

> *"I didn't have the best experience in Bridge21 because of my group, but I did learn how to work in a team in these situations better."*
>
> *"How to work with different people."*
>
> *"I personally learned more about compromise."*

These comments are evidence of what the students knew and were able to do in respect of the *Working with others'* key skill at the time of the post-questionnaire. Additionally, in their explanations of how to work effectively as part of a team, students strongly reference elements of other key skills, such as '*Communicating'* and '*Managing Myself*', stating that they learned competences such as time management (*"I learned how to work in teams and put a time limit to my work"*), planning, setting and achieving goals (*"We first as a team planned it all out"*), and listening and expressing themselves (*"I've learned to listen more"*).

As described in Chapter 3, technology as a means to mediate learning plays a central part in the Bridge21 model. Quantitative data analysis, described above, shows that there was an increased frequency in student ICT use in classes as a result of the school's engagement with Bridge21. This result is validated by qualitative data relating to the positive influence of ICT. Student comments show that they became more knowledgeable and confident with computers (*"improving skills on computers", "I've learned more about technology"* and "*use ICT responsibly in a school environment"*), and ICT facilitated engagement with learning ("*It made learning fun working with computers", "helped me see that computers are a great way of learning"* and *"That you don't always need books to learn"*).

In summary, analysis of qualitative and quantitative data indicates that students responded favourably to the Bridge21 model of learning. It appears that the particular element of teamwork resonates very positively with the students. There is evidence of improvement in student awareness of developing some of the key 21st century skills under investigation.

Findings – Teacher experiences

Data yielding from teacher interviews and written reflections indicate, while there were some challenges, they generally perceived a range of benefits to their students who participated in the Bridge21 programme. These benefits relate to curriculum or subject-specific learning outcomes and also to the acquisition of 21st century skills. Teachers strongly reference students' increased depth of understanding and recall of subject topics:

> *"It was really fantastic, they really enjoyed it and they all knew the story that we'd studied and they could all understand it to a much deeper level than would normally happen in a first year class" [English class]*

> *"I was asking the students did they understand the word 'landscape' ... and I thought now I have to explain this and then one of the students put up her hand and said 'oh yes Miss, the Bridge21 project we did' – she understood the word and was able to explain it to the rest of the class." [Geography class]*

Two teachers felt that the success of a Bridge21 learning activity was largely dependent on the subject topic, with one commenting that *"some topics [in Maths] lend themselves better to it than others"*. Five teachers observed that students appeared to make faster progress with subject content when working as part of a team. This worked well for those teachers who were somewhat concerned initially regarding the amount of time required to invest in training students how to work and learn effectively as a team, at the perceived expense of time spent delivering the curriculum. However, this investment was deemed to be worthwhile when teachers saw evidence of increased student engagement and motivation, which in turn led to progress in subject content.

Data analysis showed that almost half of the teachers (n = 7) perceived their students to have developed a variety of key skills through their engagement with the Bridge21 model. For example, one teacher commented on how the use of the model encouraged the development of student creativity:

> *"Some of them came up with some brilliant ideas, I wanted to enable them, that was my whole plan. I find sometimes you just end up telling them what to say and they write it down, like you would be telling them to write down anything."*

Another teacher noted how the team-based project-oriented approach of the model encouraged the development of student problem-solving skills and ability to learn autonomously:

> *"Students raised the standards and challenged each other to review work and improve it where they could in a collaborative way. Their self-direction and problem solving was more ambitious than any of my planning would have hoped for."*

Other comments illustrate the development of communication and presentation skills and the teachers' perceived value of evaluating learning via peer assessment:

> *"So they all had to present their work and they got to give each other a grade using criteria that we had agreed beforehand."*

> *"The students assessed each other's work after a presentation and we had agreed on the criteria so we had some elements of assessment for learning."*

> *"Obviously their communication skills were hugely developed and their presentation skills."*

> *"I thought their presentations were really, really good and I thought they all learnt a lot from that."*

However, some teachers (n = 3) noted that poor or underdeveloped presentation skills in students negatively affected the overall learning outcomes of a project, due to lack of practice in how to communicate or present their work. In some instances, student learning outcomes did not adequately reflect the time committed, due to the time available within the current structure of the school day limiting student engagement in the Bridge21 approach to learning. Teachers required more flexibility with break times depending on the activity and concentration levels of the students:

> *"Yeah, like even in their PowerPoints or movies – now I know there was an issue with the technology again for the movie making but in the PowerPoints they didn't portray all that they learnt that day, it didn't come out and it didn't get across to the others."*

> *"Well I think it was a pity because the research was so good – it was probably the best part of the overall project but the finished project or maybe our expectations of the finished project – maybe our expectations were too high – I'm not too sure."*

Yet other teachers noted the value of the presentation element of the Bridge21 model, suggesting that it helped focus students on what exactly they needed to know and understand about a topic:

> *"When they began to do the PowerPoint presentation, then they began to realise more about what parts they'd missed out on."*

"They knew they had to do a presentation but only actually when they were in the 'mode' and action of doing the presentation that they began to realise what bits were missing."

Much of the data suggest that, overall, teachers felt their students benefited from participation in the Bridge21 programme, with a high number of references (n = 38) to positive student engagement and motivation to learn, for example:

"I definitely noticed improved engagement where they were happy to come into class and they were happy to sit down and after a while it stopped taking ages to get started on the work."

"Nobody had to be standing there saying 'come on, you're talking' or 'get on with that' it was just what they wanted to be spending their class time on. It can often be very difficult to get them down to work and especially very quickly without a lot of direction so that was really beneficial."

"Observation will suggest that they are happier, that they are working in a more active way, that they are working harder. Their teamwork skills need a lot of work because they naturally will get into conflicts if they don't get exactly what they want. So that needs time to embed in, but they like it more."

Additionally, some teachers (n = 2) felt that the Bridge21 approach positively affected the classroom dynamic, noting a decrease in discipline issues:

"Definitely working in groups was great – to put students together was brilliant and it really improved the dynamic in the classroom."

"There was absolutely no discipline problems whatsoever. Maybe a student, here or there, getting off task but their peers were quick enough to tell them to get back on task and it wasn't about me coming along to do it."

However, other teachers (n = 2) commented that factors such as absenteeism, discipline issues and technical problems contributed to student disengagement and therefore negatively affected the overall experience for many students. For example:

"It (absenteeism) *really affects the whole group dynamic - it does, like I never had them all in, never had them all in."*

"[...] there was some serious absenteeism, really huge. It is the same individuals, you know, there is a pattern, it is not overall. But apart from those, I had six more, unwilling to work there in class. (..) I am finding it very difficult to do group work with them."

"[…] it was a lot more difficult but again I don't know if that was discipline issues for discipline sake or whether it was because they didn't feel that they were able to be engaged so I don't know whether it was a dis-improved discipline or whether it would have been an issue anyway."

Despite these challenges, teachers generally perceived a range of benefits to their students who participated in the Bridge21 programme and expressed an interest in continuing to use the Bridge21 model beyond the intervention. For example:

"Overall I am a fan and personally used collaborative learning as often as I could."

"I'll continue with them because I've seen such brilliant results and they love it – they really want to learn in this way."

Teachers experienced a personal sense of achievement, satisfaction and PD when, through the use of the Bridge21 model, student engagement improved and student enjoyment of the learning activity was evident:

"It was a group letter - pairs or in groups of three and again they had to go away and research that together and agree on it and there were lots of little arguments about what went in and what got left out and then as part of the final assessment they had a question very similar to the one they worked on and they all performed really, really well in it so that was really encouraging."

"As I said, it can be frustrating at times but to see the improved engagement particularly in the younger students is something that really works for me [...]"

"Everybody chose their subject because they loved it, so if a student is getting that joy out of your subject well then that has to be more inspiring that droning through the course that you've probably become disillusioned with because students are not enjoying it to the level that you do."

Data also indicated that sustained engagement with the model over time improved teacher's confidence levels and they were willing to persist with its use in the classroom, despite initial concerns. For example, one teacher shared that she *"stopped worrying about the impression of the noisy and messy class as I knew from my students and my own evaluation that these were the classes where learning on many levels was taking place."* One teacher identified the sense of achievement in colleagues who had collaborated on a cross-curricular project, stating:

"So the History Department and the Science Department both dedicated twenty percent of their end of year exam to group based projects on some element of the history course for First and Second year, I think where they went away and they had to research themselves and produce whatever - a project, or poster - I think they

could have done a PowerPoint if they wished or whatever, to show they were learning and they were so motivated and even the Science and History teachers have both finished the year on a real high because the students have enjoyed it so much and produced such good work."

Another teacher commented on the value of co-teaching and being able to observe one of her colleagues in the classroom, noting:

"*It was interesting for me for example, to see you Teacher B, to see you teaching, you know, different teaching styles. I found it really interesting.*"

In summary, the analysis of qualitative and quantitative data show that, despite some challenges and initial concerns, teachers responded favourably to their experience of learning and using the Bridge21 learning model. This level of positivity was primarily driven by the overall perception that students benefited from participation in the programme. There is evidence to suggest the importance of the relational approach, as teachers perceived it having a positive impact on student engagement, motivation, and subject learning outcomes. The data also show that increased levels of student engagement and enjoyment of learning in the classroom affected teacher's personal sense of achievement, satisfaction and PD. The findings point to several prevailing challenges and barriers to teachers' use of the model, related to their understanding of the model, confidence levels with particular components (such as technology-mediated learning or teamwork) and difficulties in designing and delivering Bridge21 learning experiences within the constraints of the post-primary curriculum and the formal education system. The refined model of PD and development of additional resources and teaching aids (described in the sections below) are intended to address some of these issues, which required further investigation in the next phase of the research.

Revised Bridge21 practitioner resources

One of the aims of the Exploratory Phase was to develop a set of best practice learning activities and practitioner resources that could be used in the second (explanatory) phase. The resources described here are a key output of this phase of the research and reflect the findings relating to the experiences of students and teachers, described above. The resources were designed post-Exploratory Phase with the intention of supporting teachers to tackle common challenges and issues that arise when the Bridge21 learning model is used in the authentic context of the post-primary classroom in Ireland.

The first resource is a set of practitioner guidelines for planning and delivering Bridge21 learning activities. The guidelines comprise 5 key steps, as follows:

1. **Team pre-selection & composition:**

It is not advisable to allow students to pick their own teams (Michaelsen & Sweet, 2008). The selection of teams should be done by the teacher in advance of a learning activity. Teams should be mixed ability, where appropriate. Team stability should be maintained over a set period of time – at a minimum 4-week – to allow for maximum development at an individual and collaborative level.

2. **First time tasks:**

When the teams are put together (if it is their first time working together) their initial tasks should be to:

- Choose a team name - something that captures the spirit & reflects the unique personalities in their team.
- Write a team Charter - a set of rules/promises (approximately 5) that the team agree together. A whole class briefing beforehand, during which good/bad examples of rules and promises are discussed, is recommended.
- Elect a team Leader - again, a whole class briefing beforehand, during which good/bad examples of leadership are discussed and the teacher gives clear guidelines, is recommended.
- Define team roles – See Appendix 6.3 for more tips on team roles and electing a team leader.

3. **Design of the learning space:**

Consider the design and layout of the learning space to support the collaborative nature of the learning activity. Rearrange the classroom space so that students can easily and comfortably work together, share technology and other resources, and interact easily with their peers. Consider the positioning of the teacher as a facilitator (rather than a direct instructor of the learning) and how the classroom set-up can support increased levels of student-led learning. See samples of classroom layout in Figure 6-2 (p.157). Alternative learning spaces within (and outside of) the school are also worth considering (e.g. the library, general purpose area (GPA), Art & Design Room etc.).

Figure 6-2 Sample classroom set-up (3 schools)

4. **Preparation & planning:**

Plan in advance the resources that will be needed during the learning activity/project. It is important to ensure that all ICT resources are working properly and that there is a backup plan should technical issues arise. Aim for a student-technology ratio that will support the learning model, for example, 1-2 laptops per team of 5 students to encourage collaboration. Time should be invested in developing/revising student teamwork skills before approaching any curriculum-focussed activity

5. Structure of the learning activity:

The following format can be applied to a 40-80-minute class period and makes explicit the key tasks and role of the teacher:

- *Briefing* – The teacher clearly outlines:
    - The task (what is expected of teams & individual students), including subject content and key skills, such as communication etc.
    - The deadline
- *Learning activity in teams* – The teacher scaffolds the learning by:
    - Breaking the activity down into tasks and sub-tasks
    - Identifying team roles & encouraging teams to assign one student to each role
- *Teacher facilitation* – Once the learning activity begins, the role of the teacher is to:
    - Provide strategic guidance and support to the teams
    - 'Orchestrate the learning'
    - Act as a co-learner (especially with technology)
- *Presentation/evaluation* – The teacher encourages high quality output from the learning activity by:
    - *Ensuring focus of presentation/assessment deadline*
    - *Facilitating peer-evaluation*
    - *Allowing students to lead the learning as much as possible*
- *Debriefing* – The teacher facilitates reflection on:
    - The learning activity
    - The nature of the teamwork
    - What to do (differently) next time (Conneely et al., 2012)

This learning activity format is presented below in Figure 6-3 (page 159).

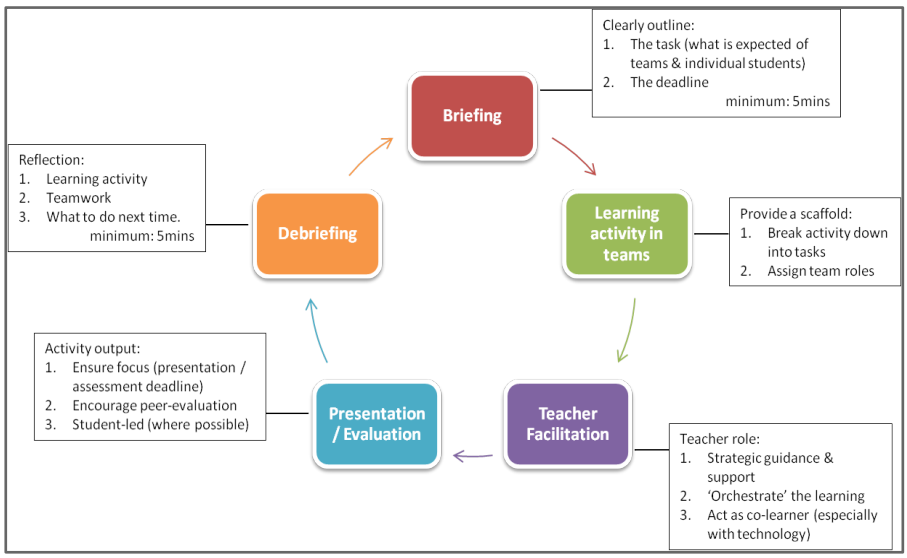

Figure 6-3 Proposed learning activity format (Conneely et al., 2012)

A key finding of this phase of the research is the perception shared by teachers and students of the effectiveness of the particular approach to teamwork in the Bridge21 learning model. Teachers highlighted that students' lack of experience in teamwork limited early implementations of the Bridge21 approach in the classroom. For example, even though students learned how to assign and be responsible for a role within a team, problems arose if teachers, on return to the classroom, did not routinely practice this. As one teacher commented:

> *"We gave out roles to everybody and everybody was assigned a role but I think that the roles were so difficult and unfamiliar to the weaker students ...it didn't really work out."*

Hence, two additional resources were developed to provide teachers with more comprehensive guidelines regarding team selection and team leader selection (see Appendix 6.3).

Additional resources that resulted from the findings of this phase of the research were a project planning template, a project design checklist and a sample assessment rubric – these are included in Appendix 6.3. These resources were developed in response to the finding that the success of a learning activity was highly dependent upon the nature and scope of the project, how teachers interpreted a project theme/title and how the related tasks were structured. In particular, teachers suggested that a narrow and concrete theme that students could relate to was more likely to succeed than a broader and more abstract project, which was less aligned to students' personal day-to-day experiences. The template and design checklist were created to provide teachers with explicit

guidance on how and what to consider when planning a project-oriented, technology-mediated Bridge21 learning activity.

These practitioner resources and best practice guidelines resources formed the basis of a subsequent Teacher Handbook[14] that was developed and published by the Bridge21 programme team in 2013. Further details on how this research informed and contributed to later work are discussed in Chapter 8.

Refined model of PD

A key output of the exploratory phase of the research is a refined version of the PD model. The overall structure of the Bridge21 programme and the design of the PD model during the exploratory phase were focussed on providing teachers with an immersive, hands-on, experiential approach to professional learning. Data analysis shows the importance of supporting teachers to develop and transform their practice through experiencing the Bridge21 model first-hand and observing their students learning in the Bridge21 setting:

> Teacher: "*We started off with by spending a day in here and I think the students really enjoyed it, they could see they had a finished product at the end of it and they all felt like they'd given it their best and that they'd really enjoyed it.*
>
> Researcher: *And were there any benefits for you? Were you here with them that day?*
>
> Teacher: *I was and I got to see them and even students that wouldn't be first to stand up in class really taking an active role, so that was brilliant. So, you kind of saw that they were able for it and that they could do it if they put their minds to it...*"

Teachers noted the benefit of the design of the PD experience and how it helped them and their students be prepared for engaging in the team-based approach of Bridge21 upon their return to school:

> *"When we went back to the classroom, we went straight into the group work project. I think to have that time together as a class and together – me and the class together would make a lot more sense and it would allow the trust to be built because when they go home then to the classroom it's seems to be - they've already done it and the world didn't end."*

[14] See bridge21.ie/resources/

Teachers identified the relational approach as important, stating that in the future they would take time to teach teamwork skills and introduce roles in advance of a Bridge21 learning activity:

> *"I would also spend some time working on teaching group work, teaching how to rely on each other. What's more, I didn't give them particular roles the last time and I'd certainly do that."*

Data also show that many teachers felt there was a need for additional time to be allocated to the PD activities, particularly in relation to technology and teamwork, for example:

> *"I think that there's some more room for – there's kind of a little bit of space – for more training or in-service on to how to use the IT effectively."*

Even for those teachers who rated their ICT proficiency level as high, it was suggested that the PD should focus more explicitly on the particular approach of integrating and using technology to mediate learning:

> *"Well, we'd be fairly proficient in using it – I'd know a fair bit about it but at the same time, it's a different ball game when you're trying to use it for educational purposes and trying to get the most out of it educationally."*

Additionally, despite the 21st century skills-focussed approach to the Bridge21 PD model, defining measures of evaluating key skill development in their students remained a challenge to some teachers, due to a lack of personal experience, understanding and confidence. The data suggest that more time should be allocated to teachers to explore the meaning of 21st century skills and develop a concrete understanding of their application in particular subject areas:

> "*But we had to learn all those skills as we went along as well like they were all new things – they were totally new skills for us."*
>
> *"[We] need support to implement this properly because it is a large step away from where we started where key skills and themes are more important than the minute details."*

One teacher also suggested that more explicit follow up should be part of the programme, with a specific request to allow for more interaction across participant schools:

> *"Perhaps more of follow up is needed. Could teachers produce proof of collaborative work? Maybe a Bridge 21 competition between schools or more links between schools in presenting work?"*

These findings in relation to teachers' experience of PD during the exploratory phase of the research informed the development of a revised version of the model (illustrated in **Figure 6-4**) which retains a strong theoretical foundation by adhering to the original design principles, as described in Chapter 4. In this version, the PD is separated into two distinct phases: Phase 1 is an initial concrete experience of 'teachers as learners' and 'observation of learners' in the Bridge21 model; Phase 2 is an active developmental cycle that includes conceptualisation, active experimentation and reflection. The intended outcome of refining the design in this way is to make explicit the teacher's transition from an initial, exploratory experience to an on-going cycle of development and action in the classroom.

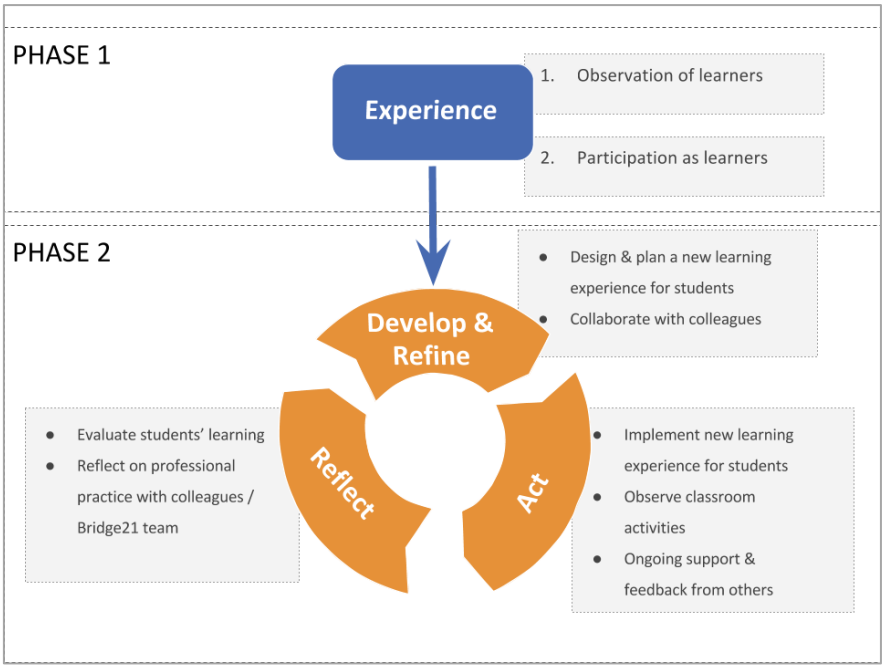

Figure 6-4 Refined model of PD

Conceptualising the initial experience as a distinct phase in the teacher's development reinforces Guskey's (2002) and Clarke and Hollingsworth's (2002) finding that positive changes in student outcomes are a motivating factor for teachers to change their own practice, and the importance of teachers seeing concrete examples of what innovative teaching looks like in practice (Ertmer & Ottenbreit-Leftwich, 2010). Further, it affirms the alignment with Blatchford et al.'s (2003), and Galton et al.'s (2009) relational approach, whereby student teamwork skills are developed over time in a developmental sequence. To this end, learning outcomes for students during the 'observation of learners' session

were specified and made explicit to teachers. The intended learning outcomes were to:

1. Develop a basic understanding of teamwork, collaboration and how to work with peers.
2. Develop a range of ICT skills through participation in 'hands-on' technology-mediated learning activities.
3. Develop a basic understanding of project-based learning.
4. Develop key skills: creativity, communication, working with others, information management & thinking skills.
5. Experience a flexible, collaborative learning space.
7. Increase confidence and positivity about learning.

Phase 1 activities include a presentation to teachers on the background and development of the model, followed by structured observation of their own students participating in a Bridge21 learning experience. Teachers are then provided with an opportunity for structured individual reflection on what they have observed, including identifying any impact the approach to learning had on the learners that they observed. Following this, teachers engage in a reflective dialogue with colleagues to share their experiences and insights. Being able to observe and speak to students ensures that this first experience is personally meaningful and directly relevant to each teacher's context (Girvan et al., 2016).

The three components that comprise **Phase 2** are designed to engage teachers in an iterative cycle of development, action and reflection, focussing on implementing change in the classroom (Wiliam, 2010). This reiteration of the model is designed to emphasise the cyclical nature of the plan-do-review phase and provide a clearer structure to engage with and guide teachers through multiple cycles. This approach is complementary to Means (2010) design of authentic technology-supported interventions as a process of iteration and refinement, whereby those engaged in a collaborative partnership (for example, researchers and schools/teachers) move collectively through iterative cycles of implementation, monitoring, adapting and improvement.

It is argued that the refined model of PD aligns more closely with the overall social-constructivist approach of the Bridge21 model and reinforces Putnam and Borko's (2000) view that professional learning interventions should provide a framework for teachers to engage as active learners who construct their own understanding and awareness of personal challenges, beliefs, needs and capabilities to cope with the changes required.

6.2.6 Summary – exploratory phase

The exploratory phase of this study sought to investigate whether the Bridge21 learning model had the potential to be transferred from its original use in the context of a laboratory classroom setting (the university outreach project) into the authentic setting of post-primary schools in Ireland. The intervention design, described in Chapter 4, facilitated the researcher to explore ways in which the Bridge21 learning model could be used and/or adapted to deliver curriculum content in the post-primary classroom, and to ascertain the nature of PD support required by teachers. Data were gathered through multiple methods with a view to illustrating the general experiences and views of a sample of students and teachers from the Pilot and Year 1 of the programme regarding the use of the model in an authentic setting.

The main finding from the overall analysis of qualitative and quantitative data is that the Bridge21 learning model has the potential to be used in the authentic setting of post-primary schools in Ireland. Data show that teachers and students responded favourably to participation in the programme. The results indicate that the learning model can lead to improvement in students' self-reported development of 21st century skills. Teachers also reported a perceived benefit in student learning outcomes, motivation and engagement in learning. Despite these positive findings, the analysis highlighted a number of issues relating to teachers' PD needs and several challenges pertaining to the constraints of the post-primary curriculum and formal education system.

The analysis informed a reiteration of the PD model design and the development of practitioner guidelines, best practice learning activities and additional teacher support materials. These are the foundation of the subsequent two years of the programme that comprised the second (explanatory) phase of research, which is now presented.

6.3 Explanatory Phase

Having found evidence during the initial phase of the study to suggest that the Bridge21 learning model had the potential to be used in the authentic setting of post-primary schools in Ireland, it became apparent that any future development of the programme and expansion to additional schools would greatly depend on the availability of rich, contextualised accounts of how, what and why the model could be used to teach the curriculum and to increase the provision of 21st century learning experiences for students. Thus emerged the importance of developing a conceptual framework to explore and define the critical elements of the school-university partnership, including a robust model

of PD, and the iterative development of best practice materials, teaching aids and classroom resources.

Data in the explanatory phase come from multiple sources: teacher interviews and unstructured reflections collected during Years 2 and 3 of the intervention, a questionnaire administered to teachers at the end of year 3 of the intervention and interviews conducted with a small sample of principals at one-year post-intervention, to probe deeper into emerging themes and clarify some results.

This section begins by describing the aims of the explanatory phase of the research in Section 6.3.1 and setting the context (Section 6.3.2). Following that, the collection and analysis of quantitative and qualitative data are described in Sections 6.3.3 and 6.3.4. The main findings of the explanatory phase are then presented under the headings of three key themes: teacher's understanding and use of the Bridge21 model and the range of barriers to using Bridge21 in the post-primary classroom. These themes will be explored in greater detail in Chapter 7.

6.3.1 Explanatory aims

The aims of the explanatory phase of this research were to:

1. Determine specific ways in which the learning model is effectively used and/or adapted to deliver curriculum content in the post-primary classroom.
2. Establish a robust practice of PD that can support teachers to effectively use the learning model to deliver the curriculum in the post-primary classroom.
3. Determine to what extent the Bridge21 model can support teachers to increase their provision of 21st century learning experiences for their students.
4. Ascertain whether participation in the Bridge21 programme has the potential to increase engagement in 21st century learning reform at a whole school level.

Within the above aims, there is a particular focus on **RQ2** and its associated parts, which focus on defining a conceptual framework for a school-university partnership to support teachers in adopting a 21st century learning approach to the post-primary curriculum by using the Bridge21 model.

6.3.2 Context

Against the backdrop of continuing policy developments relating to 21st century learning and school reform at post-primary level in Ireland, and the

results from the initial (exploratory) phase, it was decided to expand the programme to a broader and more diverse population of schools. Four schools joined the programme in each of the subsequent years, leading to 12 schools in Year 2 (2012-13) with a combined total of 97 teachers and 546 students, and a total of 16 schools in Year 3 (2013-14) with 160 teachers and 600 students. Similar to the exploratory phase, teacher participation in the programme was voluntary. For continuing schools, there was an emphasis on growing the pool of participant teachers to the 'early majority'. The target group of students was maintained the same, i.e., those of participating teachers who were in 1st Year; however, for continuing schools, teachers were encouraged to extend their use of the model to other year groups.

It was intended that all teachers would participate in a minimum number of 1 cycle of refined model of PD shown in **Figure 6-4**. Again, the programme schedule was used to guide and sustain interaction and engagement between the schools (teachers, principals and students) and Bridge21 programme stuff throughout the academic year. It must be noted that this phase of the research coincided with a significant period of industrial unrest and strike action from some teacher union groups, whose members had particular concerns about some aspects of the Junior Cycle reform programme, teacher pay and cuts in government education budget. In some schools, this affected the level of interaction and engagement between teachers and Bridge21 programme staff.

Figure 6-5 summarises the design and methods of the explanatory phase of the research. Within the overall framework of a multiphase fully integrated mixed methods design, the exploratory phase may be described as QUAL+QUAN. An opportunistic sample of teachers who participated in the programme during Years 2 and 3 was selected as the lens through which to explore the data, along with a purposive sample of principals who completed interviews one-year post-intervention. The collection and analysis of data are now described, firstly quantitative data (Section 6.3.3), followed by qualitative data (Section 6.3.4).

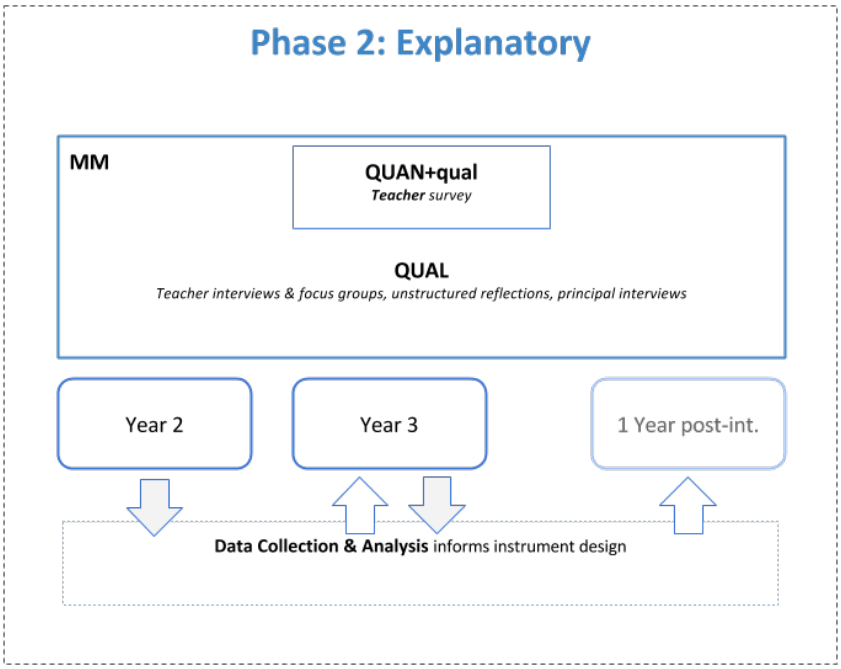

Figure 6-5 Explanatory phase design

6.3.3 Quantitative data collection and analysis

As detailed in Chapter 5, data analysis and findings from the exploratory phase of the study were used to inform the design of a questionnaire administered to teachers during the explanatory phase. The final design is a 60-item questionnaire, comprising a mixture of scaled Likert items and open-response probes, covering five main topics: Background/Participant profile information, Using Bridge21 in teaching, ICT Access and Use, Leadership and Professional Culture, and teacher PD. The questionnaire was made available to participants online in June 2014 (i.e. at the end of Year 3 of the intervention). Communication was sent via email to the full population of teachers (n=160) involved in the intervention at any time between 2010 and 2014 inviting them to complete the questionnaire, with the aim of understanding teachers' engagement with the intervention during the previous three years. The complete questionnaire is available in Appendix 5.3.

The analysis mostly relies on descriptive statistics to provide a detailed report of what has been found in the data. Inferential statistics are used to a lesser extent, due to the small sample size, but do provide some measures from which tentative conjectures can be suggested (Cohen et al., 2013). All responses were collated and analysed using SPSS. Descriptive and inferential statistical tests are carried out, including measures of central tendency, paired sample t-tests,

Cohen's d calculations and Pearson's correlation tests. The results are outlined below, using the five key topics of the questionnaire as headings.

Participant profile information

In total, 55 participants (34% of the total population of teachers who had participated in the programme 2010-14) responded to the questionnaire, with 28 complete responses and 27 incomplete responses. Two of the incomplete responses included school principals – these responses were later removed during the initial preparation of data for analysis. The highest number of responses from an individual school was six (returned by two schools), with a further two schools returning five responses. A broad range of age ranges were represented with the 30-39 years group having the highest representation (36%). Of the respondents, 82% were in full-time employment, with the remaining 12% in part-time roles. 39% of the respondents were male, 61% were female. This compares reasonably well with the national statistic of 68% female and 32% male teachers at second level[15].

Descriptive analysis of respondents' third level qualifications showed that 75% had a Bachelor's Degree and Postgraduate Diploma. A further 39% reported also having a Master's Degree, with 20% citing additional other qualifications, of which 9% had attained Doctorate level. Descriptive analysis of data relating to teaching experience revealed a high number of respondents who had been teaching for 4-10 (33%) and 11-20 years (36%), with a mean (m) of 16.3 years. 44% of respondents reported having spent 4-10 years teaching at their current school (m = 11.7 years). A Pearson's correlation test revealed no link between the respondent's reported use of the model and the number of years teaching (r = .145, p = .405), nor with the number of years teaching at the current school (r = .038, p = .828). Furthermore, there was no significant correlation between teacher's use of the model in their teaching and the date their school joined the programme (r = .185, p = .137).

The questionnaire sample was representative of schools that had joined the programme at different points in time. **Figure 6-6** shows 34% were from schools that had a long-standing relationship with Bridge21, having been a partner in the programme before the current research commenced with a pilot programme in 2010-11. However, a quarter of the teachers who responded to the questionnaire did not know what year their school joined the programme.

[15] Retrieved from the Central Statistics Office (cso.ie) on 1/11/14.

Appendix 6.1 contains additional graphs and tables to illustrate participant profile data described above.

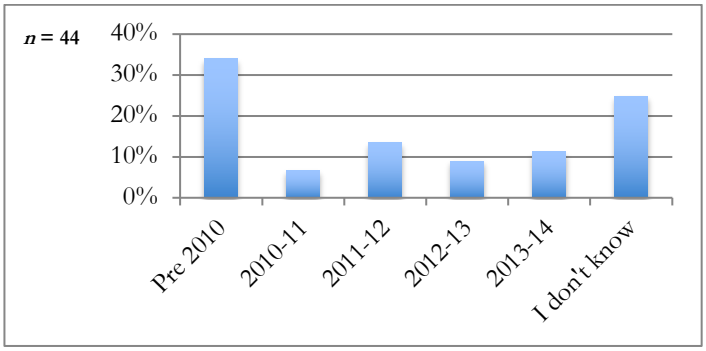

Figure 6-6 Year teacher's school joined Bridge21

Use of the Bridge21 model

Data were analysed to examine how teachers used the model in their teaching. 91% (n = 32) of the sample reported that they used some elements of the model, while only 9% stated that they used the complete model. Analysis shows a somewhat even distribution of reported use of the Bridge21 model across all year groups, with a high proportion of teachers reporting that they use the model with four or more year groups (see **Figure 6-7**). English was the most frequently reported subject (n = 8), with Maths, Science and Irish among the next highest scores. Participants were asked to report on their use of specific components on a five-point scale (from 1=Never to 5 = Daily). On, average the respondents reported using all but two elements on a weekly basis (m = 3.81), with project-based learning (m = 2.9) and learning space design (m = 2.84) being used monthly.

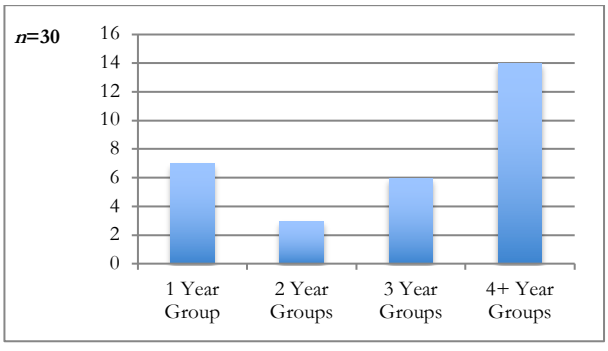

Figure 6-7 Teacher's use of the Bridge21 model by year group

Figure 6-8 shows a high frequency of individual components of the model being used by teachers in their classrooms: 45% teachers reported using teamwork on a weekly basis, with 35% using it daily; 42% of teachers stated that they act as a facilitator in their students learning on a daily basis, with a further 26% doing so weekly; 35% of teachers reported using technology on a weekly basis to mediate their student's learning, with a further 26% doing so daily; 35% of teachers reported that skills are a focus of their student's learning on a weekly basis.

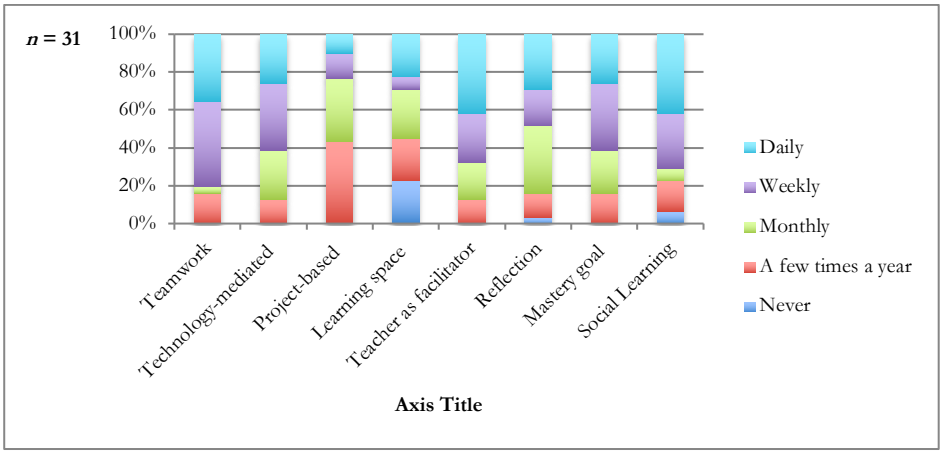

Figure 6-8 Frequency use of model components

Figure 6-8 also shows those components that teachers do not use as frequently in the classroom: the majority of respondents reported using project-based learning a few times a year (43%) or monthly (33%), with only 10% stating that they used it daily; 23% of teachers reported never considering the design of the learning space, with an additional 23% only doing so a few times a year; however a further 23% stated that the design of the learning space was something that they considered on a daily basis. These findings are corroborated by qualitative analysis of data collected via responses to open-ended questions relating to teacher's understanding of the model and their reflective descriptions of a class taught in the last month using Bridge21. These are discussed at length in Section 6.3.4.

60% of respondents stated that Bridge21 was effective as a model of 21st century teaching and learning, with a further 34% stating that it was very effective. The remaining 6% of the sample rated the model as average. **Figure 6-9** shows the mean effectiveness score for each component, e.g. teamwork (m = 4.4), teacher as facilitator (m = 4.3), learning space design (m = 3.5). A closer examination of these frequency scores in relation to each component of the

model is shown in **Figure 6-10**. An independent sample t-test was undertaken to examine whether males and females rated the effectiveness of the Bridge21 model differently. Results showed there were no significant differences in the reported use and effectiveness of all components of the model by male respondents when compared to females (see tables in Appendix 6.1).

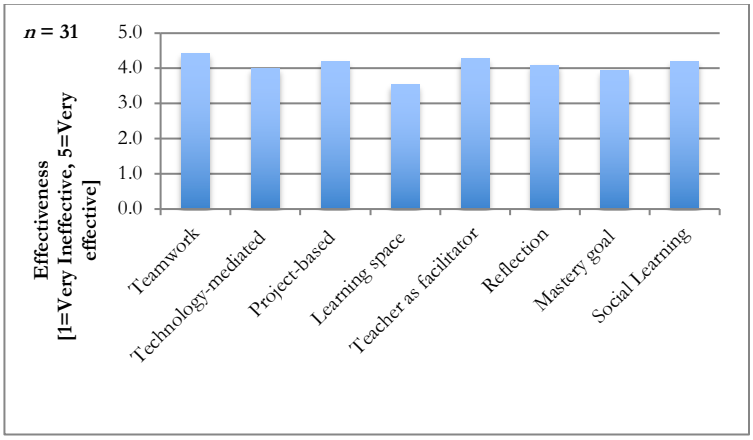

Figure 6-9 Mean scores: Teacher perceived effectiveness of Bridge21

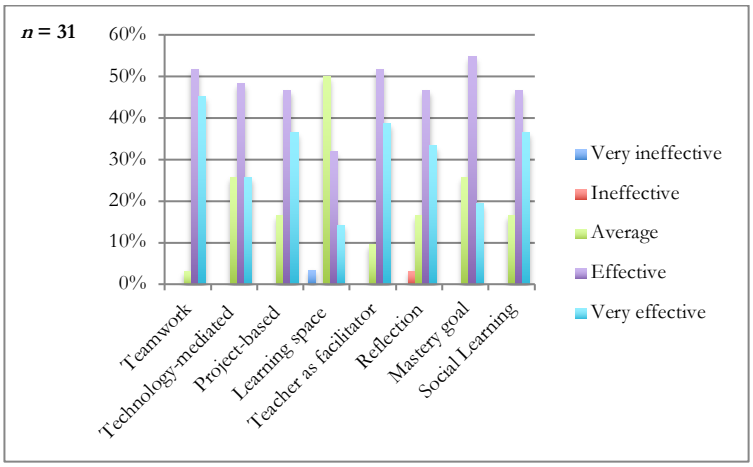

Figure 6-10 Frequency Scores: Effectiveness of the model

Pearson's correlation tests were conducted to explore any links between respondents' perceived effectiveness of components of the model and their reported use in the classroom. There was a significant correlation between teacher's perceived effectiveness of teamwork and its use in the classroom (r = .515, p = .003), similarly for learning space design (r = .614, p = .001), project-based learning (r = .426, p = .021), teacher as facilitator (r = .591, p = .000), skills-focussed learning (r = .633, p = .000) and social learning (r = .408, p = .025). There was a significant correlation between extent to which teachers use the technology-mediated learning and skills-focussed learning components of the model (r = .407, p = .023).

The extent of respondents' reported use of the role of facilitator in teaching using the Bridge21 model had a significant correlation with all other components, except for technology-mediated learning: there was a significant correlation at the 0.01 level (2-tailed test) with the extent to which respondents use teamwork (r = .628, p = .000), project-based learning (r = .475, p = .008), reflection (r = .607, p = .000) and skills-focussed learning (r = .556, p = .001); furthermore, there was a significant correlation at the 0.05 level (2-tailed test) with the extent to which respondents stated they used learning space design (r = .335, p = .05) and social learning (r = .441, p = .013), and with their perceived effectiveness of teamwork (r = .406, p = .023), project-based learning (r = .375, p = .041) and skills-focussed learning (r = .360, p = .046).

The questionnaire contained two sections that required respondents to answer a set of closed questions in relation to a target class, yielding some quantitative data. In the first set of questions, teachers were required to think of a class where they regularly used the Bridge21 model for teaching and learning. In the second instance, teachers responded to the same set of questions for a class where they did not use the Bridge21 model. Paired samples t-tests were undertaken to examine differences in teacher's practices, student's learning and the profiles of class groups.

Figure 6-11 presents teacher's (n = 30) reported descriptions of the types of learners in their two target classes. Mixed ability classes are the highest reported for both target classes, with 67% of respondents stating that their Bridge21 class contained a mix of student academic abilities, compared with 48% for non-Bridge21 classes. Only 10% of respondents stated that their Bridge21 class contained students whose academic work is behind most students their age, compared with 28% for non-Bridge21 classes. This suggests that some teachers might perceive the learning model to be difficult to utilise with weak students or those with behaviour challenges. This issue will be discussed further in Chapter 7. Paired sample t-tests were undertaken to calculate statistical differences in a number of key areas. Results show that there is a difference in the type of learners in Bridge21 and non-Bridge21 classes at a significance level of p=.026. There are no differences, however, with regard to average number of times the class was taught per week, the duration of the class, the number and average age of students in the class.

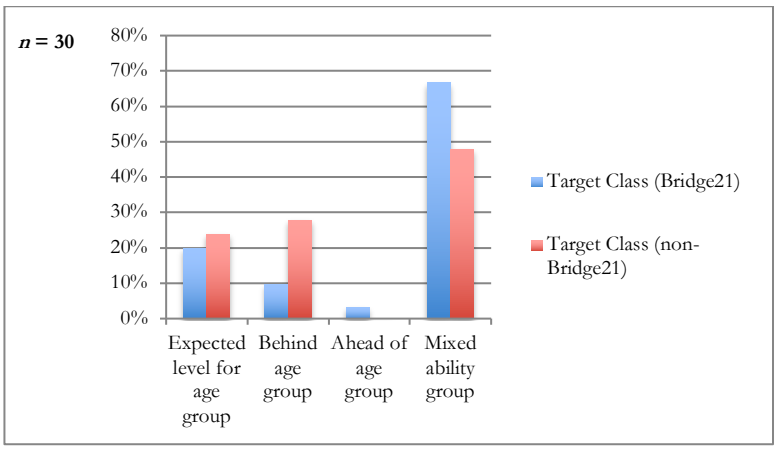

Figure 6-11 Types of learners: Bridge21 & non-Bridge21 target classes

Table 6-6 shows moderate differences across four of the six variables relating to the type of student activity in Bridge21 and non-Bridge21 classes. For example, there is a difference at a significance level of p=.007 in how often students in Bridge21 classes combine information from multiple subject areas. A Cohen's d calculation yielded an effect size correlation of r=.28, which would be considered moderate (Cohen et al., 2013). Similarly, there is a difference at a significance level of p=.001 in how often students in Bridge21 classes apply their knowledge to develop solutions to real problems from outside the school setting, effect size r=.31 again considered to be moderate. Finally, teachers report that students develop their own answers in Bridge21 classes 1-3 times per month, compared to 3-6 times per year in non-Bridge21 classes. A paired t-test of the mean difference resulted in t=4.39 at a significance level of p=.000, suggesting a statistically significant result. The calculated effect size r=.4 would be considered a large effect.

Focus activity: Target Bridge21 class & target non-Bridge21 class	**Mean Difference**	**SD**	**t-value**	**Effect size *r***
Analyse information	0.46	1.14	1.87	0.21
Support own ideas	0.36	0.95	1.79	0.16
Summarise information	0.59	1.10	2.52	**0.25**
Combine info from multiple subject areas	0.55	0.86	2.98	**0.28**
Develop own answers	0.91	0.97	4.39	**0.40**
Apply knowledge to develop solutions	0.68	0.78	4.10	**0.31**
Calculations based on participant responses *n* = 29				

Table 6-6 Student activities: target class differences & effect sizes

Analysis of mean scores revealed that in Bridge21 classes, the most frequent reported activities were students discussing their work with one another and completing specific tasks with other students (1-3 times per week). Less frequent were creating joint products that include contributions from each student and presenting their group work to the class (1-3 times per month). The mean scores, shown in **Figure 6-12**, show a higher frequency of all variables in Bridge21 classes.

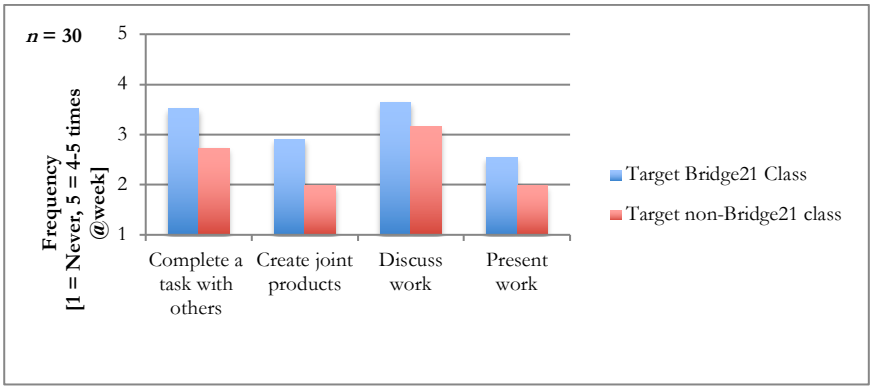

Figure 6-12 Mean scores: frequency of small group activities

Paired samples t-tests were also carried out in order to further explore the mean differences between Bridge21 and non-Bridge21 classes in the reported frequency of small group activities. The results are summarised in Table 6-7, showing moderate effect sizes across three of the four variables. There is a significant difference in how often students in Bridge21 classes complete a specific task with other students (p=.003), with a moderate-large effect size r=.33 (see line 1 in Table 6-7). There is a difference at the significance level of p=.019 in how often students present their group work to the class, with a moderate effect size r=.27 (see line 4 in Table 6-7). Finally, a paired t-test of the mean difference between Bridge21 and non-Bridge21 classes in how often students create joint products that include contributions from each member of the group resulted in t=4.63 at a significance level of p=.000, suggesting a statistically significant result. The calculated effect size r=.4 would be considered a large effect.

Focus activity: Target Bridge21 class & target non-Bridge21 class	Mean Difference	SD	t-value	Effect size *r*
Complete a task with others	0.78	1.13	3.33	**0.33**
Create joint products	0.91	0.92	4.63	**0.40**
Discuss work	0.48	0.95	2.42	0.20
Present work	0.55	1.01	2.53	**0.27**
Calculations based on participant responses *n* = 30				

Table 6-7 Small group activities: target class differences & effect sizes

The results presented in Table 6-8 show a difference between the two target classes in teacher's reported frequency of various instructional strategies. There is a difference in the frequency of students choosing their own topics of learning at the significance level of p=.030, choosing how to accomplish a task or demonstrate what they have learned at the significance level of p=.023 and selecting topics that are relevant to their lives outside of school at the significance level of p =.022. Further, there was no significant difference between Bridge21 and non-Bridge21 reported classes in how often teachers provided students with opportunities to learn or work at their own pace or how often teachers adjusted assignments for individual students based on their knowledge, skills or learning needs. A Cohen's *d* calculation yielded small to moderate effect sizes across all variables.

Focus activity: Target Bridge21 class & target non-Bridge21 class	Mean Difference	SD	t-value	Effect size *r*
Choose own topics	0.44	0.90	2.33	0.20
Choose how to accomplish or demonstrate	0.61	1.20	2.44	**0.28**
Adjust pace instruction	0.22	0.90	1.23	0.18
Adjust assignments	0.36	1.00	1.70	0.32
Select topics relevant outside school	0.44	0.84	2.47	0.17
Learn at own pace	0.04	1.30	0.16	0.03
Calculations based on participant responses *n* = 30				

Table 6-8 Instructional strategies: target class differences & effect sizes

Analysis of mean scores relating to teachers' estimates of the average skill level of their students in target Bridge21 and non-Bridge21 classes is summarised in

Figure 6-13, where 1 = I don't know, 2 = Students do not know how to do this, 3 = Beginner, 4 = Competent, 5 = Expert. The data show that teachers perceive students in their target Bridge21 class to have a more advanced level of skill in all areas, compared to students in their target non-Bridge21 class. Paired samples t-tests were conducted to further examine these differences. Results (see summary in Table 6-9) show moderate effect sizes across four of the eight variables. For example, teachers perceive students in Bridge21 classes to be at the 'competent' level in planning the steps they will take to accomplish a complex task, whereas they perceive students in non-Bridge21 classes to be at a 'beginner' level. This results in a difference at the significance level of p=.008, with a moderate effect size of r=.3. There was also a difference in teacher's perception of student's aptitude to select the appropriate technology tool for a task, at a significance level of p=.005 and with a moderate effect size of r=.27 when compared to non-Bridge21 classes. Additionally, teachers perceive students in Bridge21 classes to be more skilled in using technology to find information (significance level p=.008, with a moderate effect size of r=.25). Finally, a paired t-test of the mean difference in teacher's perception of student ability to evaluate the quality of their own work in Bridge21 and non-Bridge21 classes resulted in t=3.97 at a significance level of p=.001, suggesting a statistically significant result. The calculated effect size r=.56 would be considered a large effect. However, of note, there is no significant difference in teacher's reported level of student's collaboration skills (p = .203) for either class group. This result warrants further exploration in qualitative data, to be discussed in Section 6.3.4.

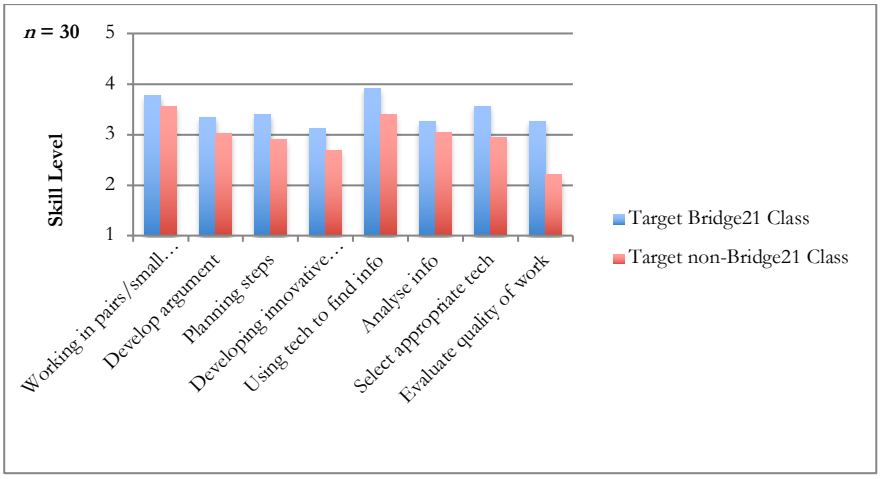

Figure 6-13 Mean Scores: Teacher perception of student skill level

Focus activity: Target Bridge21 class & target non-Bridge21 class	Mean Difference	SD	t-value	Effect size *r*
Working in pairs or small groups	0.22	0.80	1.31	0.12
Develop argument	0.30	1.02	1.43	0.18
Planning steps	0.50	0.80	2.93	**0.30**
Developing innovative solutions	0.44	1.12	1.86	**0.23**
Using technology to find info	0.50	0.80	2.93	**0.25**
Analyse info	0.23	1.15	0.93	0.13
Select appropriate technology	0.61	0.94	3.10	**0.27**
Evaluate quality of own work	1.04	1.26	3.97	**0.56**
Calculations based on participant responses *n* = 30				

Table 6-9 Student skill level: target class differences & effect sizes

ICT Access & Use

Teachers were asked to report on their use of ICT both in and outside of the classroom during the past year. Analysis of mean scores revealed that teachers most frequently use ICT to present information or give instructions to students (*m* = 4.37), to prepare a lesson (*m* = 4.14), and to organise classroom data such as grades, attendance (*m* = 3.89), reportedly doing these activities 1-3 times per week. Additionally, teachers state that 1-3 times per week they use ICT to collaborate with teachers in the same school and other locations (*m* = 3.59). The analysis also indicates that teachers rarely (3-6 times per year) use ICT to post teaching or learning resources on the Internet for other teachers or students (*m* = 1.96), and to communicate with parents outside the classroom, for example via email (*m* = 1.74).

The mean scores relating to student activities using ICT are shown in **Figure 6-14**. The analysis shows that in Bridge21 classes, the most frequent reported student activities were using ICT to find information on the internet and to practise routine skills and procedures (1-3 times per month). Less frequent were students using ICT to access class resources or online materials from a remote location and to collaborate online with peers (3-6 times per year), with the majority of teachers reporting that their students never use ICT to work with students or adults from outside the class.

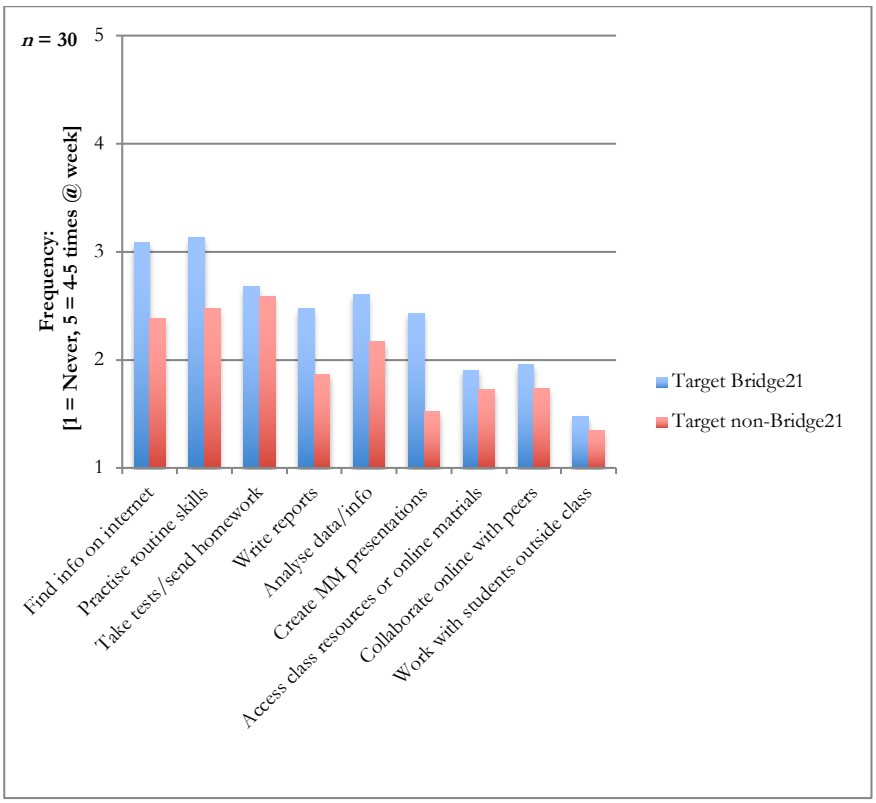

Figure 6-14 Mean scores: frequency of student use of ICT

Focus activity: Target Bridge21 class & target non-Bridge21 class	Mean Difference	SD	t-value	Effect size *r*
Find info on internet	0.70	0.97	3.43	**0.32**
Practise routine skills	0.65	1.07	2.92	**0.26**
Take tests or send homework	0.09	1.23	0.35	0.03
Write reports	0.61	0.89	3.28	**0.27**
Analyse data/info	0.44	1.12	1.86	**0.20**
Create MM presentations	0.91	0.85	5.16	**0.45**
Access class resources or online materials	0.18	0.96	0.89	0.10
Collaborate online with peers	0.22	1.17	0.89	0.10
Work with students outside class	0.13	0.69	0.90	0.12
Calculations based on participant responses *n* = 30				

Table 6-10 Student use of ICT: target class differences & effect sizes

Paired samples t-tests were undertaken to further examine differences in the teacher's reported frequency of student's use of ICT in Bridge21 and non-Bridge21 classes. Results (see summary in Table 6-10) showed a statistical difference in the frequency of students using ICT to find information on the Internet (p = .002), to practise routine skills and procedures (p = .008), to write or edit stories, reports, or essays (p = .003) and to create multimedia

presentations (p = .000). However, there were no differences in all other items on this scale, including using ICT to take tests or send in homework (p = .732) and to access class resources or online materials from a remote location (p = .383; see Table 6-10). These findings are replicated in other data relating to barriers to ICT access and use, discussed in greater detail in Chapter 7.

The questionnaire respondents were asked to rate thirteen items on a five-point scale according to what extent they considered them to be barriers to using ICT as one of the main elements of the Bridge21 model. **Figure 6-15** and **Figure 6-16** display the results of a descriptive analysis of the data, which showed that not having enough student computers (m = 3.5) was the most significant barrier. This is in contrast to the low mean score of the item 'not enough teacher computers' (m = 2.18). Additionally, 'not enough professional development' (m = 3.46) and 'Required curriculum not supported' (m = 3.11) were also rated as significant barriers. These are corroborated by analysis of qualitative data, discussed in greater detail in Sections 6.3.4 and 6.3.5

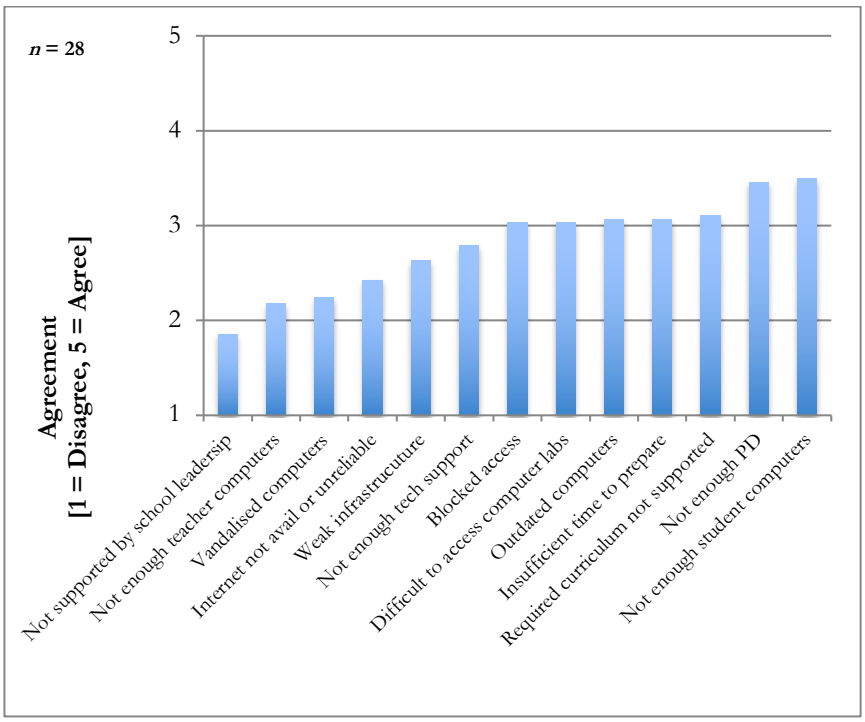

Figure 6-15 Mean scores: ICT barriers – teacher perception

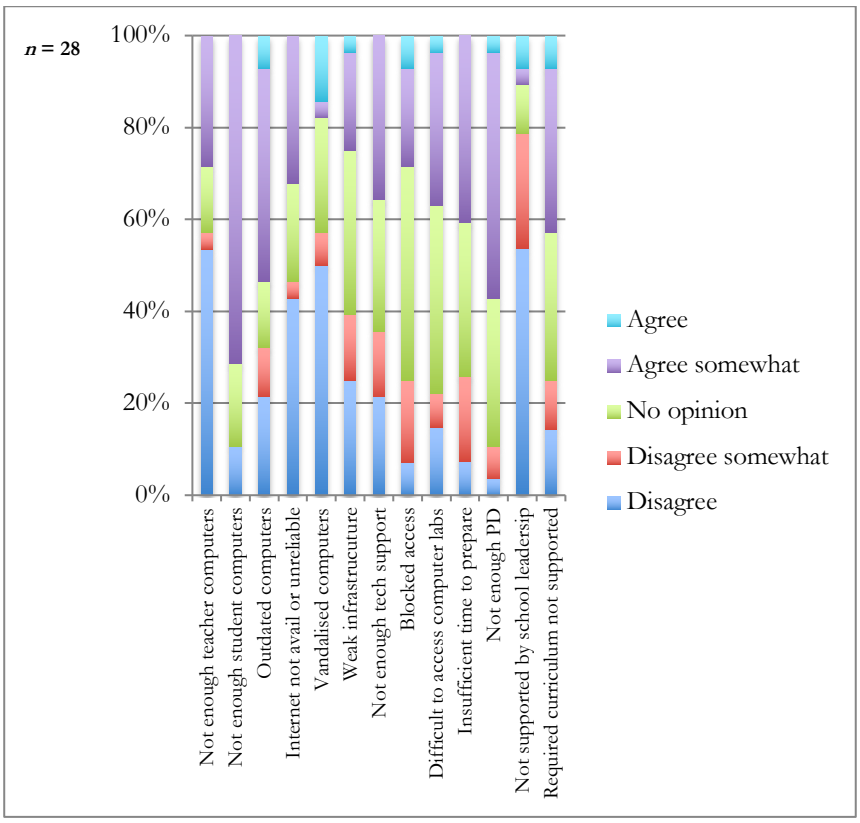

Figure 6-16 Frequency scores: ICT barriers – teacher perception

Descriptive analysis shown in Figure 6-17 reveals that the majority of teachers agree that ICT gives students access to a wider range of learning content and resources (m = 4.75), that students are usually more attentive when using ICT (m = 4.11) and that ICT usually helps students become more active and independent in their learning process (m = 4.07). Pearson's Correlation tests were used to determine associations between items in the scale. An exploration of teacher's perception that ICT gives student access to a wider range of learning content and resources shows a significant correlation at the 0.01 level (2-tailed) with the item 'Students are usually more attentive when using ICT' (r = .541, p = .003); and at the 0.05 level (2-tailed) with two items: 'ICT usually helps students become more active and independent in their learning process' (r = .410, p = .030), and 'Students are usually more motivated to learn when using ICT' (r = .418, p = .027). A further exploration of teachers' beliefs that ICT helps improve student motivation to learn shows a significant correlation at the 0.01 level (2-tailed) with two items: 'Students are usually more attentive when using ICT' (r = .849, p = .000) and 'ICT usually helps students become more active and independent in their learning process' (r = .689, p = .000). Additionally, results show a significant correlation at the 0.05 level (2-tailed) between the extent to which teachers use the technology-mediated learning

component of the Bridge21 model and their belief that students usually understand subject matter more deeply when they use ICT ($r = .471$, $p = .013$).

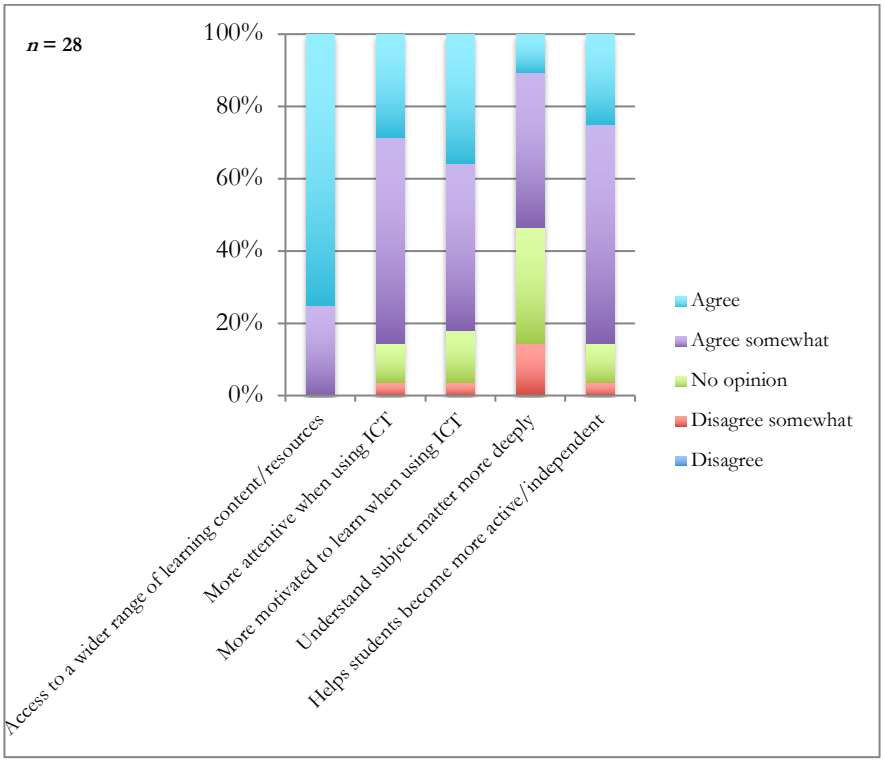

Figure 6-17 Frequency scores: Teacher perception - student benefits of ICT use

Leadership and Professional Culture

Data were gathered in relation to leadership and professional culture within the respondents' schools. The results are presented in **Figure 6-18** (p.182). Descriptive analysis indicated that 61% of teachers agreed somewhat and 18% agreed most teachers in their school had similar goals for student learning; however, a further total 18% of teachers disagreed that this statement was true for their school. While 43% of respondents agreed somewhat and 18% agreed that most teachers at their school shared the same beliefs and values about effective instruction, a further 21% disagreed somewhat and 14% disagreed that this was the case in their school. 37% of respondents agreed somewhat and 22% agreed that teachers and school leaders share a common instructional vision for this school. However, 15% disagreed somewhat and a further 15% disagreed that a common instructional vision existed in their school, with 11% having no opinion.

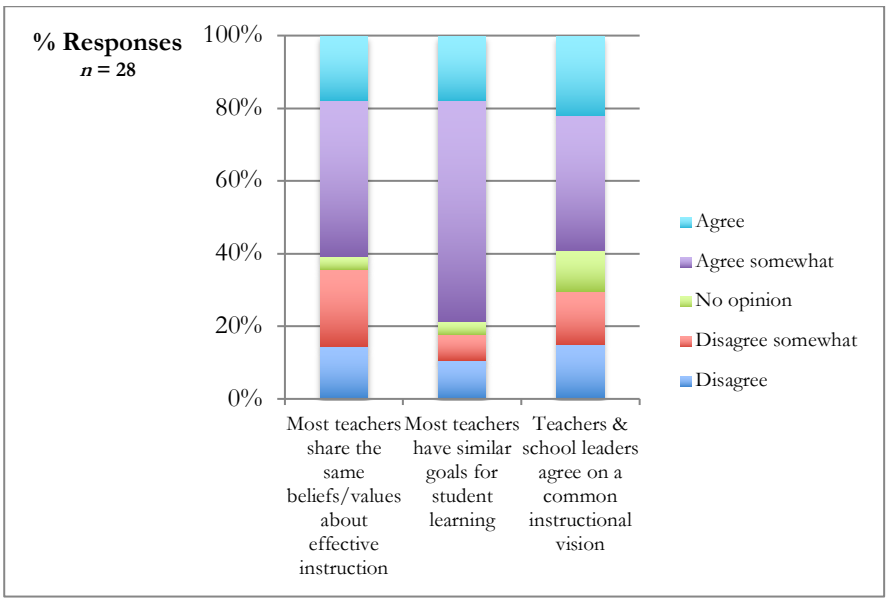

Figure 6-18 Frequency scores: School culture – teacher perception

The questionnaire also sought to determine respondents' perceptions of the behaviour of their school principal, in an effort to understand the role of school leadership in supporting teachers to use Bridge21 in the classroom. The frequency scores are presented in **Figure 6-19**. Analysis shows that 50% of teachers agreed and 39% agreed somewhat that their principal encouraged them to implement what they had learned during PD activities. 64% agreed and 21% agreed somewhat that they were encouraged by their principal to try new things in the classroom. While a quarter of respondents agreed and 36% agreed somewhat that they believe that their principal communicates a clear vision for their school, 18% disagreed somewhat and 4% disagreed that this was true for their school, with a further 18% having no opinion.

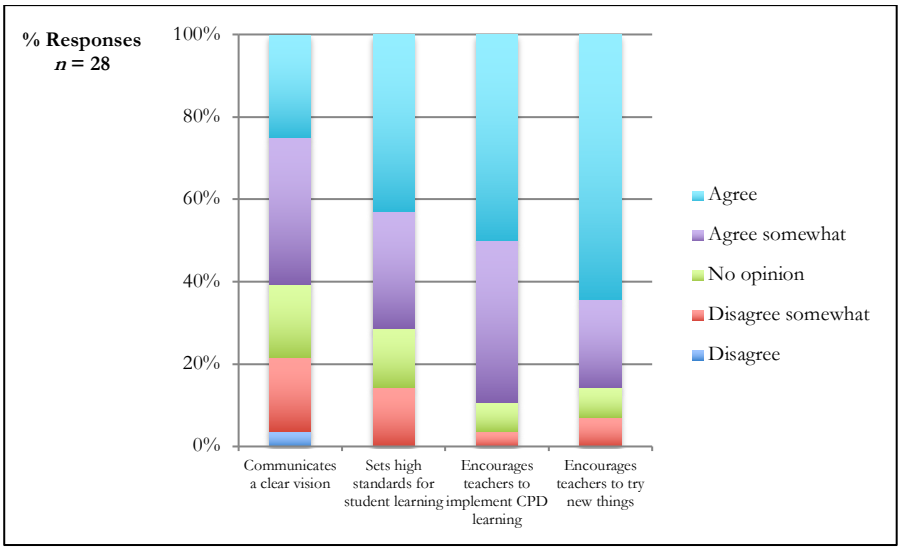

Figure 6-19 Frequency scores: School principal – teacher perception

Results of a Pearson's Correlation show a significant correlation at the 0.05 level (2-tailed) between the extent to which respondents agree that their principal communicates a clear vision for the school and their belief that teachers and school leaders agree on a common instructional vision (r = .422, p = .028). A further exploration of teacher's perception that their principal communicates a clear vision for the school shows a significant correlation at the 0.01 level (2-tailed) with the items: 'Sets high standards for student learning' (r = .759, p = .000), 'Encourages teachers to implement what they have learned in professional development' (r = .690, p = .000) and 'Encourages teachers to try new things in the classroom' (r = .612, p = .001). Analysis of qualitative data in Section 6.3.4 allowed for a further exploration of how this description of existing culture of leadership and professional culture were affected by engagement with Bridge21, in particular the model of PD.

Teacher Professional Development

The questionnaire contained questions that sought to probe teachers' needs and preferences for programmes of continuing PD. Respondents were asked to rank, in order of priority, topics of PD for which they felt they needed most support. Results are presented in **Figure 6-20**. The highest ranked items were: 'Creating opportunities that help students be active in their learning (working on extended projects, collaborating with peers, assessing their own work, etc.)' with 38% of teachers ranking it as first priority and a further 41% ranking it as their second priority; and 'How to use ICT in teaching and learning', ranked first by 28%, second by 24% and third priority by 21% of teachers. The most frequent lowest ranked item was 'Improving knowledge of national standards', by 52% of respondents. Additionally, PD topics relating to traditional issues of 'Improving student performance on standardised assessment' and 'Classroom management' were ranked as 5th priority (out of 6) by 24% and 31% of teachers respectively.

Respondents were also asked to rank, in order of priority, types of PD activity they would prefer or from which they felt they would most benefit. Results (see **Figure 6-21**) show an even distribution across many items. Of note, 'Formal class instruction or workshop' was the highest ranked item with 24% of teachers ranking it first, and an additional 24% ranking it second priority. Additionally, 'Informal dialogue with your colleagues on how to improve your teaching' was ranked highly, 14% of respondents ranking it first and 17%

ranking it second priority. The lowest ranked item was 'Individual or collaborative research on a topic of interest to you professionally', by 24% of respondents.

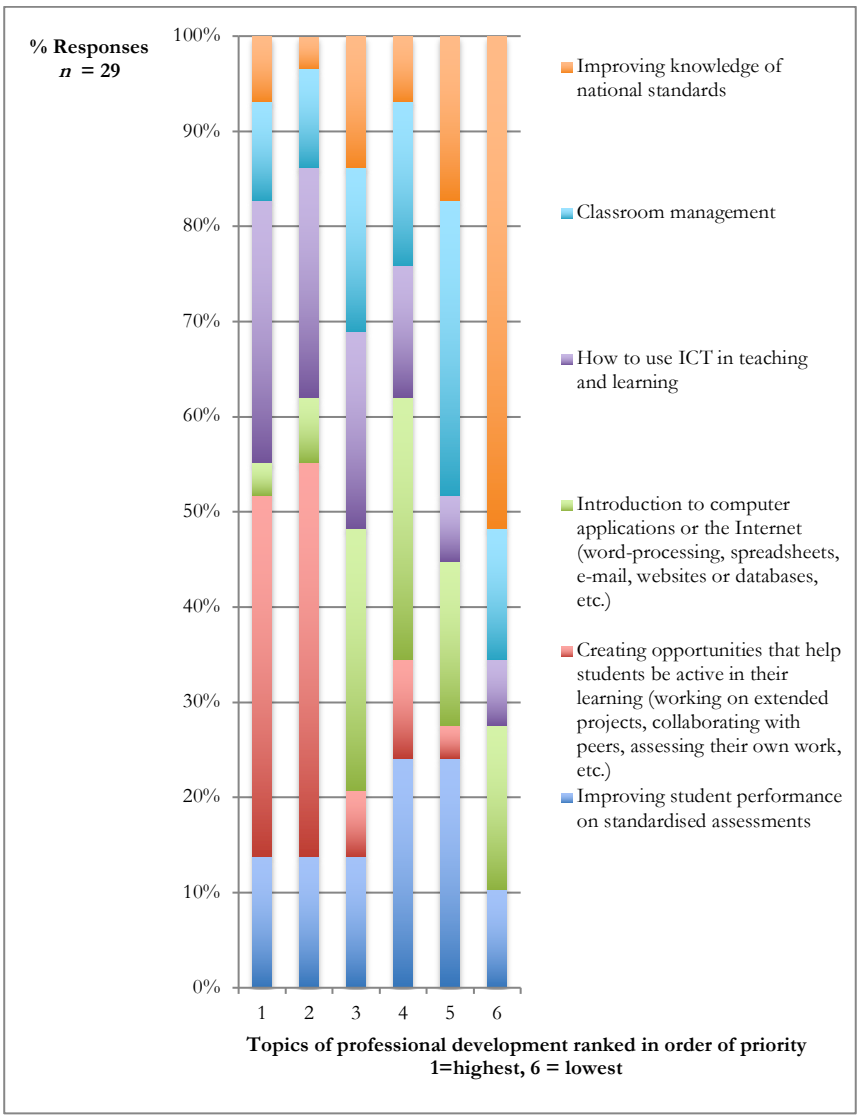

Figure 6-20 Teacher priority of PD topics

A large majority of respondents (86%) noted that, since their engagement with Bridge21, there was no change in support for teacher collaboration via a formal peer network or mentoring programme within the school, with the remaining 14% stating that there had been a great or slight increase. Moreover, 21% of respondents ranked 'Mentoring or peer observation and coaching, as part of a formal school arrangement' as their lowest preference for PD. This was a result that warranted further exploration in the interviews with school principals and analysis of data collected from other sources. It will be discussed in Chapter 7.

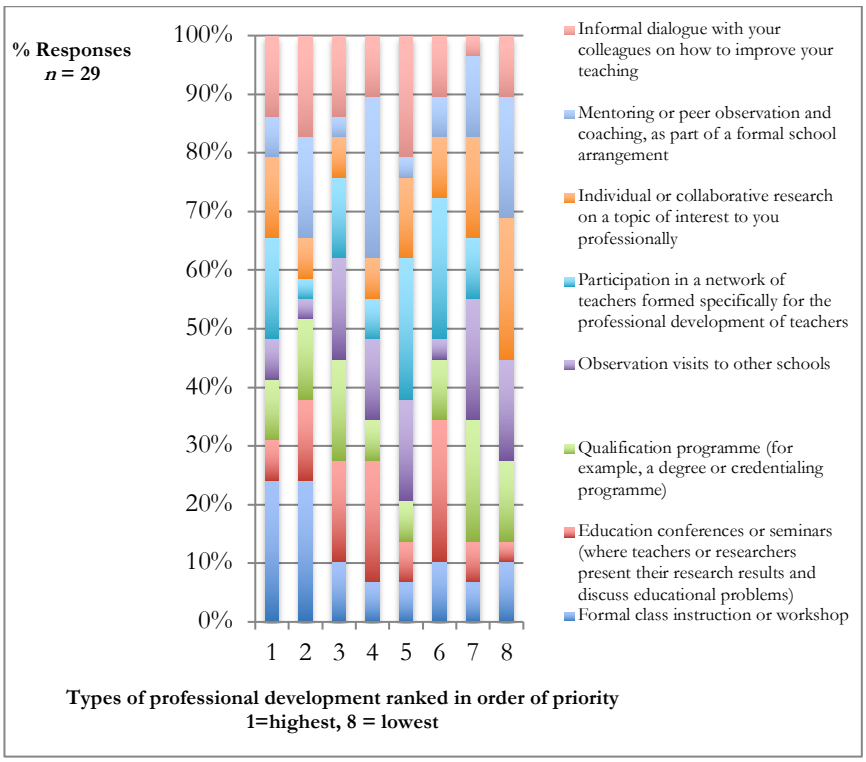

Figure 6-21 Teacher priority for types of PD

In an effort to probe teachers' needs and preferences for continuing PD, the questionnaire asked respondents to rate their level of agreement with topics specific to the Bridge21 model. A descriptive analysis of frequency scores (see **Figure 6-22**) showed that 38% of teachers disagreed and 21% disagreed somewhat with the statement they needed assistance assigning their students roles and organising them into teams for group work. Additionally, 24% of teachers disagreed and 24% disagreed somewhat with the item 'I need assistance with integrating teamwork into classroom activities'. These results suggest that teachers perceived that they had developed these abilities through their engagement with Bridge21, a theme that is explored further in the qualitative data analysis.

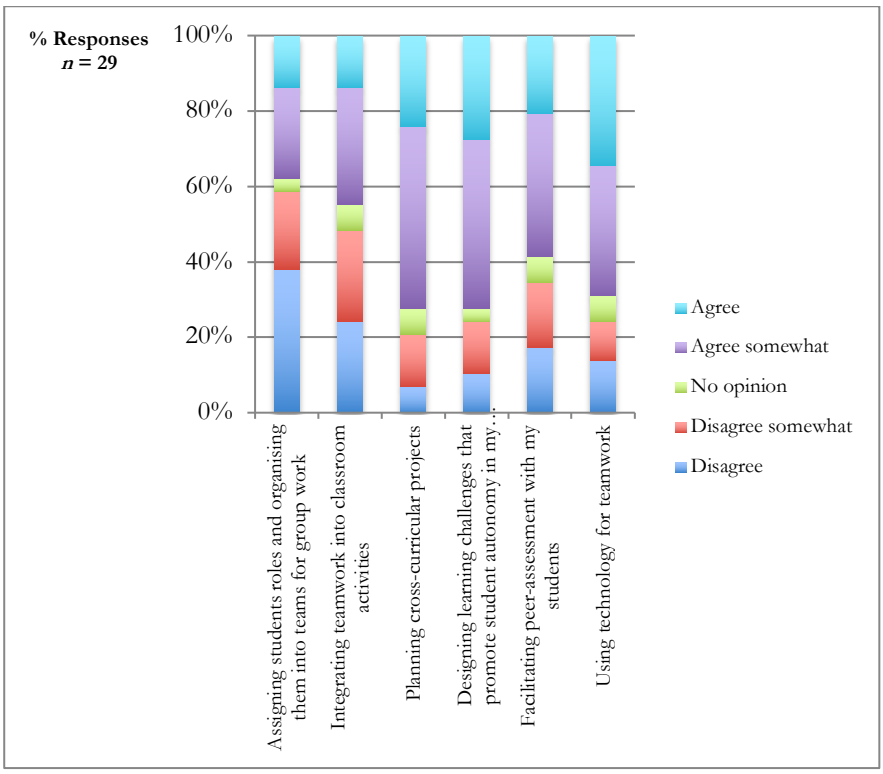

Figure 6-22 Frequency scores: Bridge21 PD topics

A majority of teachers (35% agreed, 35% agreed somewhat) stated that they needed assistance with using technology for teamwork, while others perceive that they need assistance planning cross-curricular projects (24% agreed, 48% agreed somewhat) and designing learning challenges that promote student autonomy (28% agreed, 45% agreed somewhat). Analysis of qualitative data allowed for a deeper exploration of these findings, which point towards a number of areas for development within the model of PD. These are discussed in greater detail in Chapter 7.

6.3.4 Qualitative data collection and analysis

As described in Chapter 5, the methods used to collect qualitative data during the explanatory phase of the research include a teacher questionnaire, interviews with teachers and principals, and memos and observations collected in the researcher's journal. Table 6-11 shows a summary of the methods used and the corresponding numbers of responses (*n*) from participants.

Method	Respondents	*n*
Questionnaire	Individual teachers	55
Semi-structured interviews	Teachers Principals	25 3
Research Journal entries	Researcher	30

Table 6-11 Summary of qualitative data collected during explanatory phase

The 60-item teacher questionnaire, described in Section 6.3.3, contained a number of open-response probes yielding qualitative data. As already stated above, in total, 55 participants (34% of the total population of teachers who had participated in the programme over the four-year period) responded to the questionnaire that was administered in June 2014 (i.e. at the end of Year 3 of the intervention). Additionally, teacher experiences and views of the programme were captured through individual and focus group interviews conducted either at the end of a Bridge21 learning activity or at the end of the academic year (similar to the first phase of the research). A total of 25 teachers participated in either a focus group or individual interview across the two years of the explanatory phase.

The researcher's journal was used less frequently during this phase of the research, compared to the exploratory phase. Whilst there are only a total of 30 log entries for this phase of the research, they remain a useful source of qualitative data that can be used to validate and corroborate other analyses.

Semi-structured interviews were conducted with a small, purposive sample of principals (n = 3) one-year post-intervention. All of the principals were from schools that had a minimum of 3 years' engagement with the Bridge21 programme. Two of the principals were from schools that had the highest response rate in the teacher questionnaire (n = 6), whilst only one teacher questionnaire response was received from the remaining principal's school. Some brief profile information on each of the principals is provided in **Table 6-12**. The design of the principal interview protocol (see Appendix 5.4) was informed by the results of the teacher questionnaire and sought to provide insight into key themes and richer and more contextualised information on the data from a leadership and whole school perspective.

Participant	School Code	*n* Years Principal	*n* Years Principal (current school)	*n* Years School in Bridge21	*n* Teacher Responses (Questionnaire)
Principal 1 (P1)	C	1	1	6	6
Principal 2 (P2)	E	9	9	8	6
Principal 3 (P3)	F	10	10	4	1

Table 6-12 Participant Profile Information – Principal interviews

As before, NVivo10 was used to support the directed content analysis of qualitative data collected during the explanatory phase. Initial coding schemes were concept-driven, derived from theory or relevant research findings, and were outlined before analysis began (Hsieh & Shannon, 2005). As the analysis process proceeded, a data-driven approach was used to generate additional codes and revise and refine the initial coding schemes. Analytic and thematic coding processes were undertaken to allow for a more descriptive analysis of the data and for common meanings to emerge in relation to aspects of the research such as context, causal conditions and actions or interactions (Strauss & Corbin, 1990).

The first stage in the directed content analysis involved the development of a coding scheme based on the Bridge21 learning model and key components as defined in Chapter 3. **Table 6-13** (p.189) shows that each component of the learning model was treated as a category, with a description and significant number of related codes.

Category	Description	Codes	*n*
Technology-mediated	***Technology*** *used as an integral tool in the learning process.*	Present work, develop tech skills, tools/software, digital media, novel use, support learning, a conduit, enhance learning, awareness, responsible use	64
Project-based	*Delivery of content through student-led, active* ***cross-curricular, thematic projects.***	Project work, thematic topic, subject topic, present to peers, deadline, project class, learning by discovery, open problem, authentic topic	59
Learning Space	*Design/consideration of the physical* ***learning space*** *to support the model.*	New learning environment, out-of-school, team spaces, classroom design	4
Teamwork	*A structured* ***team-based*** *pedagogy; students working together to complete a joint task (incl. group work, collaboration, cooperative learning)*	Formation, physical space, identity, task design, roles/accountability, interaction, peer learning, presentation/feedback, reflection, differentiation	84
Mastery Goal Orientation	*Focus on* ***skill acquisition*** *(in addition to content knowledge) rather than a performance-based approach.*	Key skills, integrated to learning, active learning, social skills, confidence, critical thinking, skills-based, creativity, communication, transferrable, process-driven, self-esteem, achievement	35
Social Learning Protocols	*A* ***social context of learning*** *that emphasises trust, respect & personal responsibility for learning.*	Student ownership of learning, student-centred, self-directed learning, motivation, engagement, peer relationships, teacher-teacher relationships, excitement	25
Facilitator/ Mentor	*Adult support that seeks to* ***guide*** *and* ***mentor****, with teachers orchestrating and scaffolding learning activities.*	Team teaching, facilitation, guide, less reliance, provide learning opportunities, mentoring skills, less passive, teacher confidence	21
Reflection	*Incorporation of team and individual student* ***reflection*** *as a regular part of the learning process.*	Feedback, written reflection, oral reflection, teacher reflection, progress learning, awareness of assessment, individual reflection, team reflection	16

Table 6-13 Coding Scheme based on elements of Bridge21 model

Table 6-13 shows that teamwork was the highest referenced component of the learning model, with 84 unique references contained in questionnaire responses. This suggests that teachers viewed teamwork as core to their understanding of the Bridge21 model and as central to its implementation in

the classroom. The first stage of the directed content analysis revealed that teachers used a variety of different words interchangeably in their descriptions of teamwork. A specific coding scheme was developed for the teamwork element of the model to strengthen the systematic and logical approach of the directed content analysis. This coding scheme is shown below in **Table 6-14.** These terms were used to refine the Bridge21 coding scheme (**Table 6-13**) and were used to direct subsequent stages in the coding process.

Category	Code	*n*	Example
Teamwork	Formation	12	*"I put them in groups, gave them the assignment, gave them 5 success criteria."*
	Physical space	3	*"We used the room to good effect in this by moving tables away and sitting in groups of four."*
	Identity	2	*"Groups - roles distributed, designed charter for work (had been doing projects all year)"*
	Task design	21	*"I have recently given my Y2 maths class a hexagonal-prism box to design using dotted paper to make the net. They were also asked to work out the surface area of the cardboard used as well as the volume."*
	Roles & accountability	15	*"The class was divided into teams. Each team chose a scene or part of a scene [from Romeo and Juliet] to enact. Roles were assigned: director/leader, prompter, designer etc. Leader was responsible for making sure that lines were learned."*
	Interaction	4	*"Each group was given the same scenario, but asked to look at it from their group's perspective. They then had to debate with each other in order to find a resolution. This worked as students had to engage with each other having first worked within their own group."*
	Peer learning	11	*"I began working through groups on getting students to speak amongst themselves about their strengths and fears around public speaking [...] I moved between groups facilitating discussion and ended with a reflection from each of the groups […] The process continued like this over the week with teacher and peer mentoring leading to a result on the Friday when there was a speech competition with marks schemes filled out by the groups and some small prizes awarded."*
	Presentation, feedback & reflection	11	*"The time for written reflection at the end helped the students to consolidate what they had learnt and where they could go forward in filling gaps in their understanding. The reflections also allowed me to add to my observations of how they were progressing in using mathematical skills in new contexts, along with helping me to tweak the activity for further use."*

Table 6-14 Coding Scheme for teamwork

Table 6-13 shows a total of 64 unique references to technology-mediated learning in questionnaire responses, making it the second highest referenced component of the learning model. This suggests that teachers viewed technology-mediated learning as an important aspect of their understanding of the Bridge21 model and as central to its implementation in the classroom. A coding scheme was developed to analyse teachers' descriptive narratives of how technology was used to mediate a Bridge21 learning activity. **Table 6-15** shows the coding scheme, which is informed by the SAMR Model of technology integration (Puentedura, 2010), as discussed in Chapter 2. The scheme includes example of instances cited where technology-mediated learning was classified as either enhancement (technology being used to either substitute or augment) or as transformation (technology being used to either modify or redefine).

Category	Sub-category	Definition	*n*	Example(s)
Enhancement	Substitution	Teachers use technology as a direct substitute for what they might do already, with no functional change.	2	*"Students used their textbook and the internet in a treasure hunt format to find definitions of key terms."*
	Augmentation	Teachers use technology as a direct substitute, but there is functional improvement over what they did without the technology.	4	*"Each group presented their summary to the class using technology"* *"I let them use the computer rooms for research"*
Transformation	Modification	Teachers use technology to significantly redesign the task.	2	*"Use of laptop per group [to brainstorm and categorise local problems] …could use personal tablets and phone (if need identified) to provide a model/experience to show their solution."*
	Redefinition	Teachers use technology to design learning tasks previously not possible.	6	"*Each group produced a movie on cyber bullying. Each group presented their movie and all the students assessed their movie based on the 5 criteria I had given them…. anonymously using Google forms".* *"In TY World of Science, students were asked to present a science investigation as a video and email it to me. They worked in groups, used their phones to take photographs or video clips."*

Table 6-15 Coding Scheme for technology-mediated learning

Findings from the teacher questionnaire and analysis of qualitative data in the exploratory phase were used to develop a coding matrix to analyse the interviews with a small sample of principals. As discussed in Chapter 5, the purpose of the interviews with principals was to facilitate in-depth exploration of the key findings from the teacher questionnaire and to provide insight into unexpected themes surfaced by the overall synthesis of results from both phases of the research. The data gathered from interviews with school principals were intended to provide richer and more contextualised information on the intervention under study from a leadership and whole school perspective. As such, the coding scheme, shown in **Table 6-16**, contains a focussed set of categories to be analysed.

Category	Description	Codes	*n*
Programme & PD design	*Data relating to the overall design of the university-school engagement programme, including the PD model.*	PD value; inter-school collaboration; outside school value; Teacher collaboration; relational approach; understanding of the B21 model;	21
Role of Leadership	*Data relating to principals' perceptions of the effect of the role of leadership on the intervention.*	Teacher support; hopes and vision; teacher isolation; Champion teachers;	36
School-level barriers	*Data relating to the barriers and/or challenges at the school level encountered during the intervention*	Culture as barrier; School time; school organisation; Time needed for change to happen; Education system;	16
Benefits	*Data relating to principals' perceptions of the benefit of their school's engagement with the intervention*	Teacher benefits; student improvement; student engagement; long-term school-wide benefits; Teacher as facilitator	8

Table 6-16 Coding Scheme: principal interviews

6.3.5 Results of explanatory phase

Teacher understanding and use of the Bridge21 model

Data yielding from the questionnaire provide a rich and contextualised insights into how the components of Bridge21 translated in practice in the post-primary classroom. Coding of teachers' narrative descriptions revealed patterns in the data to show that teachers viewed teamwork as core to their use of the model

in the classroom. For example, in describing an example of a class taught during the past month using the Bridge21 model, or elements of it, respondents stated:

> *"Last week I organised my LCA[16] class into groups with a group identity, each group name agreed by them. They have to collaborate and co-operate to get the work done in class... Last year, I increasingly got pupils talking, interacting, reflecting and peer tutoring/mentoring before actual writing or arriving at a finished product."*
>
> *"Students were to work in teams to come up with a solution for a question given in class. Each team had one personal whiteboard and were to elect leader, reporter, writer and timekeeper. Students were to work within their team. This led to great discussion and engagement with the question, introduction of other mathematical topics and concepts and students were mainly left to work within their team with little influence from myself. Each group had to report back and reflect on what they'd learned and where they could improve."*

Teamwork features strongly in teachers' descriptions of their understanding of the Bridge21 model. Teachers view Bridge21 as:

> *"A collaborative approach to learning using ICT"*
>
> *"About collaboration of learning, working as part of a team."*
>
> *"Students working in groups to figure out an authentic problem…."*

In cases where participants first reference other components, analysis of their description suggests that teamwork is still viewed as core, for example (underline added by the researcher):

> *"Facilitating students in the use of technology for self-directed learning <u>through</u> collaboration in group work."*
>
> *"Student lead/teacher facilitates. Open problems allowing for variety of approaches. <u>Emphasis</u> on group work to reflect real world problem solving situations."*

There is a strong pattern in the responses to show that respondents understand the integral role of technology is to mediate, support and enhance learning in the Bridge21 model:

> *"…the use of technology to enhance the learning experience."*
>
> *"The use of technology as a means to learner progress not as an end in itself."*

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[16] Leaving Certificate Applied (LCA) is a 2-year programme designed for students who do not wish to proceed directly to higher education or for those whose needs, aptitudes and learning styles are not fully catered for by other upper secondary examination programmes.

"…using ICT as a learning tool."

"…supported by technology"

"Technology is promoted as the conduit for the process."

"Facilitating students in the use of technology for self-directed learning".

Data also show that teachers understand the model as focussing primarily on skill development, with an emphasis on the learning process, rather than merely subject content:

"[…] *skills based rather than knowledge based"*

"It's a process-driven model of teaching - rather than product-driven."

"I found this model encouraged collaboration, change of classroom design, teacher as facilitator, social learning, reflection and […] an end to the idea of the test being the end of learning."

Teacher responses show the direct connection they perceive between the model and the key skills of the new Junior Cycle:

"It addresses the key skills and statements of learning as prescribed in the new Junior Cycle curriculum"

"This will help students develop the key skills required for the new junior cycle."

There are 35 references to ways in which teachers perceived the Bridge21 model to engender the development of 21st century skills, including social skills and social intelligence, self-confidence, communication and critical thinking skills. For example, two teachers said:

"This provides them with the critical thinking skills required for 21st century employment and allows the space for creatively responding to obstacles."

"Some aspects of engaging students in group work and considering alternative methods of presenting problems have been inspired by teacher workshops. It has also been highlighted for me that some students prefer to work individually and that this needs to be provided for in the 21st century emphasis on communication with others."

The high number of teachers' comments (n = 59, see **Table 6-13**) about project-based learning highlight their perception that it is closely related the teamwork component of the Bridge21 learning model, for example: *"Open problems allowing for variety of approaches. Emphasis on group work to reflect real world problem solving situations."* Teachers also describe project-based learning as "*learning by discovery"* and one teacher noted that it can contribute to student engagement and autonomy: *"The programme aims to empower students through project-*

based learning, teamwork and ICT." The data also suggest that project-based learning encourages teachers to develop cross-curricular links with their subject, which they may not have previously attempted. Several respondents refer to the importance of the design of the project topic or task, noting that it must be an "*authentic problem*" and one that is open-ended to "*allow for a variety of approaches*" and to encourage students to *"use [their] own life experience"*. One teacher commented: *"Students, in my experience, are much more motivated to complete real world problems as opposed to staged or imaginary situations."*

The respondents' understanding of the social constructivist approach of the Bridge21 model is strongly reflected in the data, specifically relating to student autonomy and self-directed learning skills. In their detailed descriptions of their understanding of the learning model, teachers strongly reference the student-centred approach (n = 25). For example, teachers describe Bridge21 as *"a model of student-centred learning"* and specifically note that learning is *"student, not teacher, centred"* or *"student led rather than content directed"*. One teacher stated:

> *"My understanding of the model is that it attempts to break down multiple barriers that have developed in the ways students learn, to encourage more holistic, collaborative, active, cross-curricular and project-based approaches to teaching and learning"*

Data also highlight that teachers understand the specific design of the model promotes learner autonomy, through *"demanding more participation by the learning"*, instilling *"excitement and interest in learning"* and encouraging students to take ownership of their learning. One teacher shared an observation that during a Bridge21 learning activity *"all students wanted to perform – it was an enjoyable learning experience"*. Other examples of the 'student autonomy' code include:

> *"[It] enables and encourages student ownership of the direction of the lesson."*
>
> *"[… by] encouraging them to be responsible for their own learning."*
>
> *"[… the] development of students as self-directed learners."*
>
> *"Engaging with B21 has taught me to engage more with my students not just on a personal level but also in generating a less teacher dependent relationship and encouraging a greater autonomy on their part to become independent learners."*

The directed content analysis shows a strong pattern of usage of the word 'facilitate' (or derivatives thereof, e.g. facilitation, facilitator) (n = 21, see **Table 6-13**) to suggest that respondents understand that the integral role of teachers in the Bridge21 model is to mediate, guide and scaffold student learning. For example:

"Facilitating students in the use of technology for self-directed learning through collaboration in group work."

"Bridge21, through the facilitation of group work and projects, strives to encourage students to look at learning in a different light."

"The teacher is more a guide than a traditional style teacher. The students lead and direct the lesson with the teacher acting as a facilitator."

"Student leads/teacher facilitates."

The above quotes also suggest that teachers perceive the role of the teacher as facilitator to be closely associated with other key components of the Bridge21 model, such as teamwork, technology-mediated learning and project-based learning. Teachers cite direct examples of how they have acted as a facilitator of student learning in their descriptions of a recent lesson taught using the Bridge21 model. For example:

"I moved between groups facilitating discussion and ended with a reflection from each of the groups."

"Myself and another teacher combined 5th year classes and facilitated a project that involved the students working in groups to produce and publish book of essays on Othello."

"The process continued like this over the week with teacher and peer mentoring leading to a result on the Friday when there was a speech competition with marks schemes filled out by the groups and some small prizes awarded."

Data also indicate that teachers acknowledge that using Bridge21 in the classroom demands a change in their role and that it is a skillset that they will develop over time:

"Changes the role of the teacher to one of learning facilitator."

"Trying to develop skills as a mentor."

Further, the data suggest that teachers have developed an awareness of their role in the classroom and the Bridge21 PD process has encouraged them to reflect on, analyse and evaluate their professional practice according to the needs of their students and the design of the learning activity:

"There is still a need for some teacher led learning but not half as much as I was doing."

"I am much more conscious of providing learning opportunities and evaluating results rather than 'teaching' every aspect of the course and expecting the answers I gave in response."

"The reliance on the teacher is much less in the Bridge 21 model."

Instances of codes in the 'Reflection' category are noticeably lower (n = 16, as shown in **Table 6-13**) than other components, suggesting that teachers might view this component as less integral to the Bridge21 model. However, there is some evidence to indicate that teachers view it to be closely associated with other key components of the model, such as:

> *"Model of teaching and learning involving collaboration, reflection and the use of technology."*
>
> *"The Bridge 21 model uses technology to help develop learning through the use of project based, self-directed teamwork with the focus on skills and reflection."*
>
> *"This all leads, at the end of the year, to a much more reflective approach to learning, a greater confidence in ability to learn for themselves, and less passive acceptance of information feeding."*

The learning space category refers to the design and consideration of the physical learning space to support the use of the Bridge21 model. It was the lowest referenced component of the Bridge21 model (n = 4, as shown in **Table 6-13**). While the majority of teachers directly reference dividing their students into groups (for example, "*The class was split into groups", "Class were put into groups of 3-4"*, "*mixed ability groups of 4 students"*), there were only four explicit references to the classroom set-up or physical layout in describing an example of a recently taught Bridge21 lessons, such as:

> *"We used the room to good effect in this by moving tables away and sitting in groups of four. I moved between groups facilitating discussion […]"*
>
> "*I change the configuration of the classroom a number of times a year, depending on the needs of the curriculum* […] *I found this model encouraged collaboration, change of classroom design, teacher as facilitator, reflection* […]"
>
> *"I promote more group work within the classroom, my classroom has physically changed shape, students are encouraged to discuss tasks with each other and plan how to achieve results, we use more technology when available."*

Barriers to using Bridge21 in the post-primary classroom

Descriptive statistical analysis of data in the teacher questionnaire showed the most significant barriers that affected teachers' use of the Bridge21 model in the classroom, grouped broadly into three main categories: pedagogy, school support and goals, and ICT access and use. Following this initial analysis, directed content analysis of qualitative data allowed for an in-depth exploration

of these barriers and led to additional emergent codes. The findings are presented under each of the three headings in the sections that follow.

(1) Pedagogical barriers:

Analysis of quantitative data showed that pressure to prepare students for exams and tests (m = 3.06) was the most significant pedagogical barrier to using Bridge21 in the classroom, partially affecting 28% of teacher's use of Bridge21 in the classroom and 44% of respondents stating that it adversely affected them "a lot". This finding was verified in the qualitative data, with teachers stating that "*time constraints imposed by curriculum*" were a barrier, and that "*exam classes would have time constraints, and the course needs to get covered."* Others commented that similar models are "*common practice at primary level*", but the pressures of exams at post-primary are in contrast with the "*real world of work*" and that "…*there is the matter of the traditional Leaving Cert. which does not directly reward this learning model*". One respondent shared an insight that the Bridge21 model was particularly suited to certain cohorts of learners (such as Junior Cycle and Transition Year groups), but expressed frustration with the domination of the rigid traditional structures of the examination system that would not permit its use in Senior Cycle:

> "*I enjoy it all and hope to use it in new Junior Cycle. It is frustrating that there are no plans to reform Leaving Cert. In a way we are teasing the TY students with all these nice learning models. They have to go back to traditional learning for Leaving Cert. I feel bad about that.*"

31% of teachers reported as being partially adversely affected by lack of content, with one teacher commenting "*Don't know if Bridge21 offers materials for my subject. English?*" Another respondent noted that there is a "*Lack of teacher knowledge on how to properly create groups and record the learning*", suggesting the need for additional content and pedagogical support for participants. Quantitative data analysis revealed that there were a number of barriers that did not adversely affect respondents: insufficient pedagogical support ("a little": 29%, "not at all": 29%; m = 2.35), lack of adequate content ("a little": 16%, "not at all": 41%; m = 2.16) and difficulty integrating Bridge21 into the curriculum ("a little": 31%, "not at all": 28%; m = 2.25). The data are supportive of findings presented earlier in relation to teacher's perceived effectiveness and benefits to using the model in the classroom with the item "no or unclear benefit" not affecting the majority of teachers at all (69%, m = 1.38, see **Figure 6-23**).

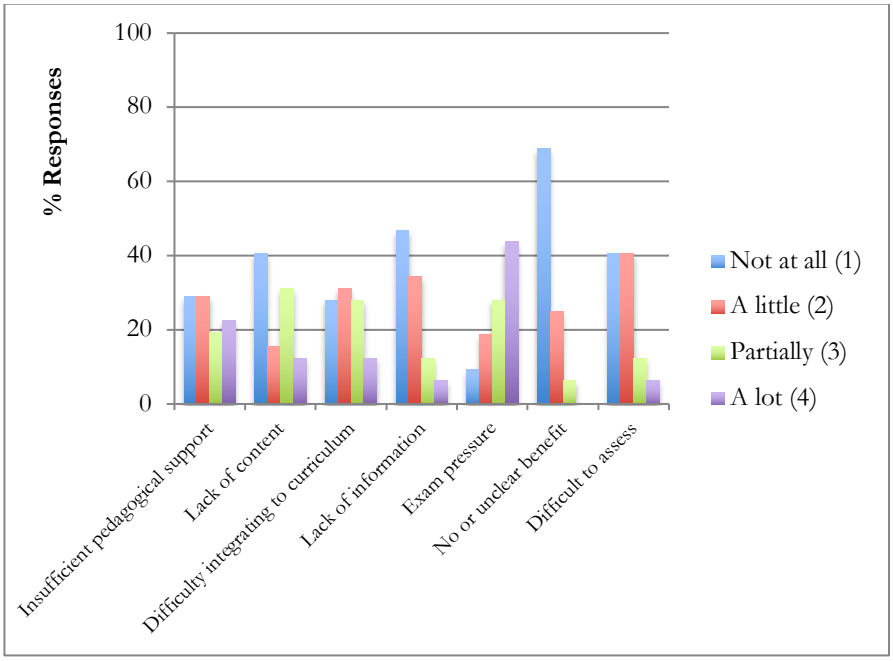

Figure 6-23 Frequency scores: Pedagogical barriers

Descriptive content analysis of qualitative data relating to barriers highlighted the perception amongst some respondents that using Bridge21 as the only pedagogical approach could adversely affect its use in the classroom, for example:

> *"… as the only form of learning it doesn't work... A variety of Different learning and teaching styles are required for the whole development of the students...Sometimes they need direction. In my experience, it sometimes lacks a structure."*

This quote also reveals a concern regarding the participant's perception of a lack of structure in the model. It further illustrates the adverse effect that examination pressure and the demands of an over-loaded curriculum can have on implementing a team-based, project-oriented model in the formal classroom, as noted above. This barrier surfaced a tension, often experienced by respondents, between delivery of content and a skills-orientated approach to learning, as highlighted in this quote from one respondent:

> *"Teachers need to have more self confidence in interpreting the syllabus and reducing content overload in favour of skills training, initially reduce content to up skills then the content catches up automatically. I have tested this and thus far the results are holding up well. There are a lot of myths about the need for content which have no basis other than the fear it engenders among overwhelmed practitioners."*

There was conflicting evidence from respondents in relation to viewing Bridge21 as a model, with many teachers noting that many of the components are already well established as best practice. One teacher commented that she was "*Not sure exactly of what constitutes the 'B21 method' as it contains much that is already considered good practice in education. Sometimes overemphasizing a 'model' can weaken its aims as it can be seen as one model among many, whereas there are 'good practices' that better serve teachers and students as free standing than any adoption by a particular model.*"

However, there is evidence to suggest that many teachers viewed Bridge21 as a model that combined "many of the cornerstones of progressive teaching" and while respondents may have used some or all of the components previously, "*the approach of combining them together in a structured way was useful.*"

(2) Barriers relating to school support and goals:

A descriptive analysis of mean scores of barriers relating to school support and goals showed that those most significant relate to time: school time organisation ("partially": 34%, "a lot": 31%; *m* = 2.91) and time required for a Bridge21 activity ("partially": 19%, "a lot": 28%; *m* = 2.69), see **Figure 6-24**. School space organisation also scored highly, with most teachers reporting that it partially adversely affected their use of Bridge21 in the classroom (*m* = 2.90).

Directed coding of qualitative responses surfaced additional data relating to the barrier of school time and space organisation. One respondent noted the difficulty of organising the "*Learning space - furniture, room size, noise travels to other classrooms*", with another teacher stating:

> "*[I] need 50-60 minutes class periods…furniture needs to be altered and teachers need to be less territorial about space and the physical layout of the classroom - this latter point is bigger than it sounds as it is based on hierarchy and status....if Bridge 21 is more democratic teaching practice then it is operating largely within a very undemocratic system and resistance is strong as is the sense of entitlement of various stakeholders...uphill struggle.*"

Teachers also noted the challenges in finding time to plan Bridge21 activities, with this barrier "partially" affecting 19% of respondents and affecting 31% of respondents "a lot". One teacher noted that "*unstructured time for planning*" was an additional barrier.

The trend in response pattern in **Figure 6-24** suggests that those items with the least adverse effect on teachers in the sample were parents not in favour (*m* =

1.32) and students not in favour (m = 1.40). Qualitative data suggest that, for those participants who report this barrier as having a little or partial adverse effect, it is related to the barrier of exam pressure, feeling that they "*must cover the course or risk complaint from student and their parents*".

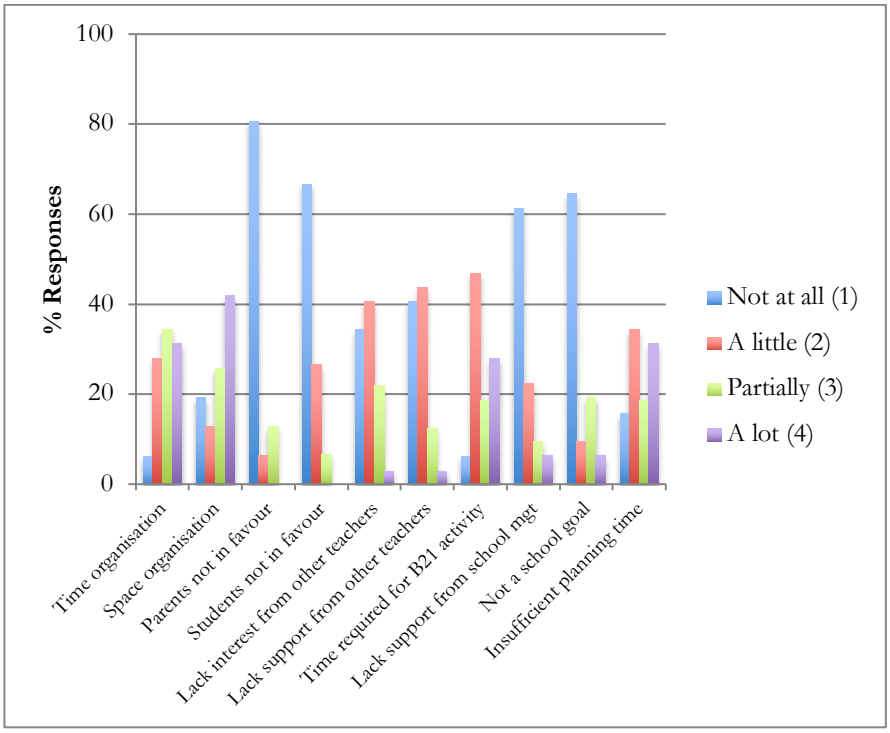

Figure 6-24 Frequency scores: School support & goals - barriers

Some respondents were somewhat adversely affected by other members of staff not being in favour of Bridge21 ("a little": 44%, "partially": 13%; m = 1.78) or not showing interest in it ("a little": 41%, "partially": 22%; m = 1.94). This finding was supported by qualitative comments that highlighted the difficulty associated with "*teachers who are not on same wavelength expected to implement [the] model together*", with one respondent admitting that "*I only use Bridge21 in TY where I have complete independence from my colleagues*". The importance respondents placed on support from and collaboration with their colleagues is further highlighted in their descriptions of the model, such as:

> "*Working with fellow teachers to apply modern teaching and learning methods to the classroom and develop cross-curricular education*"
>
> "*It also encouraged me to practise team teaching.*"
>
> "*Collaborative teaching… Building student-student learning bridges & teacher-teacher bridges.*"

The issue of exam pressure and traditional forms of assessment discussed above was intertwined with this barrier relating to lack of support of colleagues, as illustrated by the following narrative account of one respondent:

> *"[The] same maths test must be given to all second years this Friday. Most of my colleagues are very traditional. I am under pressure to keep up with them. It is all very stressful because when I try some elements of Bridge21 model, it takes more time and the method of assessment insisted upon (i.e. the test on Friday) is not appropriate."*

(3) Barriers relating to ICT access and use:

Data analysis revealed that, for many teachers, barriers relating to ICT access and use prevail on a daily basis in their schools. The following qualitative quotes are used to illuminate this issue:

> "*Lack of access to ICT, broadband problems.*"
>
> "*Access to technology is a major barrier, so much more could be achieved if classrooms and schools had more funding and up to date equipment*"
>
> "*Lack of access to technology. Difficulty in downloading programmes due to network security."*

Findings suggested a concern amongst some participants in relation to the lack of devices available to students. One respondent stated that there was a need for "*portable student devices*", another teacher called for "*more flexible in-class IT - i.e. iPads or tablets and Wi-Fi*", while yet another said:

> "*I don't have laptops for my students. If I had - say - five laptops for thirty students, I think I could use technology better in my teaching".*

These quotes illustrate the theme of 'technology as the conduit', discussed above, and are indicative of teacher's understanding of the integral nature of the teamwork, teacher as facilitator and technology-mediated components of the Bridge21 model. One teacher stated:

> "*I feel I am learning to apply the methodologies e.g. collaboration and teamwork, but without the technology. My students don't have laptops so when I'm in the classroom; I feel I'm the only one using technology. However, I strongly feel that ICT has massively improved the quality of teaching and learning in my classroom over the last three/four years.*"

Despite the prevalence of barriers relating to ICT access and use, school support and goals, and pedagogy, one respondent commented that:

> *"The difficulties in using B21 […] are real enough but are outweighed by the benefits which are greater student engagement and therefore learning, a sense of satisfaction with getting work done and the learning of new skills sets which are then carried forward to the next project. This all leads, at the end of the year, to a much more reflective approach to learning, a greater confidence in ability to learn for themselves and less passive acceptance of information feeding."*

These issues and barriers experienced by teachers in relation to pedagogy, school support and goals, and ICT access and use are discussed in greater detail in Chapter 7.

6.3.6 Summary – explanatory phase

The explanatory phase of the research sought to determine specific ways in which the Bridge21 learning model was effectively used and/or adapted to deliver curriculum content and to what extent it has the potential to support teachers to increase their provision of 21st century learning experiences to students in post-primary classrooms. Additionally, the goal of this phase was to establish a robust practice of PD that can support teachers and to ascertain whether participation in the Bridge21 programme has the potential to increase engagement in 21st century learning reform at a whole school level. Within the above aims, there was a particular focus on **RQ2** and its associated parts, which focus on defining a conceptual framework for a school-university partnership to support teachers in adopting a 21st century learning approach to the post-primary curriculum by using the Bridge21 model. Qualitative and quantitative data were gathered through multiple methods in order to gather data on the experiences and views of a sample of teachers from Years 2 and 3 of the programme, and a purposive sample of principals (1-year post-intervention).

The results provide a rich and contextualised insight into the participant teachers understanding and use of the Bridge21 model in the post-primary classroom. Teachers' detailed accounts of Bridge21 learning activities across a range of subject areas illuminate their understanding of the model and demonstrate how it can be used to teach the curriculum, engender the development of 21st century skills, promote learner autonomy and to facilitate a technology-mediated approach to learning. 94% of teachers who responded to the questionnaire perceived the Bridge21 model to be an effective approach to 21st century learning. Further analysis showed that there was a significant correlation between teachers' beliefs regarding the effectiveness of elements of

the model and their use of it in the classroom. This was also true for teachers' beliefs about ICT in general. For example, teachers who held the belief that students usually understand subject matter more deeply when they use ICT were more likely to use the technology-mediated learning component of the Bridge21 model.

Results also suggest that, through the Bridge21 PD process, teachers have developed an awareness of their role as a facilitator of student learning and have been encouraged to reflect on, analyse and evaluate their professional practice according to the needs of their students and the design of 21st century learning activities. Further, it was evident that principals had a significant role to play in supporting teachers to use Bridge21 in the classroom and in creating the conditions for success of the intervention in the school through a range of measures, including organisational, cultural and leadership. Finally, a number of prevailing barriers to the use of the Bridge21 in the post-primary classroom have been identified, relating to pedagogy, ICT access and use, and school support and goals.

6.4 Summary – Data Analysis and Results

This chapter has presented an account of the aims, context and data analysis processes for each of the two phases of the research. The mixed methods design facilitated the collection and analysis of qualitative and quantitative data at multiple levels during an initial (exploratory) phase, the results of which informed the second (explanatory) phase.

The main finding from the exploratory phase is that the Bridge21 learning model has the potential to be used in the authentic setting of post-primary classrooms in Ireland. Data show that teachers and students responded favourably to participation in the programme. The results also indicate that the learning model leads to improvements in students' self-reported development of 21st century skills. Teachers also reported that they perceived the use of the learning model to teach the curriculum to be of benefit to student learning outcomes, motivation and engagement in learning. The primary output of the exploratory phase was a revised version of the PD model and the development of practitioner guidelines, best practice learning activities and additional teacher support materials.

Results from the explanatory phase provide a rich and contextualised insight into the participant teachers understanding and use of the Bridge21 model in the post-primary classroom. Teachers' descriptive accounts of Bridge21 learning activities across a range of subjects illuminate their understanding of

the model, give an insight into their beliefs in relation to pedagogy and the use of ICT, and demonstrate how the model can be used to teach the curriculum, engender the development of 21st century skills, promote learner autonomy and to facilitate a technology-mediated approach to learning. Results also show that principals had a significant role to play in supporting teachers to use Bridge21 in the classroom and in creating the conditions for success of the intervention in their school through a range of measures, including organisational, cultural and leadership.

Despite these positive findings across both phases, the analyses highlighted several challenges pertaining to the use of the Bridge21 in a setting where there are significant constraints, at multiple levels of the classroom, school and education system. A number of prevailing barriers relating to pedagogy, ICT access and use, and school support and goals in the context of post-primary schools have been identified. These barriers and the initial results summarised above form the basis of the in-depth discussion of findings in Chapter 7.

7 Discussion of Results and Presentation of Conceptual Framework

7.1 Introduction

This study describes the iterative design, development and implementation of the Bridge21 programme, delivered over a sustained period of four years, to support teachers to use a pragmatic model of technology-mediated team-based 21st century learning in the authentic setting of post-primary classrooms in Ireland. The mixed methods design, described in Chapter 5, facilitated the collection and analysis of qualitative and quantitative data at multiple levels during an initial (exploratory) phase, the results of which informed the second (explanatory) phase. Chapter 6 presented an overview of the key results and emerging themes from both phases of the study.

These analyses led to an overall interpretation of the findings under two key headings, guided by the aims of the research and the research questions. These headings form the basis of this chapter, as follows. Firstly, the primary factors that affected the use of the Bridge21 model in the post-primary classrooms under investigation in the study are discussed in Section 7.2. This specifically addresses the first part of **RQ1**:

> **RQ1(a)**: what are the primary factors that affect the use of the Bridge21 learning model in the post-primary classroom?

Section 7.3 considers the data relating to critical aspects of the design of the PD model and the overall programme of engagement with schools, in order to explore the development of a conceptual framework for a school-university partnership to support teachers to adopt the model as a pragmatic approach to 21st century learning in post-primary schools in Ireland. This specifically addresses the two parts of **RQ2**:

> **RQ2(a)**: What are the key elements of a school-university partnership framework designed to support teachers to use the Bridge21 model of technology-mediated team-based learning in the post-primary classroom?
>
> **RQ2(b)**: How do the defining features of the framework, including the approach to PD, facilitate teachers to use this model to teach the curriculum and to increase their provision of 21st century learning experiences for their students?

The chapter concludes in Section 7.4 with a brief summary. The overall conclusions of the study, including addressing the aims and answering the research questions, are presented in Chapter 8. Limitations and potential areas for further research are also outlined.

7.2 Salient Factors

Similar to the approach of Laferrière et al. (2013), analysis of data collected by several methods during both phases of the research uncovered a number of key themes in relation to the dynamics between barriers and essential conditions for successful use of the Bridge21 model in the post-primary classrooms under investigation. Use of analytic and thematic coding processes allowed for a descriptive analysis of the qualitative data and for common meanings to emerge in relation to aspects of the research such as context, causal conditions and actions/interactions (Strauss & Corbin, 1990). In this way, initial codes relating to barriers and conditions for success were mapped into generic categories and main themes, as illustrated in Figure 7.1.

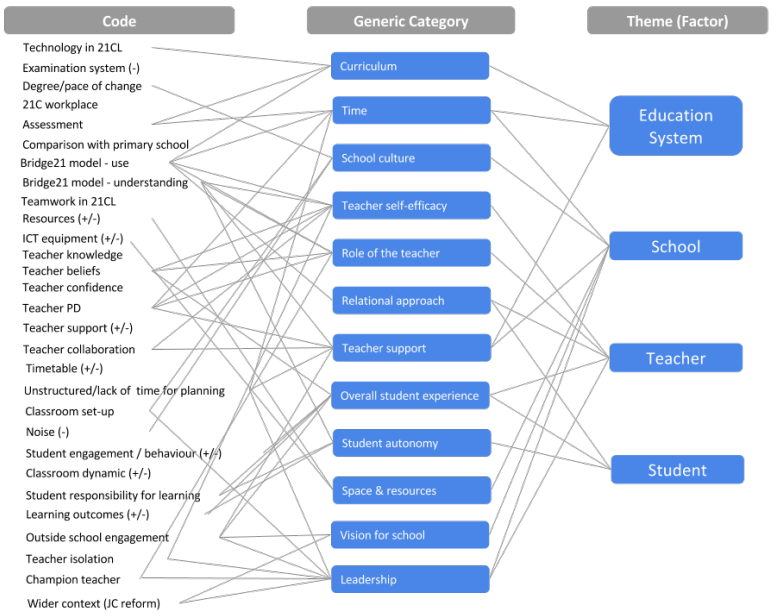

Figure 7-1 Thematic coding process

Figure 7-1 shows how the thematic coding process led to the identification of critical factors at four inter-related levels of student, teacher, school and system that had a significant impact on how the Bridge21 model was explored, used and adapted in the participant schools. **Figure 7-2** presents an overview of the

salient factors and highlights their inter-relatedness. Each one is discussed in the sections that follow below.

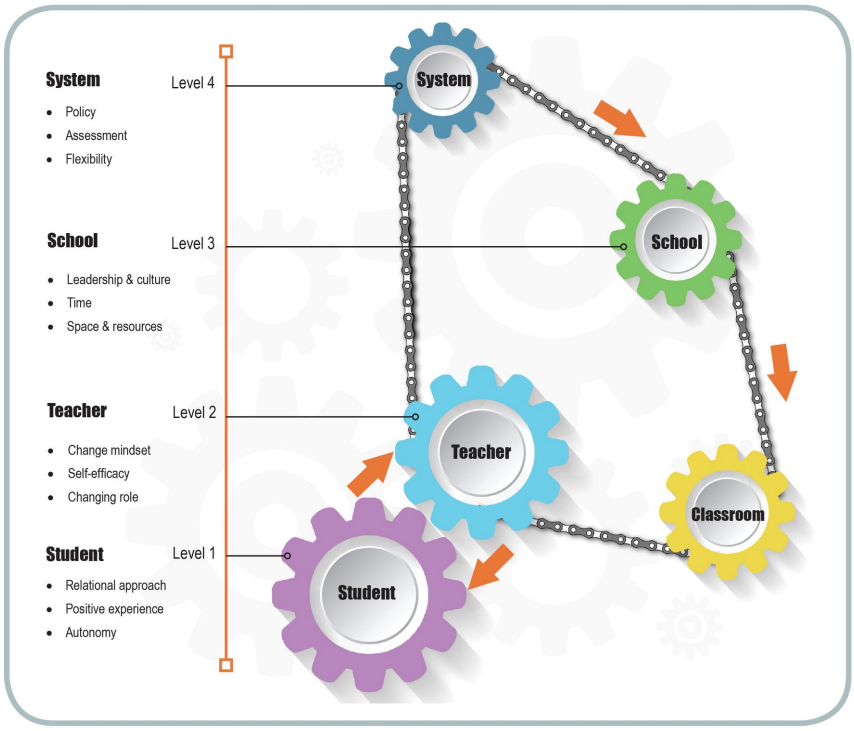

Figure 7-2 Overview of salient factors

7.2.1 Level 1: Student

Analysis of qualitative and quantitative data collected by several methods during the exploratory phase of the research indicates firstly, that the overall response of students to participation in the Bridge21 programme was positive, and secondly, that use of the Bridge21 learning model in the post-primary classroom can lead to improvements in students' 21st century skills. The results presented in Chapter 6 relating to students' overall experience suggest that they perceived Bridge21 learning activities to be active, engaging and enjoyable. As summarised by one student:

> *"It was a wonderful experience because we worked in teams and used the technology. It's taught us so much."*

Qualitative and quantitative data suggest that students had a favourable view of teamwork, in particular, as a key component of the model. There was a statistically significant increase in student self-reported frequency of team-based learning activities, belief that working collaboratively with other students helped them learn and belief that they learned from working as part of a team. These

data indicate positive changes in both the quantity and impact of team-based learning as an integral component of the Bridge21 programme, from the point of view of the students. Comments from teachers also demonstrate how students experienced learning via the Bridge21 model, as evidenced by these sample quotes:

> *"They've all said it - being challenging - they've enjoyed it. They like the challenge, they've learned stuff about themselves, some of them have found that they're leaders, some them have found that they're not leaders. So it is good, I think for the future…"*

> *"Oh yes, well I think when you do [Bridge21] there's no going back, because you actually see that, kids actually, when they are more actively involved in something that they are way more focused."*

> *"I also find that kids respond very well to group work and the Bridge21 model, kind of hidden within the group work. For them they don't really know what it is they're doing but they know they're doing group work and they very much like that. They also kind of fall naturally into roles within the groups. Now we do try to direct them by mixing the roles up a little bit, you know […] so it is directed by the teacher but the students warm to it very much and use it effectively I think."*

> *"Traditional teaching methodologies are not stimulating enough for current technology-competent students. From observation of students involved [...] it was evident they were stimulated by the Bridge21 approach."*

Data emerged during the interviews with school principals to suggest a common view that participation in the Bridge21 programme had a long-term impact on students, extending from their first exposure to the learning model in 1st year:

> *"In first year, some of the projects that the groups were involved in …. I can still remember to this day; certain groups that just did not get on, big fighting between members, but somehow those conflicts resolved themselves. And those students are now in fifth and sixth year, and are talking and getting on with each other. So it has kind of, I would say, accelerated their learning in terms of working in a group and respecting each other, so in that sense the effect [of Bridge21] has been long lasting."*

> *"They were a group who, when they came in the first year, people were very critical of them: they felt they couldn't sit still, they felt they were restless, that their behaviour left a lot to be desired. In fact, some of the students who were most intellectually challenged in the group, were the people that Bridge21 identified as being outstanding, in terms of working as part of the team [...] I would certainly be very*

clear, they were the Bridge 21 class, they suited that model of learning extremely well, and they have, in a sense, Transition Year has restored it to them. And the unanimous verdict of the staff was that they are one of the best Transition Years we have ever had. And I would think that as part of the learning, they will go into the Leaving Cert tunnel, but they will come back out into Third Level and they will fly."

A related finding suggests that student enjoyment and engagement are critical factors in the successful use of Bridge21 in the post-primary classroom. Where students were engaged and enjoying the Bridge21 learning activity, teachers reported a positive classroom dynamic, an increase in student motivation and autonomy, and the development of subject knowledge and 21st century skills. In describing the impact of Bridge21 learning activities on academically weaker students, one teacher said:

"They'd be checking each other's [work] you know, and then if they got the same right answer they'd start high-fiving each other and all this sort of stuff. Oh yeah, sharing answers, and 'what did you get', and 'how did you get that' and 'what did I do wrong', you know, whatever."

Data analysis indicates that student disengagement was usually driven by technical problems, team conflict, absenteeism of team members, poor project/task design, or inappropriate duration of learning activity. Student disengagement was often a factor in affecting teacher self-efficacy, as shown in this quote from one teacher:

"I know that interest generates that within the student – to move the thing forward - but because they were losing interest and it wasn't moving fast enough, I think, that left me feeling 'oh my God what time is it?' ...you know."

These finding are similar to results of research conducted in the laboratory classroom setting of the university which showed that teamwork had a significant positive impact on participants, that students attributed their broader learning to the positive team-based learning experience and that the use of the learning model in the post-primary setting can affect student motivation and attitudes towards learning (Lawlor et al., 2010; Lawlor, 2016). Additionally, there is evidence to suggest that the relational approach (Blatchford et al., 2003; Galton et al., 2009) was an important factor in the successful use of the model in the classroom at both the level of the student and the teacher. This will be discussed in greater detail later in this chapter (Section 7.3.1), as a key element of the design of the PD model.

7.2.2 Level 2: Teacher

Teacher Mind-set & Self-efficacy

Analysis of data from both phases of the research indicates that an attitude of openness and willingness to change on the part of the teachers was a primary factor that affected the use of the Bridge21 model in the post-primary classroom. Findings indicate that sustained and successful use of the model required teachers who were willing to try new ideas in their classroom, to re-think their approach to teaching in the context of 21st century learning, to engage in critical evaluation and learn from mistakes, and also to involve their students in the learning journey of changing their classroom practice (Claxton, 2008; Fullan & Langworthy, 2014; Desimone, 2009). These sample quotes from teachers support this finding:

> *"I think it's about being open to it, I think that's the big thing. You can't say that it's not going to work, without trying it."*

> *"I am open to investigating many models of teaching & learning and incorporate into my own teaching practice those elements which I feel will engage the learners most effectively and allow me to carry out my profession in a sustainable way."*

> *"I am hoping to work on my mistakes."*

> *"Regarding last year and Bridge21, I think we made mistakes but hopefully learned from them."*

Findings show that teachers understood the need to be confident in their own beliefs and ability to trial the use of the Bridge21 model to teach the curriculum, as highlighted in this comment from one teacher:

> *"Can't teach autonomy unless you believe in your own autonomy."*

Yet other comments highlighted the challenges to teacher confidence associated with using teamwork in the classroom, particularly in some schools where only a small group of teachers were involved in the programme. In these cases, there was often a risk of staff feeling isolated and worried about the perception of other teachers who were not involved in the programme, as shown in these comments from teachers:

> *"I believe teachers do not understand collaboration and think it is glorified group work. Sometimes they are afraid to let go and do not differentiate between "constructive" and "destructive" noise. This is not helped by our school's classroom layout with teachers having just a wooden partition between rooms. I do think teachers need training in proper collaboration…"*

"I stopped worrying about the impression of the noisy and messy class as I knew from my students and my own evaluation that these were the classes where learning on many levels was taking place."

"I was just doing group work there [...] and someone came into the classroom and I kinda jumped up and felt a bit guilty cause it looks like I'm doing nothing. Cause it does look like you're doing really nothing. But then it's a lot more work definitely outside the classroom cause if you try and do it unprepared it really is a disaster, full on like killings in the groups and everything, so you do have to prepare everything, and make sure that you know there's no 2 minutes where somebody doesn't know what they're meant to do..."

These comments also provide an insight into the prevailing cultural practice in many of the schools and the engrained traditional beliefs and systems that were often a barrier to teachers wishing to use the Bridge21 learning model to teach the curriculum. These are addressed further under school-level factors in Section 7.2.3.

This finding also surfaced in interviews with principals, with one observing that participation in the programme created a new bond between teachers, but that this led to some teachers feeling isolated from their colleagues:

"There weren't too many volunteers. Therefore, they were isolated when they were fewer in number. Therefore, the conversations they were having with each other in terms of the struggles they were having were a foreign conversation to the other teachers. [...] They had a common bond. Here were these people, some of them were in the school 30 years, others might have been here 3 years. And they had a new common bond which was foreign to everybody else."

Participant teachers acknowledged a degree of fear associated with change (Ertmer, 2005; Donnelly et al., 2011), and that this would likely impede other teachers' willingness to embrace the use of Bridge21 in the post-primary classroom, particularly key elements of the model such as teamwork, 21st century skills and technology-mediated learning. These sample quotes give an insight into teachers' perceptions of collaborating with colleagues and increasing the number of teachers participating in the programme:

"I think it's this big fear maybe, well, probably in myself as a teacher as well, like there's such a change happening and it's happening so quickly – how will we be able to manage it and change it effectively by using all this because I think there is no way of stopping it [...]"

"Collaboration between staff is difficult to find time, it really is, and I think if you haven't been in touch with anyone in Bridge21 or never been here or anything like

that, it can seem very, I don't know, kind of a bit scary maybe if you're new or … sometimes I just think, what we're doing, and it doesn't look very structured which turns people off."

There is some evidence to suggest that critical measures taken by school principals had an impact on teacher mind-set and self-efficacy, supporting them to overcome some of the challenges and issues referred to above. These are discussed further below.

Changing role of the teacher

Data analysis reveals that the role of the teacher was a key factor in how the Bridge21 learning model was used in the post-primary setting. A total of 82 references to the codes 'Role of the Teacher' and 'Facilitator' were found in data from the two phases of the research. Teachers reported that they were unfamiliar with the particular approach to facilitation integral to the Bridge21 model and that they felt unsure as to the amount of guidance they should provide to their students when engaged in team-based learning. As one teacher commented:

"I have to admit I found it very taxing from our point of view [...] not wanting to be dominant in what we were doing because it wasn't our project but you still had to be there on top, I shouldn't be saying on 'top' but you had to be there to try and keep a structure on it and that was very, very difficult."

The data highlight that while teachers understood Bridge21 as *"a model of student-centred learning"* and that learning needed to be *"student, not teacher, centred"* or *"student-led rather than content directed",* they were uncertain how this role translated in practice. There is some evidence to suggest that teachers struggled to find the correct balance between facilitating and directly leading students' learning, as in the following quotes:

"So, we were left there saying [...] how much do we put in? I think in the middle of this, I said to you, I felt I wanted to move it forward and I think you said to me yes, there is a balance and you were more or less encouraging me not to be afraid to get involved…"

"We tried not to be teacher/student, you know what I mean, like providing the information. We tried to get the information from them [...]"

The role of the teacher in the Bridge21 model - as a facilitator and mentor of student learning - is in stark contrast to the role of the traditional, didactic

teacher. Teachers' comments indicated that they were aware that it required a shift in their teaching style, but they were uncomfortable with what they perceived as a more unstructured approach and therefore, more difficult to manage and maintain control in the classroom, and to keep students engaged in learning:

> *"Because some students weren't working at what they were supposed to be – they were completely switched off and it was very hard to manage and to keep it going forward.*
>
> *At times I felt there was lots of chaos."*
>
> *"At the same time while we were trying to work on the weaker ones and motivate them, the other ones, who were well able, they went off on their own tangent and it was kind of like nearly like we were losing control over what they were doing because it was like they were moving so fast [...]"*
>
> *"But sometimes you think, you nearly, feel redundant in that they're busy, they're doing things, and they don't need you for anything, and you could go away and have a cup of tea. And that's not the way you'd feel in a normal class."*
>
> *"It was very much 90% they were working, 10% me."*

The perceived loss of control experienced by some of the participant teachers, along with their concerns about colleagues' views on how they were changing their pedagogical approach and the physical layout of the classroom appear to be rooted in their personal beliefs and experiences of teaching and learning (Hämäläinen & Vähäsantanen, 2011):

> *"When I went to school you'd sit in your rows, and [...] putting the classroom in groups like this scared me a small bit, but I think now that I've done it I'd be lot more confident to see the tables done like this, and it just allows you to, you know the way sometimes you're like 'oh God they're chatting' and it's noisy and it's not what the classroom is supposed to be, but just to be able to get them to work together and talk through things, you know."*
>
> *"I felt a loss of control because I'm usually there, doing what I do, and they're sitting in front of me. And then when you suddenly give them the room, and they're suddenly uplifting chairs and moving furniture, there's an element where you go 'oh God', and I just feel a little bit uncomfortable about that. And then you think 'God if anyone comes in, this looks like mayhem'. That's the thing I'd feel real[ly] conscious of."*

These findings provide an insight into the participant teachers' beliefs and uncover some of the complexity involved in teacher's understanding of their

role in using the Bridge21 model of 21st century team-based technology-mediated learning to teach the formal curriculum in the post-primary classroom. This resonates with Guskey's (2002) and Clarke and Hollingsworth's (2002) finding that teacher beliefs follow, rather than precede or cause, changes in behaviour and practice.

It is evident from the data that teachers were aware of the potential of the Bridge21 model to foster students' ownership of the learning. The findings show that teachers made a conscious effort to change their typical practice in order to encourage student autonomy and also to invest in developing student-student relationships in their classrooms and trust within the teams:

> *"And it takes us a while. I had to actually stop myself physically telling them answers – I had to say 'I can't tell you – you have to come up with the plan' because again, as a teacher, you're always thinking of the question they'll ask you and the answer that you want – just automatically."*
>
> *"Well I found with one or two of my students with the TYs, they weren't interacting with their team and you kind of had to give them a little push because they wouldn't have chosen that team and I had to go 'come on, you're part of that team – get going' and in Fifth Year there'd be one or two who would prefer to work on their own so you're trying to say 'come on – help the ones beside you'."*
>
> *"Yeah they must trust each other and they need to trust me."*
>
> *"I even found their expectation of me as a teacher changed. There was a sense that we were co-educators in the classroom. We all had a responsibility to ourselves and each other. Essentially everyone's productivity was increased but not in a pressurised way but in a dynamic and creative way."*

Other teachers' comments show that consistent application and use of the model over time was highly beneficial for students and allowed for a more reflexive approach to teaching:

> *"The second time I gave them mutual work and it worked much better. I think there is maturity thing as well when it is a dynamic thing. They just worked much better together because there were less messes in the second group as well. The rest of them got down and did well. Even the ones that were messing, I was able to get around them because I was able to leave [other] groups on their own and trust them to do their work."*
>
> *"I suppose you're floating around the groups, from group to group. So it's not like all eyes on you, so it does give you more time, and breathing space to actually think about what you're doing instead of being kind of on display the whole time."*

The significance of the role of the teacher as a factor in the use of Bridge21 in the classroom is further evidenced by data to show that students were challenged by the move away from being a dependent learner. For example, teachers said:

> *"We weren't giving them the information, we wanted them to discover it themselves and they didn't really – they didn't understand, they didn't get it"*

> *"They were far less likely to trust themselves. They were more likely to question what they were doing rather than have an idea and go with it – they didn't want to take a risk of being wrong so they were a lot more afraid of the work. 'What's the answer? What do you want us to do and what's the answer?' They couldn't just take that independent role which the students much younger than them had no problem doing."*

In summary, these findings suggest that changing the traditional role of the teacher is a key factor that affects the use of the Bridge21 model in the classroom. As one principal noted, her school's experience of Bridge21 was *"the beginning of a conversation about moving the focus from the teacher to the learner."* She continued by explaining:

> *"The teachers needed guidance on having more trust in their students and trust in the fact that students have the technology, they know how to Google something and find it out, they don't need to depend on the teacher for everything. So maybe the courage to trust students a little bit more and to think differently about how they do things. Some are doing that more successfully than others."*

Figure 7-3 (Conneely et al., 2012) summarises the changing role of the teacher in a descriptive framework that illustrates the move away from a teaching style of direct instruction and control towards orchestration, coordination and facilitation of learning. This, in turn, leads to student growth from being entirely dependent on the teacher to adopting more responsibility and becoming a self-directed learner. This aligns with Hämäläinen and Vähäsantanen's (2011) research on orchestration whereby the role of the teacher changes from "monologic to dialogic actor" (p.177) and classroom activities are designed to encourage learners to challenge themselves in shared-knowledge construction with the combined support of teacher scaffolding and digital learning resources and tools. **Figure 7-3** shows that teachers may perceive a decrease in their level of influence on the learning process as they cede control and autonomy to the student, but this recovers in time to coincide with the growth in student personal responsibility for learning.

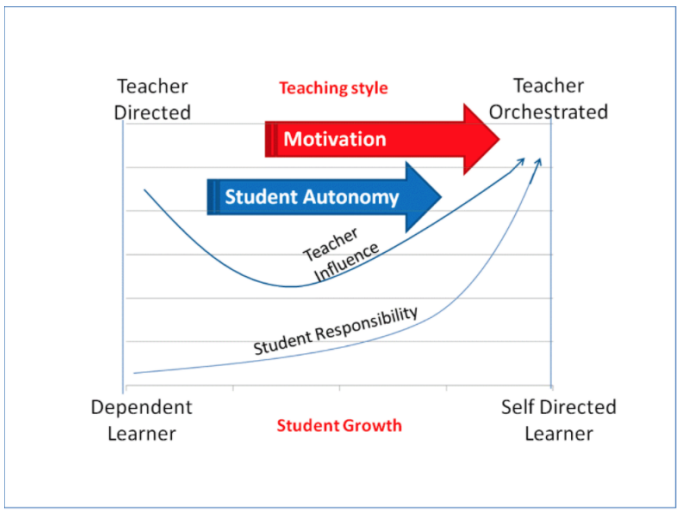

Figure 7-3 The changing role of the teacher (Conneely et al., 2012)

7.2.3 Level 3: School

Analysis of data across both phases of the study identified a number of factors at the school level, similar to the work of Means (2010), Ertmer and Ottenbreit-Leftwich, (2010) and Voogt et al., (2013). These school-level factors fall into three main categories: firstly, time (relating to timetable, planning, curriculum and degree of change); secondly, space and resources (concerning classroom and furniture layout, perceptions of noise and disruption, and access to and availability of technology); and thirdly, leadership and culture (including the principal's vision for the school, ways of supporting teachers and promoting a culture of collaborative practice). The factors and related categories are illustrated in **Figure 7-4** and discussed in the sections that follow below.

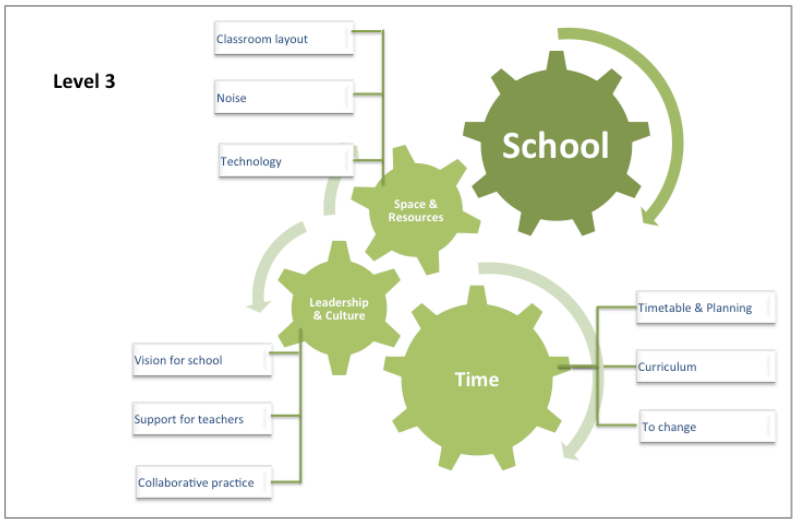

Figure 7-4 Summary of school level factors & sub-categories

Time

Data suggest that it proved challenging to engage students in meaningful collaborative, project-based learning activities as per the Bridge21 model during the typical school timetable of 35-40-minute class periods. Qualitative comments from teachers and principals highlight this factor, for example:

> *"Timetable is a problem. Classes are 35 mins and time is lost setting up and tidying the classroom. Double classes would be better." (Teacher)*
>
> *"Need 50-60 minutes class periods" (Teacher)*
>
> *"Hindrance always is the timetable and logistics." (Principal)*
>
> *"Time is the biggest constraint. I know, the time is a constraint …" (Principal)*

The fact that several schools from the programme made changes to the design of the school timetable suggests that principals acknowledged class duration to be a significant factor that affected the use of the Bridge21 model in the post-primary classroom. These quotes from a teacher and a principal illustrate the rationale for this change:

> *"I have a double sometimes so I have 80 minutes which is, 40 is too short and 80 is pretty long, an hour would be great I think. So we're talking about maybe changing the timetable next year so that English has double classes a lot more, so they'd have 80 minutes, which would be a great amount of time to get it set up and get them working. So that's on the cards for next year." (Teacher)*
>
> *"We changed our timings from 40 to 35 minutes - that was designed to give as many 1 hour 10 minutes classes as possible and that allowed other certain subjects to have classes that were more frequent. Definitely the experience working in Bridge 21 will have encouraged that very much, in that if you wanted to do anything in terms of project work or computer-based work or anything that is explored in an enquiry based manner needs more time than 40 minutes, so that definitely will have had a strong influence in our decision." (Principal)*

Data analysis from both phases of the study show that time for planning was a factor that affected the use of Bridge21 in the post-primary classroom, particularly in the context of the change scenarios that were provided to schools, as described in Chapter 4 (see Section 4.2.1). Data show that it proved challenging to find adequate time in the typical school timetable to allow teachers to plan Bridge21 learning activities, particularly in the case of cross-curricular projects involving groups of teachers collaborating and co-teaching. Teachers commented on the significant amount of planning required for

Bridge21 in comparison to traditional teaching (*"A lot of the preparation – I put in a lot of time before it started"*), realising post-activity that more planning was necessary ("*I didn't plan well enough"; "It has to be more structured, I have to plan more"*). The lack of allocated planning time was also noted (*"Oh we would have had no time, it would literally have in been in between classes"*), which highlighted how collaboration between other teachers could be a factor in tackling this challenge:

> *"It takes an awful lot of organising. Hours upon hours of organising. And I suppose that's where, you know, sharing resources with other teachers, and that's, yeah, that's gonna have to happen, because it takes hours and hours..."*

> *"There's not much time for us to actually see each other and talk about these things [...] ideally it'd be great if we had an hour a week where everyone could meet up and share ideas and things like that but it just doesn't really work that way."*

A small cohort of teachers (n = 3) commented that they failed to see the benefits of the time invested in planning in terms of learning outcomes. These teachers struggled with the trade-off they had to make by missing other classes so that they could be given time to plan and prepare a Bridge21 activity with their colleagues. This was particularly evident in data from the exploratory phase, as shown in the following quotes:

> *"I really enjoyed it but I'd have to say I'd be reluctant to do it again unless it was more structured in terms of timetabling for planning and that because I have to say it stressed me out in terms of missing my classes, trying to get supervision and I know the Principal got supervision in but at the last minute you were going 'oh my class needs to be supervised because we're going to have a meeting'. Missing a full day on the Wednesday and the kids saying 'oh Teacher F was out on Wednesday for the last five weeks' when I wasn't – like that stressed me out. That's just me personally – I like structure and I like to be where I'm supposed to be at a time."*

> *"We'd have to miss classes and our timetables would be all over the place and then you'd be missing your Sixth Years."*

> *"We had preparatory meetings, we had the full Wednesday morning and then we had evaluation sessions and one of the things that stuck in my mind afterwards was after all of that preparatory work and all of the input etc. and evaluations, I actually think their learning outcomes were very minimal for the amount of time that went into it, you know, if you're looking at putting this on as a future mode of learning, I think it needs to be really, really much tighter and I'm just saying the amount of time that was put in and if you looked at the learning outcomes and what was achieved – it was quite minimal."*

However, as discussed above, in Section 7.2.1 and in Chapter 6, the majority of teachers recognised the positive impact that Bridge21 learning activities had on student learning outcomes and generally accepted that the length of time was an important factor that affected the use of the model in the context of the post-primary classroom. For example, one teacher described:

> *"So it took me about 3 weeks, so that'd be one of the things that I'd find about it in that it took longer. Now they probably did no better than if I taught it, because they'd be a very mixed ability class so what you gain with one hand I suppose you take back with another. So I lost time, but I felt they knew it. And even long after, when I was revising [the topic] there for the summer tests, they knew it like that, they didn't know other things half as well. So I found that there was definitely a gain in the way that they acquired the knowledge."*

As presented in Chapter 6, data also reveal that teachers felt that "*time constraints imposed by curriculum*" greatly affected how Bridge21 was used in the participant schools, with a total of 35 references to the code 'School time organisation' from data collected during the two phases of the research. The content-heavy second-level curriculum in Ireland and the expectation to cover a subject course or topic within a set amount of time constrained the participant teachers in terms of how many classes they could dedicate to Bridge21 learning activities and the degree to which they could adhere to the pedagogical approach:

> *"Again, it's the time constraint. I found that I did more Geometry with my Second Years and at the end of it they knew all the physicality about slopes and everything like that, but I thought 'my God, I spent too long at this' – you had to rush the next bit, so you were constrained with time."*

> *"They have to do a lot of individual thinking, and they are obviously not ready for it. I should have done some introductory more structured tasks first with them but there's a course to cover."*

Additional comments highlight the pressure that teachers felt to meet the demands of their subject curriculum, to keep pace with school and subject department plans, or to meet the requirements of the inspectorate:

> *"Pressure to get through the syllabus"*

> *"Because of the size of the syllabus – it's bigger now, much bigger."*

> *"I tried to use collaboration while also following our school plan. If I had an inspector I probably would be criticised for not following our original plan. This will not be problem next year as I drew up the plan with collaboration in mind."*

Finally, time was a significant factor in relation to the pace and degree of change that occurred in the participant schools, both in terms of evolving towards a new pedagogical approach and in widening teacher participation in the programme. This theme emerged from qualitative data from principals and teachers in the explanatory phase, as shown in the following sample quotes:

> *"It's just going to take it a lot longer, yeah. But it is [...] - it's hard work on all sides, and it is time consuming. There's no doubt about it." (Teacher)*

> *"It was the beginning of a conversation about moving the focus from the teacher to the learner. It is one of those things you don't just get feedback in terms of how much you achieved, you can't quantify here, [...] what we are talking about the four-year period, it was the beginning of something new." (Principal)*

> *"It took a while, it started to become language of everybody. [...] But that would have taken a few years." (Principal)*

This finding is complementary to the NCCA's (2009a) foundational principles for supporting change, which propose that it takes time to achieve deep change, and that change should be characterised by quality.

Space & Resources

Results from both phases of the study indicate that the physical space of the classroom was a key factor that affected the use of Bridge21 in the participant post-primary schools. Below is a sample of teacher descriptions of the changes made to the furniture and physical layout of the classroom. In addition to providing an insight into teachers' understanding and pedagogical use of the Bridge21 model in the authentic setting of the post-primary classroom, these comments also highlight the changes to their understanding of their role (as already discussed in Section 7.2.2.2):

> *"I promote more group work within the classroom, my classroom has physically changed shape, students are encouraged to discuss tasks with each other and plan how to achieve results, we use more technology when available."*

> *"As part of an English module in TY I began working through groups on getting students to speak amongst themselves about their strengths and fears around public speaking and encouraging them to emerge with topics they might explore for speech writing. We used the room to good effect in this by moving tables away and sitting in groups of four. "*

> *"And so we've changed classrooms in school like into little pods or whatever you want to call them."*

"It's all based on group work. I changed it actually not long after to speaking to yourself [Bridge21 member of staff] the last day. I had some of the pods in the centre of the room and I had the room in a U shape initially and pods in the centre and I've changed the whole room around now. Some of the students have their backs at angles to the board or at angles to me but it actually works better because they depend on one another an awful lot which then allows me to step back a bit."

Related to this finding, there is evidence to suggest that teachers liked the team-based classroom layout and that, contrary to their fears that students would be unable to learn from one another (Lewis & Cowie, 1993) and that there would be increased conflict amongst students when engaged in group discussions (Cowie, Smith, Boulton & Laver, 1994), students were more engaged in learning:

"I personally prefer the group work setup, I don't like the rows of lecture hall style."

"I loved it when the tables were, you know, arranged for, we'll say, group work [...] kids really liked that. Kids love it, they have absolutely no problem with it at all. And they don't see it as a, that we can, oh we can chat and mess. They don't, you know, they actually don't see it like that at all, you know. So that would definitely be my preferred way of having it."

Analysis of quantitative data collected during the explanatory phase showed that the constraints of school space organisation norms adversely affected the use of the Bridge21 model in the classroom by a majority of the teachers (see **Figure 6-24** in Chapter 6). This was supported by qualitative data from teachers and principals, who referred to issues regarding the "*learning space - furniture, room size, noise travels to other classrooms"* - as a pedagogical barrier, along with the lack of understanding and support from other colleagues, as discussed above. As one teacher noted:

"Furniture needs to be altered and teachers need to be less territorial about space and the physical layout of the classroom - this latter point is bigger than it sounds as it is based on hierarchy and status...."

This resonates with McMurrow's (2006) finding that the 'architecture' of the curriculum (class size, space, absence of soundproofing) was a major constraint in using active learning methods in Irish post-primary classrooms and prevented teachers from even considering a change in their teaching methodology. Teachers in this study described how they found themselves 'tolerating' higher levels of noise in the classroom during Bridge21 learning activities. The sample quotes below provide an insight into the complex culture of post-primary schools in Ireland and the perception amongst teachers that a

silent, quiet and "orderly classroom" (ibid, p.328) is an indicator of learning. This was a significant concern for one teacher in this study, who said:

> *"I'd say 'I'm doing Bridge21, if anyone asks, and this is part of it'. Plus, I knew people, like [colleague's names], so I knew that suddenly there wasn't lunatic noise coming out of my room and that I hadn't, I don't know, lost the plot."*

For other teachers, the noise, conversation and increased levels of interaction amongst their students provided evidence for them that their pedagogical approach had changed:

> *"[My teaching practice has] totally changed. I now listen more to pupils, I let them express themselves, I put up with more noise in the class. I sit back more and put the onus on them to research answers/ solutions to problems. There is still a need for some teacher led learning but not half as much as I was doing."*

> *"You'd have to put up with a lot more noise and that's a big change, you know, teaching very much as a dictator for 32 years, [...] I would have been chalk and talk, you know. And now, often times I say nothing in class, except wander around [...] I found I became a facilitator. So it was good, but they, they, as I said noise would be a big thing."*

Finally, a key indicator that the design of the learning space was a salient factor in the use of Bridge21 in post-primary schools was that, in 2014, by the end of the intervention under study, two of the schools had undertaken substantial refurbishment projects to design a dedicated Bridge21 learning space in an under- or disused classroom. However, a detailed investigation into the design, development and use of these learning spaces is beyond the scope of this research.

It is evident from the data analysis that access to and availability of technology was a key factor that affected how teachers were able to use and apply the Bridge21 learning model in the post-primary classroom to teach the curriculum. Issues identified via qualitative and quantitative methods include Broadband/Wi-Fi problems, inadequate supply or complete lack of student devices, out-of-date equipment, teachers using personal equipment, teachers loaning their personal devices to colleagues, and teachers having to negotiate shared use of student devices – what Ertmer (2005) would define as first-order barriers. The following qualitative quotes from teachers have been selected to illuminate this finding:

"In terms of the technology, I don't know whether I will go down that road if I can't [...] get more reliable resources I don't know if I will be going down that road but I will be certainly pushing in the background to get those resources made available to me."

"Access to technology is a major barrier, so much more could be achieved if classrooms and schools had more funding and up to date equipment."

Teachers recognised the need to have "*more flexible in-class IT - i.e. iPads or tablets and Wi-Fi,"* and an adequate supply of *"portable student devices".* As already noted in Chapter 6, teachers felt that they were learning to apply many aspects of the Bridge21 model, such as teamwork and project-based learning, but that poor access to ICT resources, particularly for students, prevented them from fully exploring the use of Bridge21, and, in particular, how technology could be used to mediate the learning process. As noted earlier in relation to other factors, there is some evidence to suggest that leadership had a key role to play in addressing some of the challenges and issues in relation to ICT access and resources. These are discussed further below.

Leadership & Culture

There is evidence to show that the support of the school principal was a critical factor that affected the use of the Bridge21 model in the authentic setting of the post-primary classroom. Data reveal that a common characteristic across the participant schools who maintained a consistent engagement with the Bridge21 programme over the four-year period of the study was strong leadership. This trait generally manifested itself in a principal who had a clear vision for Bridge21 in the school that was focussed on teaching and learning. The three principals who participated in interview recalled that they were motivated to join the Bridge21 programme in order to improve student learning:

"That [students] begin to see learning as relevant, that they could put a context to it, that they see that it is fun, inspiring and that they really enjoy it."

"If we could change the way we teach and allow for more interaction and collaborative learning, then I think it would improve the style of learning for our students or help the style of learning for our students. That's really what I was trying to start."

"I'd always been concerned about the middle learners in this school [...] a lot of students weren't getting attention, and they weren't coming on. So, the whole Bridge

21 approach seemed to make sense and it seemed to be a direction that we needed to get involved and going."

Data show that the context of the wider education system at the time the Bridge21 programme was initiated, described in Chapter 3, also had a key influence on a principal's rationale and vision for engaging their school and teachers in the intervention. Similar to the factor of teacher mind-set, discussed in Section 7.2.2.1, the level of adoption of Bridge21 in schools was highly dependent upon principals who were open to exploring ideas about teaching and learning in the 21st century. Not only did the new directions of the Junior Cycle reform help the principals to reach clarity on the intention and outcome of engaging with Bridge21, it facilitated a process of evolving towards and supporting a different way of teaching and learning, which is a central tenet of the process of change (NCCA, 2009a). One principal reflected that she had a goal to examine the mind-set and approach of what she described as "traditional" members of staff:

"They just have been doing what they have been doing for years. And while they were very good at minding the students, I really felt we needed to look at how we taught them and move differently."

Presenting Bridge21 as an initiative focussed on enhancing teaching and learning, rather than a technology-led intervention (McGarr, 2009; Petko et al., 2015; Voogt et al., 2013) had a significant impact on principal's rationale for engaging their school in the programme. The following quote from one principal demonstrates how this aspect of the model aligned with her belief and vision for how ICT should be integrated in the school:

"I also found it very assuring that the conversations in Bridge21 were not about technology for the sake of technology, they were technology as an instrument to enhance the learner's opportunity and even the way the space was - they were old PCs and all of that... - at a time when most of my colleagues in other schools were talking about iPads and iPads for everybody, I felt it brought us in the right direction. We were looking at the learner experience".

It is evident from analysis of data collected in interviews with principals that, in addition to vision and beliefs, they also needed to have a degree of energy and passion for the Bridge21 model and programme of activities. For example, one principal shared this reflection on her role as principal during the four-year period:

"I think my passion and my need for everybody to be doing active methodologies [...] is far greater than any kind of energy. That's what just always keeps me going. I

am so horrified at the fact that people don't use active methodologies, that that's what energises me at all times, no matter how isolated or how lonely the journey can be. But we've got to do it. I am driven by that, really. And I'd never stop."

These findings are supported by analysis of quantitative data collected in the teacher questionnaire (presented above in Chapter 6) which shows that where principals communicated a clear vision, teachers felt supported and encouraged to try new things in the classroom and to work towards a common instructional goal for their students and the school as a whole. However, quantitative data analysis shows that 39% of teacher respondents disagreed (or had no opinion) that their principal communicated a clear vision for the school. In light of this, and the points discussed above, future iterations of the model of PD could include a vision-setting exercise for teachers and principals to explicitly emphasise the importance of having a common vision and set of goals to work towards together. As one principal reflected:

"You want to capture that interest from teachers and you get more widespread consensus, but then at the same time, you still need someone just to say, "Right. Let's go ahead and do it." I think back to the initial time when it was introduced, I think we could spend more time getting staff to understand the need for everything, instead of just rushing through it."

At the 'early adoption' stage of the programme, in particular, teachers were in need of continuous support and encouragement, both from within and outside of the school, as evidenced by one teacher who reflected "*Well, I don't think it's that difficult, it's just somebody to go through it with you, you know, only for you"*. Analysis of data collected from several methods shows that school management had a key role to play in providing support and encouragement to teachers throughout the programme to try Bridge21 in the classroom and to implement learnings from the PD activities. The following quote from one principal illuminates this finding:

"You just have to support the people who have volunteered to do it, you are just watching their back all the time [...] as long as you at least watch their back for all the kind of logistic things that they want - if they need time, if they need room. And then it can be just simple things about checking in with them how it's going. So, sometimes it's just literally, what I call corridor meetings [...] I am a great believer that let's just try it first, face it and learn and move on. And we can do it again and do it better. And it was great that somebody else was saying that as well. Giving

them not just the methodological support but also a kind of emotional support, I mean not judging but encouraging them and reinforcing them."

There is evidence that principals also supported teachers through practical means by being flexible with the timetable, by providing creative solutions to challenges in relation to technology, resources or classroom space, or by facilitating the availability of students and teachers to participate in the intervention workshops, in or outside of school, during the year. For example, in one school:

"In terms of support from the then Principal, he was open to [Bridge21], and support was expressed in terms of finance to support the project, and also in terms of giving time in meetings for planning. So that was very useful."

One principal described what she perceived as a pivotal role in solving practical problems such as those listed above:

"There is a point sometimes if you want something to cross the line and to succeed, you actually have to be the person to take on the other little fires and dampen them out. And the only person that can do that is principal; when push comes to shove. I think that's the pivotal role for the principal."

However, in other schools teachers became frustrated by a perceived lack of planning and decision-making by the principal, as shown in this comment from a teacher regarding technology resources for Bridge21 activities in the classroom:

"The only clear solution is portable devices but there is no management decision on that never mind plans.... bottlenecks can be the undoing of progress terminally so more action required here."

This negative comment is further testament to the fact that the school principal was a critical factor that affected the use of the Bridge21 model in the authentic setting of the post-primary classroom.

In addition to leadership, the professional culture of the school was a factor that significantly affected how Bridge21 was used in the participant post-primary schools. It was evident that some principals greatly appreciated the centrality of teachers as key agents of change in the school (NCCA, 2009a) by identifying small groups of "*champion teachers*" or early adopters who could begin to build momentum around the ideas of Bridge21 in the school and eventually encourage others to get involved. This is in line with Voogt et al.'s (2013) suggestion that a model of distributed leadership will ensure that change is

occurring at multiple levels within a school. This finding emerged from analysis of data collected from teachers and principals, for example:

> *"Well, I suppose, something like this can only happen if you get support from a number of teachers to get the momentum going. I would like to see more teachers who are enthusiastic, and beginning to see things outside their own subject areas and appreciation and enthusiasm for a more integrated collaboration, that is conducive to learning. It is very difficult to get into some people's hearts and minds, so it would be nice to see a little more of that." (Principal)*

> *"I definitely think that when a few teachers get involved in it, it kinda takes, maybe they're the more courageous ones, and they can go and they can try it out, and then I think when other teachers hear, oh you're doing this, then it sounds good, I can do that - that kind of encouragement to get on board." (Teacher)*

However, the quote below highlights that one teacher in particular was uncomfortable with being a leader of the intervention in his school, suggesting that the leadership and support of the principal is still critical in this regard:

> *"Well I don't want to go bugging people, you know, I need to know my place as well, you know. I'm not - I'm a subject teacher and I can't really go imposing myself on others. The computer teacher agreed, the transition year coordinator agreed, I was putting my neck out on that score and I was lucky enough that they said yes."*

Some principals took a formal approach to integrating Bridge21 and nade it visible in the wider context and culture of the school; for example, one school used their Advisory Board of Studies[17] as the vehicle through which Bridge21 could be explored, trialled and discussed. Whereas in other schools, a more informal strategy was followed with ad-hoc conversations or sharing of ideas and resources between teachers, as shown in the quotes from this principal and teacher:

> *"It was more informal, we didn't have any staff meeting or the teacher presenting that this is the project I did. There was more informal discussion at the end of the project, to invite some general feedback on the project itself." (Principal)*

> *"It'd be more just discussing ideas about what works and what doesn't work and, like [teacher P] would be great for giving ideas for group work and the best way to kind of organise it, the best way to structure the group work and things like that. And then [teacher J] just suddenly changed his classroom and he loves it. So it's*

[17] The Advisory Board of Studies was a representative group of teachers who met monthly to discuss and plan teaching and learning initiatives for the school.

more like talking about the ideas, but then we go back and do it by ourselves in our own classroom." (Teacher)

It is evident that principals sought to build and develop a culture of collaboration in the school through engagement with the Bridge21 intervention. Key features of the programme – including the model of PD, the change scenarios, and the process of co-designing and team-teaching cross-curricular projects – facilitated new opportunities for collaboration, problem-solving and professional dialogue between teachers. It is evident that principals had a critical role to play in supporting and leading collaborative practices, as shown in this quote:

> *"Encouraging but also talking things through to see how we'll solve it together. And teasing out the issues. And no filtering out what the problem is - let's see what it is, see what we can do. And no filtering out the solutions either." (Principal)*

As one teacher noted, there had been "*no change in the collaboration, but the reasons for collaboration"* with colleagues at her school. Similarly, in one school, where the principal believed that there already was "*a very good culture of professional dialogue, and the idea of learning"*, Bridge21 was positioned as "*not asking people to work harder [...] asking them to work smarter."* Yet another principal described her school's engagement with Bridge21 as *"a journey"* for staff to travel together. The small size of this particular school meant that they had fewer resources, but the principal sought to leverage this to build a sense of professional learning and collaboration amongst the staff:

> *"Being a small school in terms of resources - we have very few resources. But that can be a plus as well because that means we know each other better so therefore can we work together and better? So, there's opportunity and strength in being small as well [...] That, I think, then encourages people to have a sense that problems could be solved if we work together. But again it's all just about working together [...] You are just walking with them. It's our own little Camino really, isn't it?"*

This finding echoes the work of Laferrière et al. (2013) who found that "pivotal actions" taken by key agents in an intervention can result in tensions and contradictions becoming the "driving forces for transformation" (p. 470).

7.2.4 Level 4: System

In response to the question in the teacher questionnaire *Is the Bridge21 model relevant for teaching and learning in the 21st century?* 100% of respondents agreed. Analysis of the qualitative responses to this question and data collected from other qualitative methods provide context and further evidence in support of

the positive attitude of principals and teachers towards Bridge21 as a model of 21st century teaching and learning. Given the context of national reform in post-primary education in Ireland in which the current study was situated, as described in Chapter 3, there is evidence to suggest that the Bridge21 model was perceived to be appropriately designed to tackle some of the prevailing challenges of the post-primary system, including the transition from primary level and the rigid assessment structures (NCCA, 2011b). Teachers stated that the team-based, project-oriented pedagogical elements of the Bridge21 model are *"common practice at primary level"* and that the learning approach *"addresses the key skills and statements of learning as prescribed in the new Junior Cycle curriculum and is ideally suited to meet the needs of students as we prepare them for the major educational changes of the future."* Other quotes further illuminate this critical characteristic of the Bridge21 programme - what Desimone (2009) describes as coherence, whereby what was being experienced through the PD programme was consistent with reforms/national policies:

> *"[…] couldn't be better timed, both with pupils being so technology literate and the introduction of JC2 which requires us as teachers to change from our traditional framework."*

> *"Bridge21 can count itself among many good innovations taking up the challenge of accommodating students in new approaches to their education."*

These data suggest that teachers' levels of confidence in and willingness to use the Bridge21 model in the post-primary classroom were influenced by the context of school reform and 21st century learning approaches being promoted in the wider education system at the time. One teacher shared his observation that the Bridge21 approach, in contrast to traditional teaching methodologies, was more stimulating and engaging for students and thus he was willing to use the model to teach his subject:

> *"Traditional teaching methodologies are not stimulating enough for current technology-competent students. From observation of students involved in the workshops - both in-school and in TCD - it was evident they were stimulated by the Bridge21 approach."*

In this way, the current study addresses a criticism in the literature of PD for technology integration by attempting to "harmonise context, policy, practice and research" (Twining et al., 2013, p. 430).

Related to this finding is the shift in the role of the teacher, already discussed in 7.2.2 above, that is inherent in many of the national policy documents outlining current proposed reforms (e.g. NCCA, 2009a; NCCA 2011). Data suggest that

teachers and principals perceived Bridge21 as a model in which the pursuit of student autonomy and a skills-focussed approach to learning could be explored:

> *"The model combines many of the cornerstones of progressive teaching making the students the focus and moving away from the long redundant teacher-focused lecturing which occurs in many classrooms." (Teacher)*

> *"It has to be the way to go. Very often in secondary schools like ourselves the students have traditionally found it hard to move from being spoon-fed by the teacher to having to fend for themselves in university or the world of work. The reliance on the teacher is much less in the Bridge 21 model." (Principal)*

> *"The best teachers I have seen [...] are the people who are excited by mixed ability teaching, who themselves see the point of a less content-driven approach to teaching. And those students and those classes are just on fire." (Principal)*

It is evident that teachers perceived the role of technology in the Bridge21 model to be a central reason for its relevance in the 21st century. Data analysis suggests that teacher's use of the Bridge21 model aided the development of their understanding that technology can mediate a learning activity, and, in doing so, can develop students' 21st century skills (such as managing information, accessing knowledge, problem-solving, communication and creativity) and promote higher levels of engagement in learning. For example, in explaining why she thought Bridge21 was a relevant model for 21st century learning one teacher stated:

> *"The learning environment is changing away from an industrial age model of age-based groupings in fixed classrooms, with a knowledge-giving teacher at the front. There are so many sources of information/skills available now and what is therefore most important is an education in how to access, research and communicate this information as well as creatively connecting and expanding it into one's everyday world."*

Evidence that the education system is a critical factor in how Bridge21 can be used in post-primary schools was also found in qualitative data relating to support for teachers, both by those in the school and also from external partners, such as a university or agencies within the education system. The data highlight the crucial role of leadership and the need for formal recognition and appointment of teachers to middle management/leadership roles, such as the

'Posts of Responsibility' [18] in the Irish education system, in order to appropriately support teachers engaged in a new learning intervention and programme of PD. These sample quotes reveal the awareness of this issue among principals and teachers alike:

> *"I am lucky, as well, that all these people took on those roles of leadership at a time in particular, when the leadership roles were being knocked out of the Irish education system[19] [...] And so here we have these people who were doing things that were core to the running of the school and as time has gone on, over the years, people can see that they are more important than some of the posts." (Principal)*

> *"We don't have those, you know like there are posts in school, and we used to have somebody with an IT post, [...] but now we don't really have anyone who is officially in charge of looking after IT." (Teacher)*

> *"There are some teachers who will maybe try something once without having done enough research or without feeling confident enough to do it and it maybe won't work the first time they try it and they'll say 'oh well, I tried that and it didn't work' so they might need more support from yourselves or from the NCCA but I do believe they will need support to implement this properly because it is a large step away from where we started where key skills and themes are more important than the minute details." (Teacher)*

The prevailing pressures of the traditional education system (for example, high-stakes examinations, subject syllabi to be covered in a fixed amount of time, the inspectorate) were a significant factor that affected teacher's use of the model in the post-primary classroom. Analysis of quantitative data (see **Figure 6-23** presented in Chapter 6) showed that pressure to prepare students for examinations and tests was the most significant pedagogical barrier to using Bridge21 in the classroom. This finding was verified by qualitative data, where teachers and principals explained:

> *"I often felt frustrated in the classroom as what I perceived to be an obsession with the end result rather than the process. The question of whether the learning process could be as valuable as the outcome weighed heavily on my mind." (Teacher)*

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[18] Posts of responsibility are part of a school's official leadership and management structure. See education.ie/en/Schools-Colleges/Information/Employment-Terms-and-Conditions/Posts-of-Responsibility.html

[19] This comment is in reference to education policy funding cuts at the time, as described in the context of the explanatory phase (see Section 6.3.2)

> *"The constraints of the exam system and the kind of school this is, where parents are genuinely very concerned in relation to results…" (Principal)*

This finding is further illuminated by the following quote from one teacher who felt he had more freedom to explore the use of Bridge21 in the post-primary classroom with a particular year-group because he was not teaching a high-stakes Leaving Certificate examination class:

> *"In my 32 years teaching, this is the one [year] I've enjoyed the most, you know. Now I was lucky, I don't have a Leaving Cert class, I've a couple of Junior Certs, so I didn't have the pressure of teaching for Leaving Cert, so next year might be different."*

Additionally, data analysis showed the impact of the exam-focussed education system on students' expectations from their teachers, as shown in this sample quote:

> *"Now the Juniors, I feel they still think that… they still look back on the teacher and say 'oh look we've done the presentation but now can we have the notes'. They still want the notes to be handed to them."*

The above findings suggest that teachers face a dilemma in overcoming the tension that persists between their acceptance of the Bridge21 model as a valid approach to 21st century learning, and the challenges of using it within the constraints of the rigid, overcrowded post-primary curriculum and the demands of the high-stakes examination system. The Bridge21 learning model strongly adheres to the work of Fullan and Langworthy (2014), who advocate for a shift in the focus of teaching from covering all of the content required in a curriculum to the process of learning itself, supporting students to be self-directed learners and to develop meta-cognition of their skills and abilities. Yet many of the current forms of post-primary assessment in Ireland, in particular the Leaving Certificate, do not reflect the classroom practice of a teacher or school using the Bridge21 model, described earlier in this thesis. It is likely that teachers and principals will continue to grapple with these challenge until such a time as new approaches to formal assessment are developed that facilitate an information society pedagogy, such as the Bridge21 model, and enable students to develop 21st century skills and competencies.

Despite the above challenges, the data suggest the Bridge21 programme is closely aligned with the new Junior Cycle and its associated new measures of assessment, which strongly prioritise formative over summative modes of assessment. However, significant methodological challenges are yet to be

overcome, including the proper integration of discrete subject knowledge with key skills, the development of new models of assessing students' learning processes and thinking strategies and the means of distinguishing individual contributions and skills on collaborative tasks or projects. The findings discussed above suggest that the particular mind-set and appetite to tackle such challenges was present in Bridge21 partner schools. These final quotes have been chosen to illustrate this point:

> *"I strongly believe that if we don't embrace the vision of Bridge21 we are in extreme danger of continuing to stunt generations of children's intellectual development to a simple attitude of 'will it be on the paper?' Education as imagined by Bridge21 is one where we are educating students for the future. If we don't become radical in our teaching and learning we might as well drip feed study notes into our students from the moment they enter our schools." (Teacher)*

> *"We are not as bad as we think we are. Listening to other schools sometimes, now that we have gone down the road we kind of forget that like, when you look at other schools and you are kind of like, Oh my God they are so miles behind." (Principal)*

> *"Well, I think what [Bridge21] did is where Junior Cycle has gone. I think it has been a perfectly attuned interaction [...] As we move into the new Junior curriculum - putting together e-portfolios and independent projects - I have absolutely no doubt that one speaks to the other" (Principal)*

7.3 Towards the Development of a Conceptual Framework

A key focus of this study is to develop a conceptual framework for a school-university partnership to support teachers to adopt the Bridge21 model of 21st century learning as a pragmatic approach to teaching the formal curriculum in post-primary classrooms in Ireland. This specifically addresses the two parts of **RQ2**:

> **RQ2(a)**: What are the key elements of a school-university partnership framework designed to support teachers to use the Bridge21 model of technology-mediated team-based learning in the post-primary classroom?

> **RQ2(b)**: How do the defining features of the framework, including the approach to PD, facilitate teachers to use this model to teach the curriculum and to increase their provision of 21st century learning experiences for their students?

In light of the multi-level factors already discussed, this section now considers critical aspects of the design of the PD model (Section 7.3.1) and the overall programme of engagement with schools (Section 7.3.2). These findings then form the basis of a proposed conceptual framework (Section 7.3.3) intended to facilitate and support teachers to use Bridge21 as a pragmatic approach to increasing the provision of 21st century learning experiences for students in post-primary classrooms in Ireland.

7.3.1 Design of the PD model

Findings in relation to teachers' experience of PD during the exploratory phase of the research informed the development of a revised version of the model presented in Chapter 6 (see **Figure 6-4**). Refinement of the model separated the PD into two distinct phases: an initial concrete experience of 'teachers as learners' and 'observation of learners' in the Bridge21 model (Phase 1) and an active developmental cycle that includes conceptualisation, active experimentation and reflection (Phase 2). It has been argued in Chapter 6 that the refined model of PD aligns more closely with the overall social-constructivist approach of the Bridge21 learning model and reinforces Putnam and Borko's (2000) view that professional learning interventions should provide a framework for teachers to engage as active learners who construct their own understanding and awareness of personal challenges, beliefs, needs and capabilities to cope with the changes required.

Data collected from multiple methods during the explanatory phase of the study suggest that aspects of the refined model of PD had a direct influence on teacher's confidence and willingness to begin creating new learning experiences for their students, as already discussed in Section 7.2.2.1. Teachers stated that *"I am more confident to try new approaches", "It has given me the confidence to take risks",* and *"It also encouraged me to practise team teaching".* Additionally, data analysis indicates that the PD model heightened teacher's awareness of many aspects of 21st century learning, again emphasising the concept of coherence as a key characteristic of the PD experience by engaging teachers in learning that is consistent with their knowledge and beliefs (Desimone, 2009):

> *"I am much more conscious of providing learning opportunities and evaluating results rather than 'teaching' every aspect of the course and expecting the answers I gave in response. It was great in terms of bringing to the fore the conscious acknowledgement of using teamwork and technology in order to embed some of the 21st century skills."*

"While I would have used all of these components before, the approach of combining them together in a structured way was useful."

"I have just completed a Diploma in Learning Support/Resource ed., which promoted the same learning principles as Bridge 21 so I was already starting to apply these principles in my teaching."

Teachers and principals cited different aspects of the PD approach, including the experiential design and constructivist pedagogy of the PD model, as having a benefit on their teaching practice. For example, one teacher recalled *"the workshops where the teachers were taught using the Bridge 21 model were most beneficial."* Whilst one principal described the practical supports in terms of planning and implementing the model in practice in the classroom as particularly beneficial:

"In terms of the planning and in terms of the idea generation, and in terms of structure and the projects, I think they were quite useful. Different things were tried for the projects, and over a period of time, a model of proper working of a project emerged."

There is evidence to suggest that the relational approach (Blatchford et al., 2003; Galton et al., 2009) was an important factor in the successful use of the model in the classroom. Results highlight teachers' understanding of the importance of student training in teamwork skills - "*to build a group dynamic first*" - in advance of subject-specific Bridge21 learning activities in the classroom. Section 6.2.5.5 described results from the exploratory phase that highlighted the importance of supporting teachers to develop and transform their practice through experiencing the Bridge21 model first-hand and observing their students learning in the laboratory classroom setting on the university campus. These findings were reinforced by results of the explanatory phase. As one teacher explained:

"There's a lot of pre-teaching at the beginning but then as it went on, you know, it definitely was them working in their own groups and we'd help them if we could but it was more of us going around, observing them and making sure they were on the right track and stuff like that."

Teachers felt that the initial student workshop also gave students the opportunity to develop technical skills that would be transferrable to curricular-focussed projects upon return to the classroom. For example, one teacher stated:

"It was just fantastic going into Bridge21 just to watch [the Bridge21 staff], you know, put the teams into groups and just observing, you know, getting to choose a team captain and communicating with them to pass on a message... And the skills that he [Bridge21 staff member] gave them, just in relation to, like, filming stuff and creating audio files, they definitely stood to the students just with the projects we did with them in French. A lot of preparation went into their project and it ended up taking a lot longer than we first anticipated. But […] you could see that the students really engaged with it and they enjoyed it a lot."

Yet another teacher commented that repeated exposure to and experience of teamwork across different subjects had an impact on student's engagement, confidence and autonomy during Bridge21 learning activities:

"They must be getting used to the group work because they must be doing it in more classes, they're much more, you know at first when I was saying to get into groups it was like arguments and 'what are we supposed to do' and everything; but now they seem more used to the system like 'this is what happens now' and they kinda go off into their groups and they're prepared for it, they know what they're doing. A little bit more confident maybe."

The increase in student confidence and ability in turn boosted teacher confidence to use the Bridge21 model and tackle the challenges of creating high-level, productive collaboration in the authentic setting of the classroom (Dillenbourg & Jermann, 2010; Vass & Littleton, 2009):

"I had been to Dublin to the Bridge21 with that group [...] so I felt they knew immediately what I was at, and it was much easier for me to kind of say, now this is what we're gonna do…"

In addition to engendering the development of students' 21st century skills, the relational approach in the PD model was designed to afford teachers the opportunity to observe and understand their students learning using the Bridge21 model. There is evidence to suggest that having a concrete experience of the Bridge21 model, outside of the classroom in the purpose designed learning space of the university campus, was of benefit to the teachers. Seeing how technology and student-centred approaches to learning could be used in practice, helped teachers to visualise how they might implement it in the classroom (Ertmer & Ottenbreit-Leftwich, 2010). As one teacher said:

"I suppose unless you see it [the Bridge21 model and learning space], it's definitely an advantage going into [Bridge21] and seeing it. Like and I sort of came out and 'OK, I know where I'm going now', you know, that was the advantage of it."

These findings were supported by comments from school principals who observed how the relational approach helped teachers to envisage how the model could work in practice in the classroom. Principals perceived the experience as giving teachers the time and space away from the normal school environment to interact with their colleagues, to reflect on their knowledge, beliefs and culture, and to give what Rigelman and Ruben (2012) describe as a valid starting point from which they could experiment with the learning model upon their return to school:

> *"In Bridge 21 where [the students] got exposed to the ideas of working in a group [...] that was very, very well received and successful. There were teachers who accompanied them and began to see how this could work in practice."*

> *'For other people it was just getting into the space in Bridge 21 and away from here so it gave them head space. So, they might have gone in there saying 'but sure I knew how to do that'. But then I'd say yes, but you got time to think. You got time to talk to others. You got time to get renewed there and refreshed to come back and try something else, and then inform others here as well here [...] The modelling of that alone seeped into people's creativity and how they should operate and try to create a room that would allow for that kind of a flow."*

However, for some teachers the initial experience in the university laboratory classroom setting was too much of a 'novelty' and they found it challenging to visualise how they could use the model to teach their subject within the confines of the resources and structures of post-primary schools. This is similar to Zhao et al.'s (2002) finding that innovations are less successful when they are most distant from teachers' existing practices and the prevailing school culture. For example, teachers commented:

> *"That day was, you know, it was like a day out. It was a bit of novelty and the kids felt the novelty of it. Whereas on a day to day basis if they're going to be doing this every week the novelty is going to wear off and I'd like to kind of see it in practice, in real practice and to see it expanded and folded out over weeks and weeks."*

> *"You know, when you're up in Dublin in [the university laboratory classroom] and you have the pods and things and everything's grand and everything's set up. For you to come down here and see exactly what our scenario is and what we have been saying, and then you would probably be able to see how we'd be able to work it better."*

These comments suggest that further refinement of the model of PD is merited to explore how the teacher's transition from the initial, exploratory experience

to an on-going cycle of development and action, in the context of individual dynamics of classrooms and culture of schools, might be enhanced.

7.3.2 Overall programme design

Data analysis reveals a pattern in relation to the perception of teachers and principals regarding the on-going support from Bridge21 practitioners and the nature of the external partnership with the university. It was strongly referenced by teachers, for example:

> *"Guidance, engagement and support from Bridge21 and its staff has been very encouraging for me in my teaching practice as I attempt to move away from more traditional methods which I was finding ineffective."*

> *"Accessing energy from outside the secondary level to give momentum to learning within."*

Equally, principals referenced the nature of the partnership and described how they leveraged the Bridge21 programme to embark on a longer process of change in the school. For example, one principal reflected that:

> *"I think the initial engagement was just like an immersion project, you got to get into this, and a jump into something completely different, even though people thought that was interesting and we could endure. Bit by bit, having seen it, I think it made it concrete as opposed to traditional in-service. So in a sense what we had with you people over there doing it, and saying 'Maybe I could do some of that'. So, you know, it is a cumulative thing [...] it was like you were opening a window for staff into a different way of doing things."*

Based on these data, it is reasonable to suggest that the collaborative, non-hierarchical model of sharing expertise between the partner schools and the university throughout the intervention, as advocated for by Zeichner (2010), was a positive aspect of the overall programme design. Additionally, the extended period of engagement with the partner schools centred on the pragmatic use of the Bridge21 learning model in the classroom explicitly addressed one of the key challenges of teacher PD identified by Lieberman and Pointer Mace (2010) to be its fragmented and disconnected nature, and its irrelevance to the real problems of daily classroom practice.

For those schools that had been involved in the original outreach programme of the university (described in Chapter 3), there was a degree of trust and understanding between the Bridge21 staff and teachers and principals that facilitated a positive initial experience of the intervention in this study. This quote from one principal demonstrates this:

"I think that there is a very trusting relationship between [Bridge21 staff] and yourself [the researcher]. And then the people who were leading on it were trusting voices from here as well. If we were to use the analogy of the bridge, there are many bridges - do you know what I mean? - to get to it. I think that helped. And then I think it got a kind of energy and excitement…"

In many cases, there is evidence to suggest that the nature of support, guidance and encouragement inherent in the school-university partnership facilitated a change in teacher's practice. When asked in the teacher questionnaire '*Do you consider that your teaching practice has changed as a result of engaging with Bridge21'*, 91% of respondents said yes. Detailed exploration and analysis of the qualitative responses to this question provide context and further evidence in support of participant's change in professional practice as a result of their engagement with the Bridge21 programme. There is a high frequency of the use of the verb 'try' in teachers' responses to this question, further demonstrating the factor of teacher mind-set (discussed in Section 7.2.2.1) and willingness to adopt what they learned in their classrooms. For example:

"I try to introduce project based learning and technology into my lessons and to get students more involved in their own learning."

"Trying to implement more engagement activities and experiential activities to complement the curriculum."

"I am much more willing to engage in project work in my classroom after my experiences with B21."

Those teachers who had a high number of years' experience (11-20) make reference to the fact that engagement with Bridge21 affected their classroom practice in a positive way by sustaining their interest in and optimism for the profession.

"Looking at the length of my teaching career, one of the greatest challenges that I face is to be fresh for each new intake of students. I am open to investigating many models of teaching and learning, and incorporate into my own teaching practice those elements which I feel will engage the learners most effectively and allow me to carry out my profession in a sustainable way."

"I have 20 years' experience teaching. I have found it essential to develop personally and professionally to retain an optimistic approach and to remind myself of the importance of incorporating creative responses to the pressures and demands of the job, rather than relying on control or discipline. Also, students gain by being

exposed to a variety of methodologies and of being out of the school for learning. I find that the opportunity for the students to connect a variety of experiences outside of the school building enhances their learning, but also their experience of schooling."

"While I would have used all of these components before, the approach of combining them together in a structured way was useful."

The final quote above also illustrates the finding that, for many teachers, engagement with Bridge21 reinforced concepts previously learned during initial teacher education or at other PD, which they may not have otherwise put into practice. Other teachers cite that they had previously used some components of the model but had not combined them in the structured manner of the Bridge21 learning model. This finding was echoed in the views of the school principals. One stated:

"It's about changing that culture and building, putting in resources within our own staff. [...] And when it worked - you see, the other piece is, it has to be seen to be working - and when it worked then they were kind of excited about it. But it also gave energy, space and freedom to teachers who had been here for a long time, who were dying to do it, but never had the opportunity"

Those teachers who considered their teaching practice had changed since engagement with Bridge21 referred not only to their own PD but also to changes that they witnessed in their classroom, in student-student and teacher-student relationships, and in student's engagement in learning, as already discussed in Section 7.2.1. This was evident in data from teachers and principals alike, for example:

"Engaging with B21 has taught me to engage more with my students not just on a personal level but also in generating a less teacher dependent relationship and encouraging a greater autonomy on their part to become independent learners." (Teacher)

"Teachers are realising that a group can be an effective way of learning in teaching, and project work and challenge-based learning can be very effective. So, in that sense, a lot of teachers have adopted and see changes in the culture of the school." (Principal)

7.3.3 Proposed conceptual framework

To achieve greater and more sustainable impact of research in education systems, it is critical to provide conceptual frameworks, so that solutions and interventions, particularly those related to ICT, can be more easily integrated into the classroom, school and wider education system (Prieto, Dlab et al., 2011). Jabareen (2009) defines a conceptual framework as a network of interlinked concepts that together provide a comprehensive understanding of the phenomenon or phenomena under study. A conceptual framework may be developed and constructed through a process of qualitative analysis, leading to a graphical or narrative representation of "the key factors, constructs, or variables, and [...] relationships among them" (Miles and Huberman, 1994, p. 440).

Accordingly, findings in relation to the design features of the PD model and the overall programme of engagement between the university and school, along with the critical factors examined above, form the basis of a proposed conceptual framework to facilitate and support teachers to use Bridge21 as a pragmatic approach to 21st century learning in the authentic setting of the post-primary classroom. The conceptual framework also draws on related research from the literature (Chapter 2) and the original design principles for PD (Chapter 4) to propose a school-university partnership centred on 21st century learning that seeks to address some of the constraints and complexities of the post-primary education system in Ireland at a time of national reform.

At the core of the conceptual framework (presented in **Figure 7-5** on page 243) is a vision of 21st century learning for the school that is developed collaboratively by principals and teachers and shared with students. Teachers engage in a cyclical and dynamic process of PD (Levin & Wadmany, 2008) that is experiential and constructivist in nature and adheres to a relational approach by explicitly including a developmental sequence of student learning in parallel that aims to engender the development of students' collaboration and teamwork skills over time. Additionally, the relational approach afforded teachers the opportunity to observe and understand their students learning in the Bridge21 model. Principals take on the critical role of leadership by supporting teachers and students engaged in the programme, whilst also recognising teachers as key agents of change and the centrality of the whole school to the change process (NCCA, 2009a). Further, principals explicitly demonstrate support for the programme by addressing issues and overcoming barriers relating to school organisation (timetable, classroom allocation etc.) and resources (ICT access and availability, furniture etc.). A collaborative

partnership between the school and the university, centred on active participation from all involved, is proposed in order to enhance the integration and adaptation of the Bridge21 model for the learners (Means, 2010). These critical aspects of the partnership also seek to break down the insulation and isolation of teachers that is particular to post-primary education in Ireland (Hogan et al., 2007).

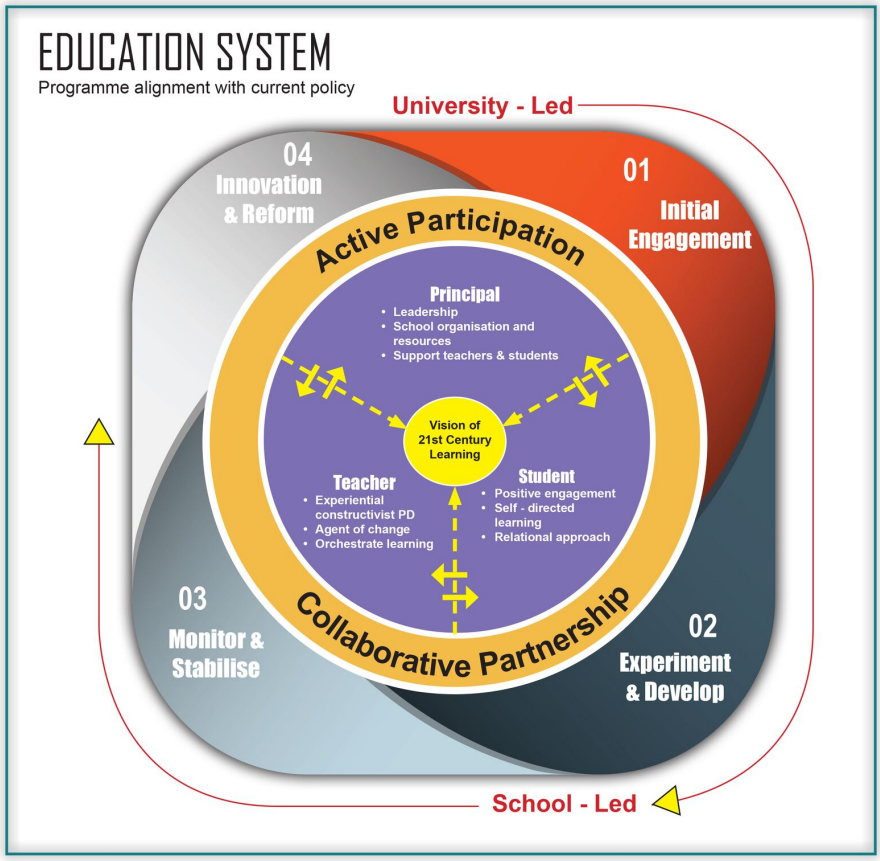

Figure 7-5 Proposed conceptual framework

As shown in in **Figure 7-5**, four stages of engagement are proposed in the framework, the first two (Initial Engagement, and Experiment and Develop) being led by the university (or external partner), whereas the second two (Monitor and Stabilise, and Innovate) are driven by the school. As discussed in Section 7.2.3, analysis of qualitative data showed that time was a significant factor in relation to the pace and degree of change that occurred in the participant schools, both in terms of evolving towards a new pedagogical approach and in widening teacher participation in the programme. Thus, progression from the University-led stages (Initial Engagement, and Experiment and Develop) to School-led stages (Monitor and Stabilise, and Innovate) occurs over time, as shown in Figure 7-6 (p.244). This reinforces the

NCCA's (2009a) foundational principles for supporting change, which suggest that it takes time to achieve deep change in schools, and that change should be characterised by quality rather than pace or duration. Thus, the exact duration of each of the phases of the proposed conceptual framework vary greatly from school to school, depending on many of the salient factors at four inter-related levels of student, teacher, school and system, as discussed in Section 7.2.

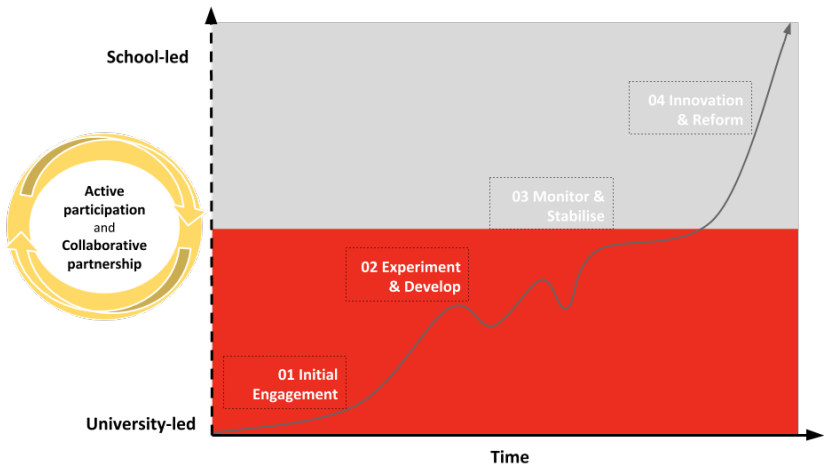

Figure 7-6 Proposed conceptual framework v time

In a research context, this school-university engagement framework may be viewed as a 'win-win' collaborative partnership that provides expertise and external support for schools embarking on a journey of innovation and change, and simultaneously provides universities (or external organisations) with real context and data to inform research and refine models and methods of best practice in education reform. It is suggested that the proposed conceptual model directly addresses a key recommendation identified in the review of literature (Chapter 2) to break down the traditional barriers that often exist between schools and universities by creating a non-hierarchical model of sharing expertise and building partnerships that promote collaboration and learning (Zeichner, 2010).

7.4 Summary

Analysis of qualitative and quantitative data from both phases of this study led to the discussion of findings in this chapter under two key headings, guided by the aims of the research and the research questions. Firstly, key factors at four inter-related levels of student, teacher, school and system have been identified as having a significant impact on how the Bridge21 model was explored, used

and adapted in the participant schools under investigation in this study. These factors bear a resemblance to categorisations in the literature of barriers to ICT integration and factors for successful use of ICT in schools (Khalid & Buus, 2013; Means, 2010). Findings in relation to the design of the PD model and the overall programme of engagement with schools have also been explored. There is evidence to suggest that the particular model of PD developed during this study includes a sufficient balance of a pedagogical and practical strategies to equip teachers to overcome some of the barriers and challenges relating to 21st century learning in schools, and technology-mediated learning in particular, as identified by Ertmer (1999), Ertmer & Ottenbreit-Leftwich (2010) and others. The key findings discussed in this chapter form the basis of a proposed conceptual framework to facilitate and support teachers to use Bridge21 as a pragmatic approach to 21st century learning in the authentic setting of the post-primary classroom.

In the final chapter that follows, detailed answers to the research questions and overall conclusions of the study are presented. The limitations of the work and areas for further research are also considered.

8 Conclusion

8.1 Introduction

The aim of this research is to document and critically evaluate the iterative design and implementation of a programme, over a four-year period (2010-14), to support and enable a cohort of teachers to use and adapt the Bridge21 learning model to teach the formal curriculum in the authentic setting of post-primary classrooms in Ireland. As discussed in Chapter 5, the rationale for the study was firstly grounded in the researcher's experience and participation as an educator, designer and researcher in the Bridge21 programme from its inception in 2007. Findings from early research on the effectiveness of the model, in which the researcher was co-author, suggested its potential as a vehicle for delivering effective 21st century learning activities to post-primary students (Lawlor et al., 2010; Tangney et al., 2010; Lawlor, 2016). Whilst these results were by no means conclusive, they served as the foundation for the design of a programme to broaden the range of contexts in which the model could be used. The authentic context that formed the basis of this study was the classroom of post-primary schools in Ireland.

Secondly, the rationale for the study was influenced by the external context of the wider education system at the time. As discussed in Chapter 3, a greater emphasis on 21st century skills was proposed than had heretofore featured as a learning outcome in post-primary education in Ireland. Hence it was a time when school leaders and teachers were seeking pragmatic models of learning that could support a paradigm shift from a traditional and predominantly didactic approach to teaching and learning, towards one that could facilitate the development of 21st century skills and improved learner autonomy. Thirdly, the rationale for the study was firmly rooted in international studies and literature, including results of recent large-scale international research projects such as the Innovative Teaching and Learning (ITL) global research project (Fullan, 2011; Bernard & Langworthy, 2011; Leahy & Butler, 2011), and the SPRinG project (Blatchford et al., 2003; Blatchford et al., 2006; Baines et al., 2007; Galton et al., 2009; Kutnick & Berdondini, 2009), that had demonstrated positive results in the areas of educational technology, innovative teaching and collaborative learning – key concepts at the heart of the research.

A multiphase mixed methods design, adhering to the principles of design-based research, was adopted to enable the researcher to examine two primary research questions. The study is qualitative dominant overall, however the research instruments facilitated the collection of qualitative and quantitative data during

two separate phases of research. This approach reflected the pragmatic epistemic values of the researcher in seeking to compare different perspectives drawn from a combination of methods and data in order to provide a "full and complete picture" (Denscombe, 2010, p.141) of the practical intervention under exploration. Additionally, the collection and integration of both qualitative and quantitative methods facilitated a comprehensive understanding of the impact of the multiple phases of the intervention over time and the evolving needs of the participant teachers and students. The research questions were explored simultaneously through both phases and the final interpretation of the entire analysis of data is the basis for the presentation of overall results and statement of the contributions of the thesis in the sections that follow.

8.2 Addressing the Aims of the Research

The overall aim of this study was to document and critically evaluate the design, development and implementation of a programme to support teachers to use the Bridge21 model in the post-primary classroom. This aim was divided into a number of key objectives that were the focus of the two phases of research. It is argued that the data analysis and results presented in Chapter 6, and the discussion of key findings in Chapter 7 provide a degree of evidence to show that these objectives have been met. Each of the objectives and related outcomes are discussed briefly below.

The first set of objectives relates to the potential of the Bridge21 learning model as a pragmatic approach to 21st century learning in the formal classroom. Specifically, these objectives were:

- To gather evidence to illustrate students' and teachers' overall experiences and views regarding the use of Bridge21 in an authentic setting, i.e. the post-primary classroom.

The intervention design, described in Chapter 4, facilitated the researcher gather a range of evidence from multiple sources during the two phases of the research to illustrate students' and teachers' overall experiences and views regarding the use of Bridge21 in the authentic setting of the post-primary classroom. The data show that teachers and students responded favourably to participation in the programme. This positivity was primarily driven by the overall perception, held by teachers and principals, that students benefited from participation in the programme. While there are data that point towards a number of challenges and barriers to using Bridge21 in a formal setting, the overall finding was that teachers perceived a range of benefits to their students who participated in the programme, including increased levels of engagement

and motivation, and positive changes in classroom dynamic. Students themselves reported that they particularly enjoyed and benefited from the teamwork element of the Bridge21 model, which is complementary to results of research conducted in the laboratory classroom setting of the university which showed that teamwork had a significant positive impact on participants and that students attributed their broader learning to the positive team-based learning experience (Lawlor et al., 2010; Lawlor, 2016).

- Objective: To determine specific ways in which the Bridge21 model can be effectively used to deliver the curriculum in the post-primary classroom.

The intervention design, particularly the development of a series of 'change scenarios' (NCCA, 2009a) described in Chapter 4, and the mixed methods research design outlined in Chapter 5, ensured that this objective was addressed. A number of examples of how the Bridge21 model was applied and adapted by teachers were collected, analysed and reported (see Section 6.2.5). These examples highlight the diverse range of approaches taken by teachers and principals to designing subject-specific and cross-curricular Bridge21 learning activities and projects and illuminate the creative ways in which the challenges of the 'architecture' of the curriculum (McMurrow, 2006), such as classroom space and layout, class size and noise, were tackled.

- Objective: To identify whether the Bridge21 model facilitates teachers to increase their provision of 21st century learning experiences and the effect these experiences have on student skill development.

In addition to the learning activity examples noted above, qualitative data gathered from teachers and principals provide rich and contextualised accounts of how the Bridge21 learning model was used as a pragmatic approach to increasing the provision of 21st century learning experiences for students in their post-primary schools. Quantitative data from the teacher questionnaire show a high frequency of individual components of the Bridge21 learning model being used by teachers on a weekly or daily basis with classes beyond the core group of target learners in the project (1st Year students). Additionally, there are some modest and significant differences in type and frequency of 21st century student activity (including collaborative learning and use of ICT), and 21st century teacher instructional strategies in Bridge21 classes compared to non-Bridge21 classes. Analysis of quantitative data collected in the student questionnaire (administered during the exploratory phase) shows a significant statistical difference for six elements across all of the three key 21st century

skills under investigation – being creative, working with others and managing information and thinking (Johnston et al., 2015; Conneely et al., 2013).

This first set of objectives described above relates specifically to **RQ1**, and thus the emerging outcomes and results are discussed in greater detail in Section 8.3 below. The second set of objectives focuses on the evolution of the programme to support teachers to understand and adopt the learning model to teach the post-primary curriculum. Specifically, these objectives are:

- To identify the PD needs of teachers and define the key features of a robust model of PD and a school-university partnership to support the use of Bridge21 in the post-primary classroom.

The focus of the initial (exploratory) phase of the research was to trial an initial version of a proposed model of teacher PD (described in Chapter 4) in order to uncover more contextualised insight into the nature of professional learning and support required by teachers wishing to use the Bridge21 learning model to teach the curriculum in the post-primary setting. The analysis of data from phase 1 informed the development of a refined PD model, which was the basis of the second (explanatory) phase. As discussed in Chapter 7, data collected by multiple methods during the explanatory phase suggests that aspects of the refined model of PD, and the core design principles, had a direct influence on teacher's knowledge, understanding, confidence and ability to begin and continue to create new 21st century-oriented learning experiences for their students. These findings in relation to the design features of the model PD and the overall programme of engagement for schools in the intervention led to the development of a proposed conceptual framework. At the core of this framework, described in Chapter 7, was the notion of a collaborative partnership centred on active participation from all agents involved in order to enhance the integration and adoption of Bridge21 in post-primary schools and to achieve a common vision for 21st century learning.

- Objective: To build a repository of best practice learning activities that can be shared with the wider community of teachers and schools in the post-primary sector in Ireland.

Analysis of data collected during the initial (exploratory) phase led to the development of best practice resources, including sample learning activities, and a set of guidelines for teachers, to support them to develop and deliver effective technology-mediated team-based learning activities for the post-primary classroom. These best practice resources and guidelines, described in Chapter 6, continue to be developed through further research and have been

widely used in subsequent on-going large-scale programmes in the researcher's university, including formal accredited programmes of teacher PD. This is discussed further in Section 8.4.3 below as a key contribution of the research.

The second set of objectives described above relates specifically to **RQ2**, and thus the emerging outcomes and results are discussed in greater detail in Section 8.3.

8.3 Answering the Research Questions

In order to address the aims of the study described above, two primary research questions were identified. The first question (**RQ1**) seeks to explore whether the Bridge21 learning model has the potential to be transferred from its original use in the context of a laboratory classroom setting (the university outreach project) into the authentic setting of post-primary schools in Ireland. The question is divided into two parts:

> **RQ1(a)**: What are the primary factors that affect the use of the Bridge21 learning model in the post-primary classroom?
>
> **RQ1(b)**: How does participation in such learning experiences affect the development of students' 21st century skills?

The second question (**RQ2**) focuses on developing a conceptual framework for a school-university partnership aimed at supporting teachers to adopt a 21st century learning approach to the post-primary curriculum using the Bridge21 model. The two parts of this question are as follows:

> **RQ2(a)**: What are the key elements of a school-university partnership framework designed to support teachers to use the Bridge21 model of technology-mediated team-based learning in the post-primary classroom?
>
> **RQ2(b)**: How do the defining features of the framework, including the approach to PD, facilitate teachers to use this model to teach the curriculum and to increase their provision of 21st century learning experiences for their students?

The following sections present the development of the research and the primary findings reported in this thesis, in order to answer each of the research questions.

8.3.1 The potential of Bridge21 in formal education

As noted above, whilst the results of previous research served as the foundation for the design of this study, it was necessary to give due consideration to the challenges and complexities of transferring research findings from specific conditions (the laboratory classroom in the university), to an authentic setting (classrooms in post-primary schools) (Hämäläinen and Vähäsantanen, 2011). Hence, a number of critical design principles were identified at the outset of the study to guide the design of the intervention and facilitate the researcher to explore the potential of the Bridge21 model in formal education settings. These design principles, described in Chapter 4, followed the 'tight but loose' approach to teacher PD, advocated by Thompson and Wiliam (2008), whereby the core components of the Bridge21 pedagogical approach were identified and embedded throughout the design of the intervention, while also giving teachers and schools a degree of adaptability and flexibility in implementing the model in their individual classrooms (McMurrow, 2006). Thus the design of the intervention included practical matters such as "change scenarios" (NCCA, 2009a) that articulated a continuum of possibilities for how the participant schools and teachers could begin and continue to integrate the Bridge21 model into their daily practice, a detailed programme schedule for delivering the intervention and the creation of teacher resources and activity planning material. In addition, a core component of the design of the intervention was the model of PD. The preliminary model that emerged during the design stage (presented in Section 4.3.5) was used during the initial (exploratory) phase of the research and was reviewed and further refined during the second (explanatory) phase, based on analysis of data and ongoing review of the literature. The key elements of the design of the refined model of teacher PD informed the development of the conceptual framework (**RQ2**), discussed in greater detail below.

The iterative design and implementation of the programme was carried out over a four-year period (2010-14) and divided into two phases of research – exploratory and explanatory. The collection and integration of both qualitative and quantitative methods during the two phases of the research yielded a rich, contextualised and comprehensive account of the broad range of ways in which the Bridge21 learning model was used in the classrooms of participating post-primary schools. These descriptive accounts, examples of learning activities and practical changes made to school organisational structures (e.g. timetable), outlined in Chapter 6, demonstrate the potential of the Bridge21 learning model as a pragmatic approach to teaching the curriculum and increasing the

provision of 21st century learning experiences at post-primary level. Moreover, there is evidence to show that teachers and students responded favourably to participation in the programme, and to particular elements of the Bridge21 model. As already noted in Section 8.2, students responded very favourably to the particular approach to teamwork that is central to the Bridge21 pedagogy.

Similar to the approach of Laferrière et al. (2013), analysis of data collected by several methods during both phases of the research uncovered a number of key themes in relation to the dynamics between barriers and essential conditions for successful use of the Bridge21 model. In answering **RQ1(a)**, key factors at four inter-related levels of student, teacher, school and system have been identified as having a significant impact on how the Bridge21 model was explored, used and adapted in the participant schools under investigation in this study. First, at the level of the student, their overall positive experience and progression towards a more autonomous and self-directed way of learning were identified as important factors. Further, there is evidence to suggest that the relational approach (Blatchford et al., 2003; Galton et al., 2009) was an important factor in the successful use of the model in the classroom at the student level. This will be discussed in greater detail later in Section 8.3.2, as a key element of the design of the PD model and conceptual framework. Second, at the level of the teacher, the most salient factors relate to their mind-set, attitude and openness to change and their self-efficacy in using the model – in particular the key elements of teamwork, technology-mediated learning and teacher as facilitator. Analysis of qualitative data highlights the challenges and complexities involved in moving teachers from a deeply ingrained style of direct instruction and control towards one of orchestration, coordination and facilitation of learning, particularly in the context of the post-primary education system (Conneely et al., 2012) (see **Figure 7-3** in Chapter 7).

Third, at the level of the school, a number of significant factors that affected the use of the Bridge21 model have been identified. The school-level factors fall into three main categories: time (timetable, planning, curriculum and degree of change); space and resources (classroom and furniture layout, perceptions of noise and disruption, and access to and availability of technology); and leadership and culture (the principal's vision for the school, ways of supporting teachers and promoting a culture of collaborative practice). Fourth, and finally, a number of factors at the level of the education system were identified as having an impact on the use of the Bridge21 model in the participant schools. These factors included the constraining nature of the state examination system and its traditional approach to assessment, and the importance of aligning

interventions, such as the one described in this study, with current education policy and national programmes of reform. Given the particular context in which this study was situated, against the backdrop of a reform of the Junior Cycle programme in post-primary schools, this factor was particularly evident from analysis of qualitative data gathered from teachers and principals.

The findings regarding the salient factors described here are complementary to the work of Laferrière et al. (2013) who found that "pivotal actions" taken by key agents in an intervention can lead to barriers, tensions and contradictions becoming the "driving forces for transformation" (p. 470). In answering **RQ1(a)** and identifying the key factors that affected the use of the Bridge21 learning model in the post-primary classrooms and schools in this study, the design of a conceptual framework emerged and is discussed in Section 8.2.3 below (to answer **RQ2(a)**).

In addressing **RQ1(b)**, there is evidence to suggest that the use of the Bridge21 model to teach the curriculum in the post-primary classroom can lead to improvement in students' self-reported development of particular 21st century skills. As shown in Chapter 6 (see Table 6-3), a significant statistical difference was found for six (out of eleven) elements across three key skills identified for examination in the student pre-post questionnaire, administered to an opportunistic sample of students during the phase 1 of the research. Significant statistical differences were found for *'Exploring options and alternatives', 'Implementing ideas and taking action', 'Co-operating', 'Using ICT to work with others', 'Using information to solve problems and create new ideas'* and *'Thinking creatively and critically'* (Johnston et al., 2015; Conneely et al., 2013). There is also evidence to show an increase in student beliefs about working collaboratively with other students and learning as part of a team. Additional data indicate positive changes in both the quantity and impact of team-based learning in the classrooms of students and teachers who participated in the intervention under study.

Teachers also reported a perceived benefit in student learning outcomes, motivation and engagement in learning. Analysis of teachers' descriptive accounts of Bridge21 learning activities across a range of subjects demonstrate how the model was used to teach the curriculum, engender the development of 21st century skills, promote learner autonomy and to facilitate a team-based, project-oriented, technology-mediated approach to learning. Moreover, principals expressed the view that participation in the Bridge21 programme had a long-term impact on students, stating that they had observed long-lasting benefits and attitudes towards learning that they believed were rooted in the

student's first exposure to the learning model in their 1st year of post-primary school.

8.3.2 A model of PD and proposed conceptual framework

Chapter 4 proposed an initial model of PD as part of the overall design of the intervention to bring the Bridge21 approach to learning into the authentic setting of the post-primary classroom. Findings in relation to teachers' experience of PD during the exploratory phase of the research, described in Chapter 6 (see Section 6.2.5), informed the development of a revised version of the model, which retained a strong theoretical foundation by adhering to the original design principles and review of the literature. In the final version of the PD model, presented in **Figure 6-4** Refined model of PD (and below in **Figure 8-1**, for the reader's ease), the experience is separated into two distinct phases, so as to make explicit the teacher's transition from an initial, exploratory experience to an on-going cycle of development and action in the classroom.

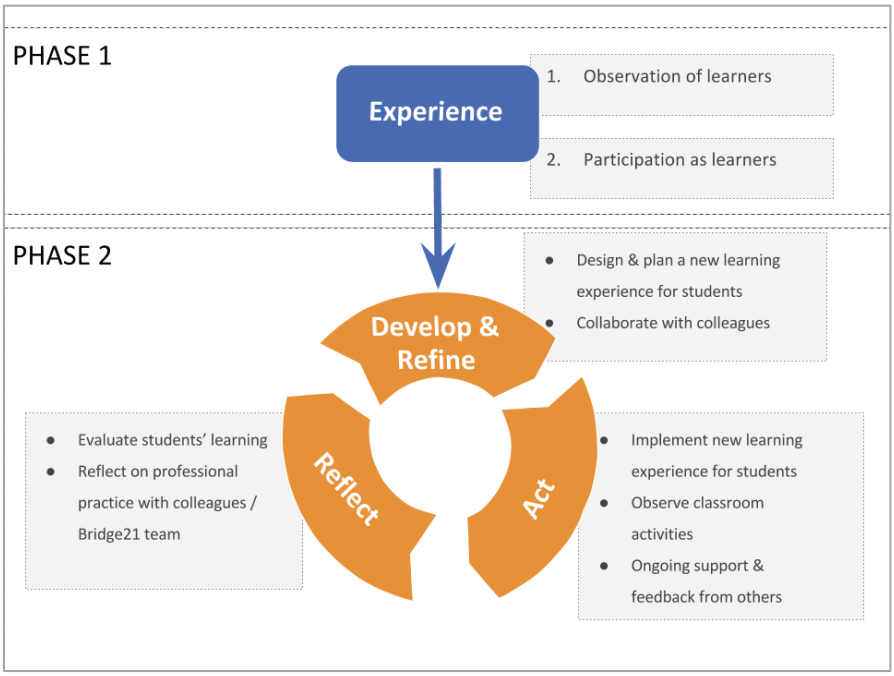

Figure 8-1 Refined model of PD

Phase 1 of the PD model is an initial concrete experience of 'teachers as learners' and 'observation of learners' in the Bridge21 model, reinforces Guskey's (2002) and Clarke and Hollingsworth's (2002) finding that positive changes in student outcomes are a motivating factor for teachers to change their own practice, and the importance of teachers seeing concrete examples of

what innovative teaching looks like in practice (Ertmer & Ottenbreit-Leftwich, 2010). Further, it affirms the alignment with Blatchford et al.'s (2003), and Galton et al.'s (2009) relational approach, whereby student teamwork skills are developed over time in a developmental sequence, which was found to be a salient factor that affected the use of the model, as discussed in Section 8.3.1 above.

Phase 2 of the PD model is an active developmental cycle that includes conceptualisation, active experimentation and reflection. It is argued that the refined model of PD aligns more closely with the overall social-constructivist approach of the Bridge21 model and reinforces Putnam and Borko's (2000) view that professional learning interventions should provide a framework for teachers to engage as active learners who construct their own understanding and awareness of personal challenges, beliefs, needs and capabilities to cope with the changes required.

To achieve greater and more sustainable impact of research in education systems, it is critical to provide conceptual frameworks, so that solutions and interventions, particularly those related to ICT, can be more easily integrated into the classroom, school and wider education system (Prieto, Dlab et al., 2011). Accordingly, findings in relation to the design features of the PD model, along with the critical factors outlined above, form the basis of a proposed conceptual framework to address **RQ2(a)**. The key elements of the conceptual framework designed to support teachers to use the Bridge21 model of technology-mediated team-based learning in the post-primary classroom, discussed in Chapter 7 and presented in **Figure 7-5** (presented again below in Figure 8-2, for the reader's ease), have been identified as follows:

- A common vision for 21st century learning.
- A cyclical and dynamic process of teacher PD (Levin & Wadmany, 2008), as described in **Figure 8-1**, that is experiential, constructivist and adheres to a relational approach by explicitly including a component for students to engage in a developmental sequence of learning teamwork skills.
- Teacher orchestration leading to student autonomy
- Teachers as key agents of change (NCCA, 2009a).
- Explicit demonstration of support from principal by addressing issues relating to school organisation and resources (ICT access and availability, furniture etc.).
- A collaborative partnership between the school and the university, centred on active participation from all involved.

- Four stages of engagement are proposed in the framework:
  1. Initial Engagement
  2. Experiment and Develop) } University-led (or external partner)
  3. Monitor and Stabilise
  4. Innovate and Reform } School-led

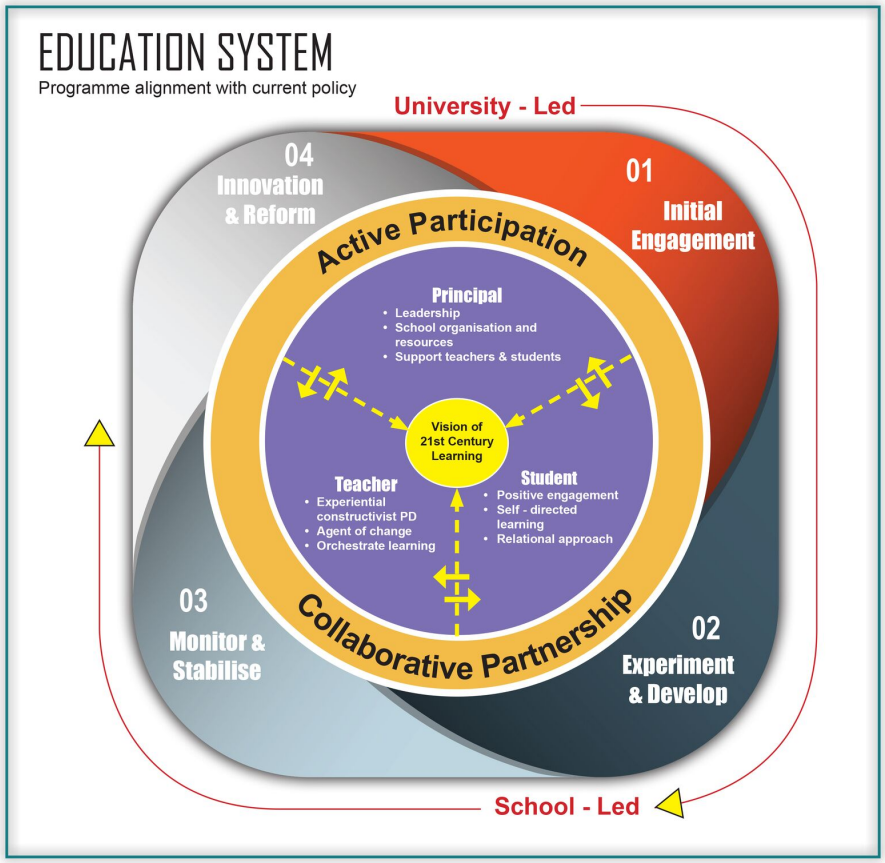

Figure 8-2 Conceptual framework

It is argued that this conceptual framework can facilitate and guide the design of future university-school partnerships and interventions centred on supporting teachers to use the Bridge21 learning model in the post-primary classroom. Further, the framework may have the potential to be applied to other 21st century learning interventions or research programmes, particularly where the relationship and collaboration between teachers and university staff is critical. In light of this, the conceptual framework is considered to be a key contribution of the research and is discussed further in Section 8.4.2.

RQ2(b): How do the defining features of the framework, including the approach to PD, facilitate teachers to use this model to teach the curriculum and to increase their provision of 21st century learning experiences for their students?

The second (explanatory) phase of the research sought to address **RQ2(b)**, by determining specific ways in which the defining features of the intervention, including the model of PD described above, facilitated teachers to effectively use the Bridge21 learning model to teach the curriculum and to explore the extent to which it supported teachers to increase their provision of 21st century learning experiences to students in post-primary classrooms. Qualitative and quantitative methods were used to gather data on the experiences and views of a sample of teachers from Years 2 and 3 of the programme, and a purposive sample of three principals (1-year post-intervention). The results provide a rich and contextualised insight into teacher's understanding of the Bridge21 model and belief regarding its potential for use in the post-primary classroom. It appears that, through participation in the Bridge21 PD experience, teachers developed an awareness of their role as a facilitator of student learning, and of key components of the model – teamwork, technology-mediated learning and 21st century skills. The experiential, constructivist design of the PD model and the school-engagement programme encouraged teachers to reflect on, analyse and evaluate their professional practice according to the needs of their students and the design of 21st century learning activities. This is evidenced by teachers' descriptive accounts of their experiences of the PD model and the Bridge21 curricular-focussed learning activities they designed and delivered across a range of subject areas. These data are corroborated by findings from interviews with principals and observations and field-notes recorded in the researcher's journal.

94% of teachers who responded to the teacher questionnaire in phase 2 of the research stated that they considered the Bridge21 model to be an effective approach to 21st century learning. Further analysis showed that there was a significant correlation between teachers' beliefs regarding the effectiveness of elements of the model and their use of it in the classroom. While only 9% of the sample stated that they regularly used the complete model in their teaching, 91% reported that they regularly used some elements of the model. Despite the fact that the intervention focussed solely on the 1st year student cohort in each school, a high proportion of teachers reported that they used the model (or elements thereof) with four or more year-groups. There is also evidence to show that schools that initially began with the single subject change scenario at

the outset of the intervention progressed to integrated curriculum and/or thematic modules towards the latter stages of the year. Data collected from principals in interviews one-year post-intervention showed the long-lasting impact of the intervention on some schools, through permanent timetable structure changes (e.g. 1 hour or 80-minute classes), the design of dedicated 21st century learning spaces, and the perception of being to the forefront innovation and reform, before national programmes become mandatory. As one principal stated:

> *"… those schools who have been lucky enough to have been able to engage with Bridge21, actually got a head start in something that they got involved in voluntarily before it was mandated by the Department [of Education]."*

These data explicitly answer **RQ2(b)** by showing how the participant teachers and schools increased their provision of 21st century learning experiences for their students.

8.4 Contributions of the Thesis

Having answered the research questions above, the primary contributions of this study may be summarised as follows:

8.4.1 Best practice and guidelines

Data gathered from multiple sources during both phases of the study, including teacher interviews and questionnaires, student questionnaires, and the researcher's field observation notes and research journal, provide a degree of evidence to suggest that the Bridge21 learning model has merit in a broader, authentic setting beyond the laboratory classroom from where it originated. A number of salient factors that directly affect the use of the model to teach the curriculum in post-primary classrooms in Ireland have been identified and discussed at length in Chapter 7. Given the specific context of the case study, these results may be of use to the wider cohort of post-primary schools in Ireland that are participating in the systematic reform now underway on a national scale.

Analysis of data collected during the initial (exploratory) phase led to the development of best practice resources, including sample learning activities, and a set of guidelines for teachers, to support them to develop and deliver effective technology-mediated team-based learning activities for the post-primary classroom. This iteration of key resources, activity templates and guidelines were used to inform the development of the refined model of PD implemented during the second (explanatory) phase (as discussed in Chapter 6).

This PD model formed the basis of the conceptual model, which is the second contribution of the research, presented in Section 8.4.2 below. In addition, the best practice resources and guidelines continue to be developed through further research and are widely used in the subsequent large-scale programmes – the third contribution of the study, discussed in Section 8.4.3 below.

Results from both phases of the research suggest that the Bridge21 model has the potential to support teachers to increase their provision of 21st century learning experiences in the post-primary classroom. Additionally, there is evidence to suggest that participation in such learning experiences can support students to develop particular 21st century skills, including creative thinking, problem-solving, teamwork and using technology to work with others. The results show that the use and adaptation of the Bridge21 model in the post-primary classroom addresses some of the challenges surrounding 21st century learning and skills.

8.4.2 Conceptual model and PD design features

A review of literature (Chapter 2) and the results of early research into the effectiveness of Bridge21 as a model of 21st century learning (Chapter 3) formed the basis of a preliminary design of a framework to bring the model out of its original context of the university laboratory into the authentic setting of the post-primary classroom. Central to this framework was an initial concept of PD for the participant teachers that was informed by five core design principles, described in Section 4.3 as follows: experiential learning, a relational approach, teacher as facilitator/orchestrator of learning, teachers as agents of change and constructivist pedagogy. The framework and PD model were trialled, developed and refined through multiple iterations across two phases of the four-year study, as described in Chapter 4.

To achieve greater and more sustainable impact of research in education systems, it is critical to provide conceptual frameworks, so that solutions and interventions, particularly those related to ICT, can be more easily integrated into the classroom, school and wider education system (Prieto, Dlab et al., 2011). Accordingly, findings in relation to the design features of the PD model and the overall programme of engagement between the university and school, along with the critical factors relating to the experiences of students and teachers, formed the basis of a conceptual framework proposed to facilitate and support the use of Bridge21 as a pragmatic approach to 21st century learning in the authentic setting of the post-primary classroom. The conceptual framework (discussed in Section 7.3.3 and presented in Figure 7-5) is a graphical

representation of the researcher's understanding of the phenomenon of the Bridge21 learning model in an authentic setting, based on the design and implementation of a four-year intervention and analysis of data collected during two phases of research. However, as stated by Jabareen (2009), conceptual frameworks are indeterminist in nature and do not enable us to predict an outcome. Thus, it is proposed as an initial conceptual framework that may be generalised for use by others, based on the researcher's interpretive approach to using a particular model of technology-mediated, team-based, 21st century learning in the setting of post-primary classrooms in Ireland.

This proposed conceptual framework is a key contribution of the research as it may be applicable to future school-university partnerships or research programmes, particularly where a non-hierarchical relationship and collaboration between teachers and university staff is critical. Within the overall framework, the results revealed a number of specific features of the approach to PD that were necessary to support and enable teachers to use the Bridge21 model to effectively teach the curriculum in the post-primary classroom. This approach to PD addresses many of the challenges and barriers to technology integration and 21st century teaching and learning identified in the literature. Given the specific context of the study, the results suggest that the framework and model of PD are a viable option for post-primary schools in Ireland wishing to engage in school reform and utilise a 21st century technology-mediated team-based model of learning.

8.4.3 Subsequent large-scale programme and research developments

The intervention under exploration in this study, which was initiated, trialled and developed by the author through an iterative design process over a four-year period, has evolved into a large-scale longitudinal school-university partnership with an ambitious agenda of national education reform. Since its inception in 2007, the programme has engaged a total of 13,208 students and 1,905 teachers from 100 schools across Ireland (Tangney, 2017). In the 2017-18 academic year, the programme will provide multiple strands of programme activity and service delivery at scale to participant schools from a broad range of socioeconomic areas across Ireland, both in the laboratory classroom setting on the university campus and in the classrooms of primary and post-primary schools. In addition, it has recently joined three European research projects, working in partnership with international universities, schools and practitioners to extend the use of the learning model to additional authentic settings.

As part of the systemic reform of the Irish education system, Bridge21 is involved in both PD and initial teacher education and is regarded as a significant partner in the field. It delivers accredited modules in 21st century learning and STEM (Science, Technology, Engineering and Mathematics) pedagogy to students participating in the Professional Masters in Education at Trinity College Dublin, and to qualified teachers participating in the Postgraduate Certificate in 21st Century Teaching and Learning.

As the project has expanded and begun operating a broad suite of activities and interventions at scale, an extensive body of research has simultaneously been undertaken in collaboration with several research groups within the university. While the current study does not amount to conclusive evidence about the effect of the Bridge21 model in post-primary classrooms in Ireland, it has provided a strong foundation for continued research and development in the area. A growing body of evidence of the efficacy of the learning model in authentic learning settings is beginning to emerge from additional studies that have been undertaken as a direct result of the intervention described in this thesis, encompassing a broad range of diverse fields and curricula including: mathematics, physics, history, language learning, peer learning, computer science teacher education and educational disadvantage. Below are some examples of the emerging findings and results, which show that the Bridge21 model:

- Has the potential to foster intrinsic student motivation (Lawlor et al., 2016).
- Can be used to support peer teaching in technology-mediated collaborative workshops (Sullivan et al., 2015).
- Can enhance student engagement in the contextual learning of mathematics (Bray & Tangney, 2016).
- Can positively impact student engagement and confidence in physics (Wickham et al., 2016).
- Is an appropriate 21st century teaching and learning approach to Computer Science education (Byrne et al., 2016; Byrne et al., 2017).
- Aligns with Computer Mediated Communication (CMC) language learning methodologies (Bauer et al., 2015).
- Can be used in a college-focused mentoring programme for students in socio-economically disadvantaged schools (O'Sullivan et al., 2017).

8.5 Limitations

Although a range of measures has been taken to address potential issues of validity and reliability in this study, it must be acknowledged that the process of undertaking research in the authentic setting of post-primary classrooms was complex and messy, and thus there are a number of limitations. First, there are limitations to the sampling methods used. The schools that participated in the intervention constituted a self-selecting sample of 'early adopters' (Rogers, 1995), and therefore it is likely that some conditions for innovation and change were already in existence prior to the school's involvement in the current study. A common characteristic of strong leadership was evident in the principals of the participant schools, which likely had an impact on the way the schools engaged with the intervention. Teachers were also a self-selecting group, as their participation in the programme was voluntary. Thus, it may be assumed that they were positively disposed to innovative approaches to teaching and learning and had an initial open mind-set towards change. However, these limitations do not account for the evidence and results that show the effect that participation in the intervention under study had on the schools, teachers and students, albeit a purposive sample, and the resulting pedagogical, structural and organisational changes that occurred in some of the participant classrooms and schools.

The availability of and accessibility to students posed a challenge to data collection and thus an opportunistic sample participated in the student questionnaire, qualitative interviews and written unstructured reflections. While the same schools participated throughout the four years of the intervention under study (2010-14), it was difficult to maintain continuity with the same teachers and students in consecutive years. Thus, the duration of the experience was not the same for all teachers and students. Additionally, the study is somewhat limited by the "tight but loose formulation" (Thompson & Wiliam, 2008, p.35) of the intervention design, in that the resulting flexibility and adaptability given to schools meant that the Bridge21 learning experiences of students and teachers were not consistent across all participating schools. Thus, the overall results that have been presented must be viewed in terms of association, rather than causal effect. However, given that the overall aim of the study was to explore and describe the progression of an innovative model of 21st century learning from its initial conception in a classroom laboratory to its use as a pragmatic approach to 21st century learning in the formal classroom, over a four-year period with 16 schools, 160 teachers and 600 students, the benefits of the intervention design outweigh any potential weakness.

Second, there are limitations to the research methods in the study. The majority of the qualitative and quantitative data are self-reported and/or observed behaviours, changes or practices. However, as described in Section 5.10.1, the fully integrated mixed methods design ensured there were multiple points of data integration and methodological triangulation. Thus, the weakness in any single research method was compensated by the strength of approach in the other methods. Another limitation lies in the fact that the data pertaining to individual students and teachers are not linked across each of the research methods. The robustness of the methods could be improved in future research by carrying out repeated observations and data collection from the same cohort of teachers, students and schools at specified points in time. A further limitation is the design of the teacher questionnaire, which prohibited a more sophisticated data analysis (for example, factor analysis and sub-scale construction (Cohen et al., 2013)), rather than the simple descriptive statistical analysis used. This limitation was due to some incomplete responses from participants and, in particular, variable *n* responses to quantitative items. As noted in Section 5.9.2, in the context of this multiphase mixed methods study, descriptive statistics were a "straightforward, yet rigorous" way of organising quantitative data, summarising findings and presenting evidence to then be explored in the context of findings from the qualitative data analysis (Denscombe, 2010, p.241).

Third, and finally, given the depth of prior practical experience and knowledge of the Bridge21 learning model, the natural bias of the researcher must be acknowledged as a limitation of the study. Several of the participant schools, particularly in the initial phase, already had a strong rapport with the researcher due to the fact that they had been participants on the earlier out-of-school intervention in the years preceding the current study (as described in Chapter 3). The insider research positionality of the study undoubtedly has the potential to result in bias, as it is impossible to completely detach the personal beliefs, past experiences, assumptions and values of the researcher from data collection and analysis (Denscombe, 2010, p.298). However, efforts have been made to minimise any such bias throughout the research process and to strengthen the overall trustworthiness of the study, as discussed in detail in Section 5.10. It may also be argued that the familiarity of the researcher with the participant schools and teachers, and proximity to the intervention, has resulted in more nuanced insights from the data (Chavez, 2008). In this way, the insider research approach may be regarded not as a limitation but as a critical feature that adds "as much as it detracts from the research validity" (Anderson & Shattuck, 2012, p.18).

These limitations do not suggest that the findings, answers to the research questions and contributions of the study are not suitable for generalisation. The multiphase mixed methods design ensured that sufficient data was gathered to provide a rich, contextualised and in-depth account of the intervention. While the results do not amount to conclusive evidence about the effect of the Bridge21 model on teachers and students in the context of post-primary classrooms in Ireland, the study has provided a strong foundation for continued research and development in the area in a range of contexts. This serves as evidence of the generalisability of the findings and results to other teachers, schools, research projects and reform programmes in the context of post-primary education.

8.6 Future Research

A number of potential areas for future research have been identified that could expand on the findings of the current study. At a very basic level, the cohort of schools, teachers and students, as well as the research context and setting, could be expanded to investigate the efficacy of the conceptual framework and the PD model. Research already underway in this area has yielded a growing body of evidence of the efficacy of the learning model in authentic learning settings encompassing a broad range of diverse fields and curricula, as described in Section 8.4 above. It would be of interest to expand this work to the context of primary education, which would have the potential to lead to further developments and iterations of the PD model and conceptual framework.

As a research method, the student questionnaire was confined to use in the initial (exploratory) phase of the research. It would be of interest to develop this instrument and use it as a longitudinal measure to explore the development of student 21st century skills over time and to explore the residual impact of student engagement with the Bridge21 programme and learning activities in the post-primary classroom. In this context, it might be of interest to include control groups of students in the study, in order to be able to provide more conclusive evidence of the impact of the Bridge21 learning model and associated interventions. Another related area of future research would be to include student work and project artefacts as a source of data in order to explore and develop best practices in assessment of 21st century skills and learning, an issue that has been identified but that was beyond the scope of the current study.

Finally, there would be merit in addressing some of the limitations in the research methods discussed above, including improving the robustness of

future studies by carrying out repeated observations and data collection from the same cohort of teachers, students and schools at specified points in time. Rather than expanding the number of participants, an alternative strategy for further research might be to carry out an in-depth study of a smaller pool of teachers over a set period of time (for example, a full academic year), in order to gain more insight into the professional learning experience of teachers and to more closely track their journey of change in knowledge, beliefs and practice. There would also be merit in exploring the role of the teacher as a practitioner-researcher as part of expanding the research in the future.

8.7 Conclusion

This research describes the progression of an innovative model of 21st century learning - the Bridge21 model - from its initial conception as a social outreach project delivered to post-primary students in a laboratory classroom on a university campus, into a school-university partnership focussed on supporting teachers and school leaders to embrace the model as a pragmatic approach to 21st century learning in the formal classroom. Specifically, this thesis has attempted to document and critically evaluate the iterative design and implementation of a programme, over a four-year period (2010-14), to support and enable a cohort of teachers to use and adapt the Bridge21 learning model to teach the formal curriculum in post-primary classrooms in Ireland. The context of the development of the intervention is significant as it was conceptualised at a time when policy leaders, school principals and teachers were seeking pragmatic models of 21st century learning that could be used in the post-primary classroom to improve student autonomy and engender key skills, and would be complementary to the programme of Junior Cycle reform.

A number of key design features shaped and informed the development of the intervention (described in Chapter 4). These considerations included three school-based scenarios that presented a continuum of possibilities to participant schools and teachers as to how the Bridge21 learning model could be used in the setting of the post-primary classroom. Additionally, five design principles were proposed to guide the preliminary design of a model of PD to support teachers to understand and use the Bridge21 learning model. This preliminary design was reviewed and iterated throughout the study, leading to a final refined version of the PD model as a key finding of the research.

The main findings of the research suggest that the Bridge21 learning model has merit in a broader, authentic setting beyond the laboratory classroom from where it originated, and it has the potential to support teachers to increase their

provision of 21st century learning experiences in the post-primary classroom. Teachers and students responded favourably to participation in the programme. There is also evidence to show improvement in students' self-reported development of key 21st century skills. Further, teachers perceived a range of benefits to their students who participated in the programme, including increased levels of engagement and motivation, and positive changes in classroom dynamic. The data also provide a rich and contextualised account of the diverse range of ways in which teachers and principals embraced the Bridge21 learning model and used it to ignite change in their schools. A number of salient factors that directly affect the use of the model to teach the curriculum in post-primary classrooms in Ireland have been identified at four interrelated levels of student, teacher, school and system.

Findings in relation to the design features of the refined PD model and the critical factors relating to the overall experiences of students and teachers, formed the basis of a proposed conceptual framework to facilitate and support the use of Bridge21 as a pragmatic approach to 21st century learning. It is suggested that the conceptual framework and model of PD are a viable option for post-primary schools in Ireland wishing to engage in school reform and utilise a 21st century technology-mediated team-based model of learning.

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10 Appendices

Appendix 4.1 Sample of Preliminary Teacher Resources

Oriel House, Fenian St, Dublin 2, Ireland | 01 896 4099 |
info@bridge21.ie | www.bridge21.ie

Learning Activity Planning Template

Subject: _____

Class/Year Group: _____

Topic(s)/Theme(s): _____

_____

_____

Elements of the Bridge21 Model you would like to use/applicable to this activity:

Teamwork ☐ Technology ☐ Project-based ☐

Reflection ☐ Skills-focussed ☐

Draft Plan:

Summary of the learning activity (*what will students do / create*) :
The learning intention (*what the activity is intended to achieve*):
Subject content knowledge that students will learn:
Key skills that student will learn (*NCCA Junior Cycle key skills*[1]): 1. 2. 3.
Resources that students will need to access/use during the learning activity:
Evidence of learning (*how students will demonstrate their understanding & skills*):

[1] http://www.juniorcycle.ie/NCCA_JuniorCycle/media/NCCA/Documents/key_skills_oct_2012_WEB_FINAL.pdf

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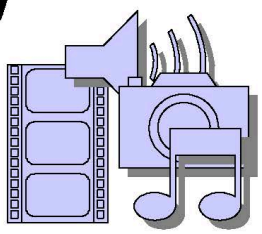
Future Technology (2050)



Team Challenge:

Create a multimedia advertisement campaign to sell your technology product for 2050. You must create the following:

- A 30-second TV ad
- An advertisement poster
- A 60-second radio ad

Your advertisements should include:

- A slogan / catchphrase about your product
- A logo for your company which is going to sell the product
- Information about the price, special offers, website etc. etc.

Your team will have to make a 5-minute presentation/pitch to the rest of the group about your product & explain your ad campaign.

2:20pm

Team Roles

Role	Contribution *What tasks are you going to do/be in charge of?*	Name
Campaign Manager		
TV Director		
TV editor		
Poster designer / artist		
Researcher(s)		
Actor(s)		

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Team Reflection

1. Overall, how would the team rate their performance today?

Excellent ☐ Good ☐ Average ☐ Fair ☐ Poor ☐

Why does the team feel this way?

_____

_____

2. What was the team's best achievement today?

3. How often did the following happen in your team today?

	Never	Only now & again	Sometimes	Nearly always	Always
We took turns when talking to each other					
We were sensitive to the needs of one another					
We discussed things and did not argue					
We were well organised					
We were interrupting & cutting each other off when speaking					
We got on well together					
We all did our fair share of the work					

4. List **3 skills** the team have learned today

_____

_____

_____

5. List **3 skills** the team would like to develop/improve on

_____

_____

_____

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Student Reflection

How well did you work with your team in this project?

	Never	Only now & again	Sometimes	Nearly always	Always
I enjoyed working with my team					
I did not contribute to my team's ideas and work					
I trusted my teammates					
I had a clear role to play in my team					
I didn't help my teammates when they needed it					
I got on well with my teammates					
I was bossy with some teammates					
I made a good contribution to my team					
I listened to my teammates' ideas					
I liked working with my team					

Three things I would like to improve about how I work and learn with other students:

1.

2.

3.

Appendix 5.1 Interview protocol (Semi-Structured Teacher Interviews)

Prior to starting the interview, the fact that the interview is being recorded will be pointed out to the participants. They will also be advised that the can stop the recording at any time or pause the recording.

Introduction – general questions about the Bridge21 programme & overall learning experience:

What was your opinion of the Bridge21 programme?

What did you learn during this experience?

What do you perceive your students learnt during this experience?

Bridge21 student workshops / teacher PD in laboratory setting (university):

Tell me about your experience of the workshops at the Bridge21 laboratory classroom in the university setting. What went well? What did not go well?

Bridge21 learning experiences in school:

Tell me about the Bridge21 learning activity you designed for your subject. What went well? What did not go well? What would you do differently next time? Did you use some aspects of the B21 model more than others (or find more relevant)?

Did the learning experience you designed for students map to the curriculum? What were the student learning outcomes?

Did you work individually or as part of a team of teachers? What impact did that have on the design and delivery of the Bridge21 learning experience with students?

Possible probing questions to get more detail:

Can you tell me more about that? Can you give me an example of that?

Can you give me an example of that in the classroom?

Any other thoughts?

Appendix 5.2 Student Questionnaire (Pre/post)

Student Pre-Questionnaire

The purpose of this questionnaire is to collect information about your general experience of school, how you like to work and how you learn. It is to help with the evaluation and development of the Bridge21 programme, which your school is taking part in.

We really value your honest opinion and want you to take your time to think about each question carefully and answer as best you can.

All of the information collected on this questionnaire will be anonymised (all names will be removed) and stored safely in accordance with the Data Protection Act in Trinity College, University of Dublin. If you have any questions you can ask your teacher and they will contact the Bridge21 staff.

Definitions: Some of the words below will appear many times in the questionnaire. We have provided a definition of each word to help you understand and answer the question as best you can. If you have any questions please ask your teacher.

Task	Any piece of work to do with learning. Can be a small task that takes a few minutes to complete (for example, answer a question, write a paragraph) or a large task that takes hours/days to complete (write an essay, complete a project)
Team	A group of students who share talents, support each other and work together to achieve or create something
ICT	Information & Communications Technology : any type of technology that you use, for example, computer, laptop, iPad, mobile phone, iPod or MP3 player, game console
Learning	The way you gain knowledge and/or skills in a particular subject area, through the tasks you complete in and outside of class
In class	During timetabled subject periods at school
Outside of class	Outside of timetabled subject periods. Can be during school time (e.g. at lunch break) or after school (either on the school premises, at home or elsewhere)
Resources	Anything that provides information or facts to help you to learn about something or complete a task. For example, a book, a CD, the internet or a website, a video, a photograph or picture, a diagram etc.

Question 1: Personal Details

Name: _____

Date of birth: _____(DD/MM/YYYY)

Gender: Male ☐ Female ☐

Name of your School:_____

In what year are you?

1st Year ☐ 2nd Year ☐ 3rd Year ☐

Name of the Primary School you attended: _____

Were you born in Ireland? Yes ☐ No ☐

What is your first language? _____

Question 2

This question is about how you learned over the last month. Put a tick (✓) in the box that describes how often you did the following:

	More than twice a day	1-2 times a day	1-2 times a week	1-2 times a month	Rarely / Never	Don't know
I brainstormed ideas						
I tried to complete a task in lots of different ways						
While solving one problem, I learned skills that I could apply to other problems						
I was encouraged to think about whether my way of looking at something was the only way						
I was given a chance to choose what I wanted to learn						
I drew up or helped to draw up an action plan for completing a task						

I knew the resources I needed to help me complete a task						
I worked with two or more other students as part of a team						
I worked with one other student on a task						
Other students helped me learn						
I learned from working as part of a team						
I learned alone						
I used the Internet for research						
I used the school library for research						
I used more than one resource to find out information I needed to help me learn						
I used information I found to develop my own ideas about something						
Information I found helped me solve problems and learn new things						

Question 3

Describe a class during the last month that you enjoyed: *Why did you enjoy it? What did you enjoy most about it?*

_____

_____

_____

Question 4

This question is about how you approach tasks and problems in your learning. Read the statements below carefully and put a tick (✓) in the box that best describes your own opinion and your previous experiences of learning:

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I am able to look at things from different perspectives					
Understanding a problem is the first step towards solving it					
I am good at solving problems					
During a task, I always have a good idea how I am getting on & can make changes if necessary					
I am able to judge the quality of my work					
I always understand what I need to achieve in a task					
I am good at figuring out what resources I need to complete a task					
I am able to make a plan in order to complete a task					
I can complete my work on time					
I am confident in making decisions					

I prefer tasks that have only one correct answer or solution					
I like to continue working on a task until I am satisfied with it.					
Learning in class is usually fun					
I don't like working in a team					
I try to understand tasks even if they seem difficult at first					
I like when the teacher gives me a task that I can do quickly					
I would like the chance to complete some tasks a second time					
I like it when tasks are challenging					
I would like to learn in different ways from how I currently learn					
Learning is usually fun					

Question 5

Have you worked with other students on a school-related task in the past month?

Yes ☐ No ☐

If yes, describe an example: What was the task? How many others did you work with? What did you do? What did you learn? How long did it take? Did you enjoy it? Why?

_____

_____

_____

If no, **skip** to Question 6

Read carefully the following statements about **working and learning with other students**. Put a tick in the box (✓) that describes **how often in the last month** you did the following:

	More than twice a day	1-2 times a day	1-2 times a week	1-2 times a month	Rarely / Never	Don't know
I helped another student to learn during class time						
I was helped to learn by another student during class time						
I helped another student to learn outside of class time						
I was helped to learn by another student outside of class time						
I used ICT to help me work with others on a task						
I used ICT to share and swap work with other students						

The next statements are about **working with other students** (in a group or a team). Think about them carefully and put a tick (✓) in the box that best describes **your own opinion and you previous experiences of learning**:

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
My teammates have to ask me to do more work in a task					
My teacher has to ask me to do more work with my team					
I feel that other people reject my ideas					
When working with a group, I feel that I do more work than everyone else					
I am often encouraged to learn with others by my teacher					
I work on the computer on my own more often than I do with others					

I contribute as many ideas and suggestions as I can to a task					
I always do my fair share of the work					
I always listen to other students' ideas					
Computers help me learn with other students					
I do not like sharing my ideas with others					
I can learn more working with others than by myself					
Computers are best suited to working on your own					
I prefer listening to other students than saying my own ideas					
I am a good team member					
We achieve good things working as a team					
I can lead a team					
It can be fun to work on tasks with others					

Question 6

Describe a class during the last month that you did not enjoy: *Why did you not enjoy it? What did you not enjoy about it?*

Question 7

This question is to find out how you manage, organise and think about your learning. Read the statements and put a tick (✓) in the box that best describes your own opinion and previous experiences of learning:

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I know when information I find is useful or not					

I am able to use the information I find in my own work					
I am able to write the important points from the information I find in my own words					
I am able to figure out what I need from all the information I find					
I put effort into organising how I store information					
I have my own way of noting the key points of information I find for future use					
I know how to identify whether or not information I find is useful					
The computer helps me to organise and store information					
Finding my own information helps increase my level of understanding					
I like when my answer is good but different to that of other students in the class					
It's OK to spend a lot of time working on a task and not find an answer					
I like to hear how other students plan their tasks					
The best tasks can be approached in a number of different ways					
I sometimes leave a task when I'm stuck and return to it later					
I look lots of different ways of completing tasks before deciding what to do					
I can laugh when my solution does not work out or things go wrong					
I often see connections between what I learn in different subjects					

I know what I am good at					
I know what I need to do better to help me learn					
I know how to judge how well I'm learning and how I'm doing at school					
My teachers' assessment of my learning is almost always the same as mine					
Reflecting and thinking about my learning helps me to improve					
Using the computer encourages me to think about how I'm learning					
Learning is all about getting the highest grade possible in a test					
I always try to do my best					

Question 8

Write down 3 things you like about school

_____

_____

_____

Question 9

Write down 3 things you dislike about school

_____

_____

_____

Question 10

If you have extra comments about any of the questions, please write them here. If you have no other comments, you can leave this box blank.

Thank you for completing this questionnaire! ☺

Student Post-Questionnaire

The purpose of this questionnaire is to collect information about your general experience of school, how you like to work and how you learn. It is to help with the evaluation and development of the Bridge21 programme, which your school is taking part in.

We really value your honest opinion and want you to take your time to think about each question carefully and answer as best you can.

All of the information collected on this questionnaire will be anonymised (all names will be removed) and stored safely in accordance with the Data Protection Act in Trinity College, University of Dublin. If you have any questions you can ask your teacher and they will contact the Bridge21 staff.

Definitions: Some of the words below will appear many times in the questionnaire. We have provided a definition of each word to help you understand and answer the question as best you can. If you have any questions please ask your teacher.

Task	Any piece of work to do with learning. Can be a small task that takes a few minutes to complete (for example, answer a question, write a paragraph) or a large task that takes hours/days to complete (write an essay, complete a project)
Team	A group of students who share talents, support each other and work together to achieve or create something
ICT	Information & Communications Technology : any type of technology that you use, for example, computer, laptop, iPad, mobile phone, iPod or MP3 player, game console
Learning	The way you gain knowledge and/or skills in a particular subject area, through the tasks you complete in and outside of class
In class	During timetabled subject periods at school
Outside of class	Outside of timetabled subject periods. Can be during school time (e.g. at lunch break) or after school (either on the school premises, at home or elsewhere)
Resources	Anything that provides information or facts to help you to learn about something or complete a task. For example, a book, a CD, the internet or a website, a video, a photograph or picture, a diagram etc.

Question 1: Personal Details

Name: _____

Date of birth: _____(DD/MM/YYYY)

Name of your School:_____

In what year are you?

1st Year ☐ 2nd Year ☐ 3rd Year ☐

Question 2

This question is about how you learned in school in the last 3 months (since February mid-term). Put a tick (✓) in the box that describes how often you did the following:

	More than twice a day	1-2 times a day	1-2 times a week	1-2 times a month	Rarely / Never	Don't know
I brainstormed ideas						
I tried to complete a task in lots of different ways						
While solving one problem, I learned skills that I could apply to other problems						
I was encouraged to think about whether my way of looking at something was the only way						
I was given a chance to choose what I wanted to learn						
I drew up or helped to draw up an action plan for completing a task						
I worked with two or more other students as part of a team						
I worked with one other student on a task						
Other students helped me learn						
I learned from working as part of a team						
I learned alone						
I used the Internet for research						
I used the school library for research						
I used information I found to develop my own ideas about something						

Question 3

This question is about how you approach tasks and problems in your learning. Read the statements below carefully and put a tick (✓) in the box that best describes your own opinion and your recent experiences of learning:

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Understanding a problem is the first step towards solving it					
I am good at solving problems					
During a task, I always have a good idea how I am getting on & can make changes if necessary					
I am able to judge the quality of my work					
I always understand what I need to achieve in a task					
I am able to make a plan in order to complete a task					
I can complete my work on time					
I am confident in making decisions					
I prefer tasks that have only one correct answer or solution					
I like to continue working on a task until I am satisfied with it.					
Learning in class is usually fun					
I don't like working in a team					
I try to understand tasks even if they seem difficult at first					
I like when the teacher gives me a task that I can do quickly					
I would like the chance to complete some tasks a second time					
I like it when tasks are challenging					

Question 4

Describe a class during the last 3 months that you enjoyed: What class was it? What did you do? Why did you enjoy it? What did you enjoy most about it?

_____

_____

_____

Question 5

Read carefully the following statements about working and learning with other students. Put a tick in the box (✓) that describes how often in the last 3 months you did the following:

	More than twice a day	1-2 times a day	1-2 times a week	1-2 times a month	Rarely / Never	Don't know
I helped another student to learn during class time						
I was helped to learn by another student during class time						
I helped another student to learn outside of class time						
I was helped to learn by another student outside of class time						
I used ICT to help me work with others on a task						
I used ICT to share and swap work with other students						

Question 6

The next statements are about working with other students (in a group or a team). Think about them carefully and put a tick (✓) in the box that best describes your own opinion and your recent experiences of learning:

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
My teammates have to ask me to do more work in a task					

My teacher has to ask me to do more work with my team					
I feel that other people reject my ideas					
When working with a group, I feel that I do more work than everyone else					
I am often encouraged to learn with others by my teacher					
I work on the computer on my own more often than I do with others					
I contribute as many ideas and suggestions as I can to a task					
I always do my fair share of the work					
I always listen to other students' ideas					
Computers help me learn with other students					
I can learn more working with others than by myself					
Computers are best suited to working on your own					
I prefer listening to other students than saying my own ideas					
We achieve good things working as a team					
I can lead a team					

Question 7

This question is to find out how you manage, organise and think about your learning. Read the statements and put a tick (✓) in the box that best describes your own opinion and recent experiences of learning:

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I know when information I find is useful or not					
I am able to write the important points from the information I find in my own words					
I am able to figure out what I need from all the information I find					
I put effort into organising how I store information					
The computer helps me to organise and store information					
Finding my own information helps increase my level of understanding					
I like when my answer is good but different to that of other students in the class					
It's OK to spend a lot of time working on a task and not find an answer					
I like to hear how other students plan their tasks					
I sometimes leave a task when I'm stuck and return to it later					
I look at lots of different ways of completing tasks before deciding what to do					
I often see connections between what I learn in different subjects					
I know what I am good at					

I know what I need to do better to help me learn					
I know how to judge how well I'm learning and how I'm doing at school					
My teachers' assessment of my learning is almost always the same as mine					
Reflecting and thinking about my learning helps me to improve					
Using the computer encourages me to think about how I'm learning					
Learning is all about getting the highest grade possible in a test					
I always try to do my best					

The last set of questions seeks your opinions and experiences of the Bridge21 programme. In answering the following questions, think about your experiences of Bridge21 throughout this school year.

Question 8

Write down 3 things you liked about Bridge21 this year:

1.
2.
3.

Question 9

Write down 3 things you did not like about Bridge21 this year:

_____

_____

_____

Question 10

Write down 3 ways in which Bridge21 has helped you learn this year:

_____

_____

_____

Question 11

The approaches below are important parts of the Bridge21 way of learning. For each one, name the subjects (maximum of 3) where the approach happened most during the year.

Bridge21 way of learning	Name of subject 1	Name of subject 2	Name of subject 3
Learning in groups/teamwork			
Using technology or computers			
Doing a project			
Learning 2 or more subjects at the same time			
Creating my own material to help me learn			
Taking time to think about what I've learned			
Telling others about what I've learned			

Question 12

Below are listed some of the **resources** that can be used by **students** in Bridge21 classes. For each one, check how often it was used by you and your classmates in **Bridge21 classes.**

Learning Resources	**Used in all B21 classes**	**Used in most B21 classes**	**Used in some B21 classes**	**Used occasionally**	**Never used**
Laptop					
PC					
Textbook					
Whiteboard					
Computer Programs? E.g Moviemaker, PowerPoint					
Worksheet					
Digital Camera					
Copybook					

Question 13

Below are listed some of the places where Bridge21 learning activities can happen. For each one, check how often you learned there.

Learning Places	**Used in all B21 classes**	**Used in most B21 classes**	**Used in some B21 classes**	**Used occasionally**	**Never used**
Classroom					
School library					
Computer room					
School Hall					
Other room in school					
Outside (in school grounds)					
Outside of school (e.g. visit to museum or field study away from school)					

Question 14

Overall, how would you rate the Bridge21 programme?

Excellent	Good	Average	Fair	Poor
☐	☐	☐	☐	☐

Question 15

In the box below, draw a picture of you learning at school using the Bridge21 approach:

Thank you for completing this questionnaire! ☺

Appendix 5.3 Teacher Questionnaire

1. Introduction

The Centre for Research in IT in Education (CRITE) and Bridge21 research teams at Trinity College are conducting a study on teachers' engagement with Bridge21 over the past 3 years.

Questions relate to your professional background, your experience of Bridge21, your understanding and use of the Bridge21 model with a target class, and the perceived benefits and barriers to using Bridge21 in the classroom.

Data Privacy and Ethics

- All of the information collected from this questionnaire will be stored safely in accordance with the Data Protection Act in Trinity College, University of Dublin. You are under no obligation to complete the questionnaire and can exit at any time by closing the browser window. You can change any responses prior to final submission.
- Should data be used for publication, information identifying you at any point in the research process will be removed from the collected data set, and processed in such a way that it does not reveal your or the school's identity.
- This questionnaire is presented to you via video display (computer screen). If you or anyone in your family has a history of epilepsy then you are proceeding at your own risk. The research team can provide you with a paper copy on request.
- Any responses relating to illicit activity will be reported to the appropriate authorities by the research team.
- By continuing, you are confirming you are over 18.

Questionnaire Administration / Contact Details

We would now like to invite you to complete this web-based questionnaire (which will approximately 30 minutes). Most questions may be answered simply by clicking in the appropriate box; others require a text response.

If you have any questions relating to the content of this questionnaire, or Bridge21 in general, please contact us at the following email addresses:

Claire Conneely (claire@bridge21.ie) and Brendan Tangney (tangney@tcd.ie)
Bridge21 / CRITE Research Team

Thank you very much for the time and effort you will give in responding to this questionnaire.

***1. Do you agree with the terms and conditions of this questionnaire?**

◯ Yes (proceed with the questionnaire)
◯ No (do not proceed with the questionnaire)

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Bridge21 Teacher Survey

2. Background

1. First name

2. Surname

***3. Name of school**

***4. School address**

***5. Which of the following categories best describes your employment status as a teacher?**

- ◯ Full-time
- ◯ Part-time (50-90% of full-time hours)
- ◯ Part-time (less than 50% of full-time hours)

***6. Including the current year, how many years have you been a teacher? (Exclude extended periods of absence, such as career breaks.)**

***7. Including the current year, how many years have you been teaching at this school?**

***8. What third level qualifications do you have? (Choose all options that apply to you.)**

- ☐ Bachelor's degree
- ☐ Postgraduate diploma
- ☐ Master's degree
- ☐ Other (please specify)

***9. What is your gender?**

- ◯ Female
- ◯ Male

Bridge21 Teacher Survey

10. What is your age?

- ◯ Under 25
- ◯ 25-29
- ◯ 30-39
- ◯ 40-49
- ◯ 50-59
- ◯ 60+

11. In what year did your school join Bridge21?

- ◯ Pre 2010 (Bridge2College)
- ◯ 2010-11
- ◯ 2011-12
- ◯ 2012-13
- ◯ 2013-14
- ◯ I don't know

12. How often have you attended the following Bridge21 programme activities/offerings? (Please select one response for each activity.)

	Never	Once	2-3 times	4-5 times	More than 5 times
Observed a group of students participate in a Bridge21 workshop in TCD	◯	◯	◯	◯	◯
Observed a group of students participate in a Bridge21 workshop in my school	◯	◯	◯	◯	◯
Participated in a Bridge21 teacher workshop in TCD	◯	◯	◯	◯	◯
Participated in a Bridge21 teacher workshop in my school	◯	◯	◯	◯	◯
Participated in a Bridge21 event (e.g showcase day, graduation etc.)	◯	◯	◯	◯	◯

Bridge21 Teacher Survey

3. Using Bridge21 in your Teaching

This section relates to your experience of using the Bridge21 model in your teaching.

1. What is your understanding of the Bridge21 model?

***2. Is the Bridge21 model relevant for teaching and learning in the 21st century?**

- ◯ Yes
- ◯ No

Please explain your answer

3. In your opinion, how effective is Bridge21 as a model of learning and teaching?

Very effective	Effective	Average	Ineffective	Very ineffective
◯	◯	◯	◯	◯

***4. Do you consider that your teaching practice has changed as a result of engaging with Bridge21?**

- ◯ Yes
- ◯ No

Please explain your answer.

***5. Which of the following best describes how you use the Bridge21 model in your teaching?**

- ◯ I use the complete Bridge21 model in my teaching
- ◯ I use elements of the Bridge21 model in my teaching
- ◯ I do not use the Bridge21 model in my teaching

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Bridge21 Teacher Survey

4. Using Bridge21 in your Teaching (contd.)

1. With which year groups do you use the Bridge21 model, or elements of it, in your teaching? (Please tick all that apply)

- ☐ 1st Year
- ☐ 2nd Year
- ☐ 3rd Year
- ☐ Transition Year
- ☐ 5th Year
- ☐ 6th Year

Please list the subject(s) you teach for each of the year groups selected above.

2. Here is a list of the elements of the Bridge21 model. For each one, please identify the extent to which you use it in your teaching. (Choose one box in each row.)

	Never	A few times a year	Monthly	Weekly	Daily
Teamwork	○	○	○	○	○
Technology-mediated learning	○	○	○	○	○
Project-based learning	○	○	○	○	○
Consideration of learning space design	○	○	○	○	○
Teacher as facilitator or mentor	○	○	○	○	○
Reflection	○	○	○	○	○
Skills-focused learning	○	○	○	○	○
Social Learning	○	○	○	○	○

3. Please describe (in as much detail as possible) an example of a class you taught during the past month in which you used the Bridge21 model, or elements of it:

Bridge21 Teacher Survey

4. Here is a list of the elements of the Bridge21 model. For each one, please select how effective you have found it to be it in your teaching. (Choose one box in each row.)

	Very effective	Effective	Average	Ineffective	Very ineffective
Teamwork	○	○	○	○	○
Technology-mediated learning	○	○	○	○	○
Project-based learning	○	○	○	○	○
Consideration of learning space design	○	○	○	○	○
Teacher as facilitator or mentor	○	○	○	○	○
Reflection	○	○	○	○	○
Skills-focused learning	○	○	○	○	○
Social Learning	○	○	○	○	○

Bridge21 Teacher Survey

5. Using Bridge21 in your Teaching (contd.)

1. If you do not use the Bridge21 model in your teaching, please explain why.

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Bridge21 Teacher Survey

6. Using Bridge21 in the Classroom

1. Below is a list of pedagogical barriers to using the Bridge21 model in the classroom, as identified by teachers in previous research. Is your use of the Bridge21 model adversely affected by the any of the following? (Please select one answer for each row)

	A lot	Partially	A little	Not at all
Insufficient pedagogical support for teachers	◯	◯	◯	◯
Lack of adequate content/material for teaching	◯	◯	◯	◯
Too difficult to integrate Bridge21 into the curriculum	◯	◯	◯	◯
Lack of information on Bridge21 as a pedagogical model	◯	◯	◯	◯
Pressure to prepare students for exams and tests	◯	◯	◯	◯
No or unclear benefit to using Bridge21 for teaching	◯	◯	◯	◯
Too difficult to assess Bridge21 learning activities	◯	◯	◯	◯

Other (please specify)

2. Below is a list of barriers relating to school support and goals, as identified by teachers in previous research. Is your use of the Bridge21 model adversely affected by any of the following? (Please select one answer for each row)

	A lot	Partially	A little	Not at all
School time organisation (fixed lesson time, length of class periods etc.)	◯	◯	◯	◯
School space organisation (classroom size, furniture, layout etc)	◯	◯	◯	◯
Most parents not in favour of Bridge21	◯	◯	◯	◯
Most teachers not in favour Bridge21	◯	◯	◯	◯
Most students not in favour of Bridge21	◯	◯	◯	◯
Lack of interest of other teachers	◯	◯	◯	◯
Lack of support from other teachers	◯	◯	◯	◯
Amount of time required for a Bridge21 learning activity	◯	◯	◯	◯
Lack of adequate support from school management	◯	◯	◯	◯
Bridge21 not being a goal in our school	◯	◯	◯	◯
Insufficient time given to teachers to prepare & plan Bridge21 learning activities	◯	◯	◯	◯

Other (please specify)

Bridge21 Teacher Survey

3. What do you consider to be the main benefits of using the Bridge21 model in your classroom?

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Bridge21 Teacher Survey

7. Using Bridge21 in a Target Class

This section contains questions which require you to think of a specific class where you regularly use the Bridge21 model for teaching and learning. This will be referred to as the "target class" in the following set of questions.

Please answer the questions based on the work students do both during and outside of class-time (for example, work done at home or after formal school hours).

1. On average, how many times per week does your target class meet during the school year?

2. On average, for how many minutes do you meet each time?

3. How many students are in your target class?

4. What is the average age of students in your target classes?

5. What is the best description of the majority of students in your target class? (Please choose only one.)

- ◯ Students whose academic work is at the expected level for their age
- ◯ Students whose academic work is behind most students their age
- ◯ Students whose academic work is ahead of most students their age
- ◯ My class contains a mix of student academic abilities

6. What subject(s) do you teach in your target class? Please list all that apply.

Bridge21 Teacher Survey

7. For your target class where you regularly apply the Bridge21 model, how often do your students do the following?

	Never	3-6 times per year	1-3 times per month	1-3 times per week	4-5 times per week
Analyze information from multiple sources to develop a report or a solution to a problem	○	○	○	○	○
Support their own ideas with numbers, facts, or other relevant information	○	○	○	○	○
Report or summarize information that students have read or been taught	○	○	○	○	○
Combine information from multiple subject areas	○	○	○	○	○
Develop their own answers using information they gather	○	○	○	○	○
Apply their knowledge to develop solutions to real problems from outside the school setting	○	○	○	○	○

8. How often do students do the following types of small-group activities in your target class?

	Never	3-6 times per year	1-3 times per month	1-3 times per week	4-5 times per week
Complete a specific task with other students	○	○	○	○	○
Create joint products that include contributions from each student	○	○	○	○	○
Discuss their work with one another	○	○	○	○	○
Present their group work to the class	○	○	○	○	○

Other (please specify)

9. In your target class, how often do you use the following types of instructional strategies to address student needs or interests?

	Never	3-6 times per year	1-3 times per month	1-3 times per week	4-5 times per week
Allow students to choose their own topics of learning or questions to pursue?	○	○	○	○	○
Allow students to choose how they will accomplish a task or how they will demonstrate what they have learned?	○	○	○	○	○
Provide students with opportunities to learn or work at their own pace?	○	○	○	○	○
Adjust the pace of instruction or repeat instruction to respond to students' levels of understanding?	○	○	○	○	○
Adjust assignments for individual students based on their knowledge, skills or learning needs?	○	○	○	○	○
Select topics, activities, or examples that are relevant to students' lives outside school?	○	○	○	○	○

10. In your opinion, how skilled on average are students in your target class in the following areas?

	Students do not know how to do this	Beginner	Competent	Expert	I don't know
Working in pairs or small groups to complete a task together	○	○	○	○	○
Developing a persuasive argument that is based on supporting evidence	○	○	○	○	○
Planning the steps they will take to accomplish a complex task	○	○	○	○	○
Developing an innovative solution to a problem with no single right answer	○	○	○	○	○
Using technology or the Internet to find information	○	○	○	○	○
Analyzing information from more than one source	○	○	○	○	○
Selecting the appropriate technology tool for a task	○	○	○	○	○
Evaluating the quality of their own work	○	○	○	○	○

Bridge21 Teacher Survey

11. In your target class this school year, how often did your students use ICT to do the following?

	Never	3-6 times per year	1-3 times per month	1-3 times per week	4-5 times per week
Find information on the Internet	○	○	○	○	○
Practise routine skills and procedures	○	○	○	○	○
Take tests or send in homework	○	○	○	○	○
Write or edit stories, reports, or essays using word processing	○	○	○	○	○
Analyse data or information	○	○	○	○	○
Create multimedia presentations (for example, using sound or video)	○	○	○	○	○
Use simulations or animations to explore a system or abstract concept	○	○	○	○	○
Develop simulations or animations of a system or abstract concept	○	○	○	○	○
Access class resources or online materials from a remote location	○	○	○	○	○
Collaborate online with peers from class on learning activities	○	○	○	○	○
Work with students or adults from outside the class	○	○	○	○	○

Other (please specify)

Bridge21 Teacher Survey

8. Teaching and Learning without Bridge21

This section contains questions which require you to think of a specific class where you do not use the Bridge21 model. This will be referred to as the "target class" in the following set of questions.

Please answer the questions based on the work students do both during and outside of class-time (for example, work done at home or after formal school hours).

1. On average, how many times per week does your target class meet during the school year?

2. On average, for how many minutes do you meet each time?

3. How many students are in your target class?

4. What is the average age of students in your target classes?

5. What is the best description of the majority of students in your target class? (Please choose only one.)

- ◯ Students whose academic work is at the expected level for their age
- ◯ Students whose academic work is behind most students their age
- ◯ Students whose academic work is ahead of most students their age
- ◯ My class contains a mix of student academic abilities

6. What subject(s) do you teach in your target class? Please list all that apply.

7. For your target class where you are unlikely to apply the Bridge21 model, how often do your students do the following?

	Never	3-6 times per year	1-3 times per month	1-3 times per week	4-5 times per week
Analyze information from multiple sources to develop a report or a solution to a problem	◯	◯	◯	◯	◯
Support their own ideas with numbers, facts, or other relevant information	◯	◯	◯	◯	◯
Report or summarize information that students have read or been taught	◯	◯	◯	◯	◯
Combine information from multiple subject areas	◯	◯	◯	◯	◯
Develop their own answers using information they gather	◯	◯	◯	◯	◯
Apply their knowledge to develop solutions to real problems from outside the school setting	◯	◯	◯	◯	◯

8. How often do students do the following types of small-group activities in your target class?

	Never	3-6 times per year	1-3 times per month	1-3 times per week	4-5 times per week
Complete a specific task with other students	○	○	○	○	○
Create joint products that include contributions from each student	○	○	○	○	○
Discuss their work with one another	○	○	○	○	○
Present their group work to the class	○	○	○	○	○

Other (please specify)

9. In your target class, how often do you use the following types of instructional strategies to address student needs or interests?

	Never	3-6 times per year	1-3 times per month	1-3 times per week	4-5 times per week
Allow students to choose their own topics of learning or questions to pursue?	○	○	○	○	○
Allow students to choose how they will accomplish a task or how they will demonstrate what they have learned?	○	○	○	○	○
Provide students with opportunities to learn or work at their own pace?	○	○	○	○	○
Adjust the pace of instruction or repeat instruction to respond to students' levels of understanding?	○	○	○	○	○
Adjust assignments for individual students based on their knowledge, skills or learning needs?	○	○	○	○	○
Select topics, activities, or examples that are relevant to students' lives outside school?	○	○	○	○	○

Bridge21 Teacher Survey

10. In your opinion, how skilled on average are students in your target class in the following areas?

	Students do not know how to do this	Beginner	Competent	Expert	I don't know
Working in pairs or small groups to complete a task together	○	○	○	○	○
Developing a persuasive argument that is based on supporting evidence	○	○	○	○	○
Planning the steps they will take to accomplish a complex task	○	○	○	○	○
Developing an innovative solution to a problem with no single right answer	○	○	○	○	○
Using technology or the Internet to find information	○	○	○	○	○
Analyzing information from more than one source	○	○	○	○	○
Selecting the appropriate technology tool for a task	○	○	○	○	○
Evaluating the quality of their own work	○	○	○	○	○

Bridge21 Teacher Survey

11. In your target class this school year, how often did your students use ICT to do the following?

	Never	3-6 times per year	1-3 times per month	1-3 times per week	4-5 times per week
Find information on the Internet	○	○	○	○	○
Practise routine skills and procedures	○	○	○	○	○
Take tests or send in homework	○	○	○	○	○
Write or edit stories, reports, or essays using word processing	○	○	○	○	○
Analyse data or information	○	○	○	○	○
Create multimedia presentations (for example, using sound or video)	○	○	○	○	○
Use simulations or animations to explore a system or abstract concept	○	○	○	○	○
Develop simulations or animations of a system or abstract concept	○	○	○	○	○
Access class resources or online materials from a remote location	○	○	○	○	○
Collaborate online with peers from class on learning activities	○	○	○	○	○
Work with students or adults from outside the class	○	○	○	○	○

Other (please specify)

Bridge21 Teacher Survey

9. ICT Access & Use

This section contains questions in relation to your beliefs and use of information & communication technology (ICT).

1. To what extent do you agree with the following statements about student use of ICT?

	Disagree	Disagree somewhat	I don't know/no opinion	Agree somewhat	Agree
ICT gives students access to a wider range of learning content and resources.	○	○	○	○	○
Students are usually more attentive when using ICT.	○	○	○	○	○
Students are usually more motivated to learn when using ICT.	○	○	○	○	○
Students usually understand subject matter more deeply when they use ICT.	○	○	○	○	○
ICT usually helps students become more active and independent in their learning process.	○	○	○	○	○

2. To what extent do you find the following to be barriers to using ICT (as one of the main elements of the Bridge21 model)?

	Agree	Agree somewhat	I don't know/no opinion	Disagree somewhat	Disagree
a. Not enough computers for teacher use	○	○	○	○	○
b. Not enough computers for student use	○	○	○	○	○
c. Outdated computers and software	○	○	○	○	○
d. Internet connection not available or unreliable	○	○	○	○	○
e. Computers are vandalised or stolen	○	○	○	○	○
f. Weak infrastructure to support ICT (for example school wiring)	○	○	○	○	○
g. Not enough technical support for ICT	○	○	○	○	○
h. Blocked access to relevant Internet sites	○	○	○	○	○
i. Difficult to access computers in labs or the library	○	○	○	○	○
j. Insufficient time to prepare lessons using ICT	○	○	○	○	○
k. Not enough professional development/ training around using ICT for teaching and learning	○	○	○	○	○
l. ICT is not supported by school leadership or policy	○	○	○	○	○
m. Required curriculum content not supported by ICT	○	○	○	○	○

Other (please specify)

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3. What is the most significant barrier? (insert letter code from above)

4. Think about your use of ICT both in and outside of the classroom during the past year. How often do you use ICT to do the following? (Choose one box in each row.)

	Never	3-6 times per year	1-3 times per month	1-3 times per week	4-5 times per week
Present information or give instructions to students	○	○	○	○	○
Conduct classroom demonstrations (for example, computer-based simulations, virtual labs, using an interactive map)	○	○	○	○	○
Prepare a lesson (for example, do research or make handouts for students)	○	○	○	○	○
Organise classroom data (for example, grades, attendance)	○	○	○	○	○
Monitor student learning using pre-determined learning goals or standards	○	○	○	○	○
Communicate with students outside the classroom (for example, via email)	○	○	○	○	○
Communicate with parents outside the classroom (for example, via email)	○	○	○	○	○
Collaborate with teachers in the same school or other locations	○	○	○	○	○
Collaborate with experts or other community members to enrich student learning	○	○	○	○	○
Post teaching or learning resources on the Internet (for example, on a blog or wiki) for other teachers or students	○	○	○	○	○

Other (please specify)

Bridge21 Teacher Survey

10. Leadership and Professional Culture

This section contains questions about your school overall, including leadership and the ways that teachers work together.

1. To what extent do you agree with the following statements about your school?

	Disagree	Disagree somewhat	I don't know/no opinion	Agree somewhat	Agree
Most teachers at this school share the same beliefs and values about effective instruction.	○	○	○	○	○
Most teachers in this school have similar goals for student learning.	○	○	○	○	○
Teachers and school leaders agree on a common instructional vision for the school.	○	○	○	○	○

2. Since your engagement with Bridge21, has there been a change in how often you collaborate with colleagues at your school in the following ways?

	Great increase	Slight increase	No change	Slight decrease	Great decrease
Share new ideas on effective teaching methods	○	○	○	○	○
Share and discuss the quality of students' work products	○	○	○	○	○
Think critically about our instructional practice at this school	○	○	○	○	○
Formally observe another teacher's classroom	○	○	○	○	○
Plan lessons and units together	○	○	○	○	○
Discuss student achievement score data with other teachers to make instructional decisions	○	○	○	○	○
Co-teach with another teacher at my school	○	○	○	○	○

Other (please specify)

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3. Since your engagement with Bridge21, has there been a change in the level of support for teacher collaboration at your school in the following ways?

	Great increase	Slight increase	No change	Slight decrease	Great decrease
Teachers are encouraged to work together to improve teaching and learning	○	○	○	○	○
Teachers have class schedules that are arranged to support team teaching	○	○	○	○	○
Teachers have scheduled time in the school calendar to work together	○	○	○	○	○
Teachers are encouraged to observe other teachers' classrooms	○	○	○	○	○
Teachers have a formal peer network or mentoring programme within the school	○	○	○	○	○
Teachers are comfortable discussing classroom practice and teaching challenges with other teachers	○	○	○	○	○
Teachers think of each other as partners in educating children	○	○	○	○	○

Other (please specify)

4. To what extent do you agree with each of the following statements about your school Principal?

	Disagree	Disagree somewhat	I don't know/no opinion	Agree somewhat	Agree
Communicates a clear vision for our school.	○	○	○	○	○
Sets high standards for student learning.	○	○	○	○	○
Encourages teachers to implement what they have learned in professional development.	○	○	○	○	○
Encourages teachers to try new things in the classroom.	○	○	○	○	○

Bridge21 Teacher Survey

11. Professional Development

This section relates to identifying teachers' needs and preferences for programmes of continuous professional development.

1. Which of the following topics of professional development do you feel you need most support and/or an opportunity to participate in a course? (Rank in order of priority 1-6)

- ☐ Improving student performance on standardised assessments
- ☐ Creating opportunities that help students be active in their learning (working on extended projects, collaborating with peers, assessing their own work, etc.)
- ☐ Introduction to computer applications or the Internet (word-processing, spreadsheets, e-mail, websites or databases, etc.)
- ☐ How to use ICT in teaching and learning
- ☐ Classroom management
- ☐ Improving knowledge of national standards

2. Which of the following types of professional development activity do you prefer/do you feel you most benefit from? (Rank in order of priority 1-8)

- ☐ Formal class instruction or workshop
- ☐ Education conferences or seminars (where teachers or researchers present their research results and discuss educational problems)
- ☐ Qualification programme (for example, a degree or credentialing programme)
- ☐ Observation visits to other schools
- ☐ Participation in a network of teachers formed specifically for the professional development of teachers
- ☐ Individual or collaborative research on a topic of interest to you professionally
- ☐ Mentoring or peer observation and coaching, as part of a formal school arrangement
- ☐ Informal dialogue with your colleagues on how to improve your teaching

3. Approximately how many hours of professional development did you attend during the last three years?

☐

Bridge21 Teacher Survey

4. To what extent do you agree with the following statements in relation to professional development for 21st century teaching and learning?

	Disagree	Disagree somewhat	I don't know/no opinion	Agree somewhat	Agree
I need assistance with assigning my students roles and organising them into teams for group work	○	○	○	○	○
I need assistance with integrating teamwork into classroom activities	○	○	○	○	○
I need assistance with planning cross-curricular projects	○	○	○	○	○
I need assistance with designing learning challenges that promote student autonomy in my classroom	○	○	○	○	○
I need assistance with facilitating peer-assessment with my students	○	○	○	○	○
I need assistance with using technology for teamwork	○	○	○	○	○

Bridge21 Teacher Survey

12. Thank You

1. Thank you for taking the time to complete this survey. We greatly value your opinions and responses.

Please provide any final comments or additional information in the box below.

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Appendix 5.4 Interview Protocol (Semi-structured interviews with Principals)

Introduction

Thank you for agreeing to take part in this Interview. My aim today is to try to understand your experience of Bridge21 and the impact it had on your school. This interview is for the purposes of my PhD, but it will also help improve the program in the future. You have been selected because teachers at your school completed a questionnaire during the summer of 2014. I will be specifically asking you questions about your school's participation in Bridge21 during the years 2010-2014 (i.e., not the past year when the PG Cert has been running).

It is important you know that what you say in here is confidential and your name or personal information will not be passed on to anyone outside of the research group. There are no right or wrong answers, all of your views are important.

You probably noticed the recording device in the middle of the room. I am recording the session so I do not miss any information. People often say very helpful things in these types of discussions and I can't write fast enough to get them all down. If for any reason you become uncomfortable during the interview and no longer want to be involved just let me know and we will stop recording and end the session.

This will last for about one hour. Have you any questions before we begin? Ok so let's begin.

Background Questions

Tell me a little about yourself - how long are you principal of this school? Were you previously a member of the teaching staff? Were you previously in management in other schools?

Briefly describe this school – size, students, ethos, vision etc.

Tell me about when/how/why your school became involved with Bridge21.

General Questions

What was your biggest hope/vision for Bridge21 in your school? Were they realised?

What were your biggest fears/concerns in implementing Bridge21 in your school? Are they still true today?

What were the most significant changes in practice, if any, that you noticed since your school joined Bridge21?

Describe the impact you think Bridge21 had on the students at your school. Did you notice any changes in student-teacher relationships?

Questions on the role of Principal/Management

What helped you, as Principal, to get Bridge21 started in your school? (external/internal supports?) What hindered you?

What was your approach to supporting / encouraging teachers engaged with the Bridge21 programme? (Probe: Formal staff meetings? Informal 1:1 mentoring? Champion teacher? Classroom observation?)

From the results of our teacher questionnaire, some teachers have reported feeling isolated in doing Bridge21? Do you think this is true of your school? Why/why not?

Do you think you built a supportive whole school community approach to Bridge21? If yes, how/in what way have you done this (give concrete examples...) If no, why not/what has been your alternative approach? (Probe: perhaps this is something that built up over time?)

Did you ever find it challenging to sustain your energy and maintain the momentum for Bridge21? If yes, how did you overcome this? If no, how did you achieve this?

Questions on teachers' professional development needs:

What areas of Bridge21 did you feel teachers needed most support/help/guidance/experience?

What were teachers' biggest fears?

What motivated your teachers to join Bridge21?

Did you provide teachers with any opportunity to share 'best practice' and/or learning experiences with their colleagues? Was this a regular occurrence or once off? Give examples.

Did you notice any change in teachers' attitudes towards Bridge21 (or any of the components of the model, e.g. teamwork, project-based learning, use of technology) over time?

Did you ever observe teachers applying the Bridge21 model in their classrooms? Can you give examples? What did you learn/discover from the observation?

Questions on factors for success of Bridge21 in the school

How did you overcome the challenge of providing time to teachers for Bridge21 (CPD, planning, implementation & evaluation)?

Were you able to achieve any flexibility in the timetable? Did you restructure the timetable in any way?

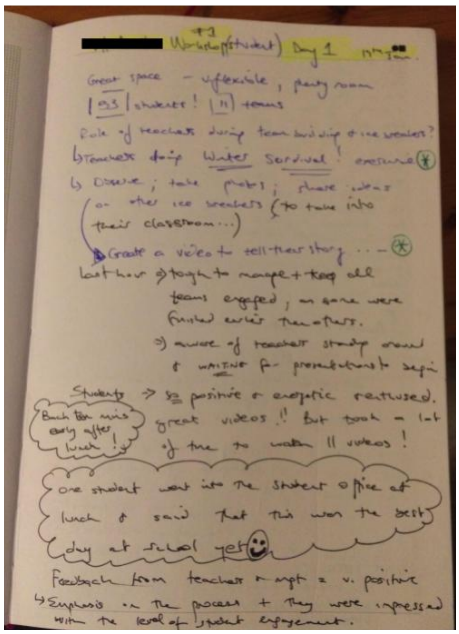
Describe the technology facilities at this school - availability? school policy? Did any of those facilities change during the time the school took part in Bridge21?

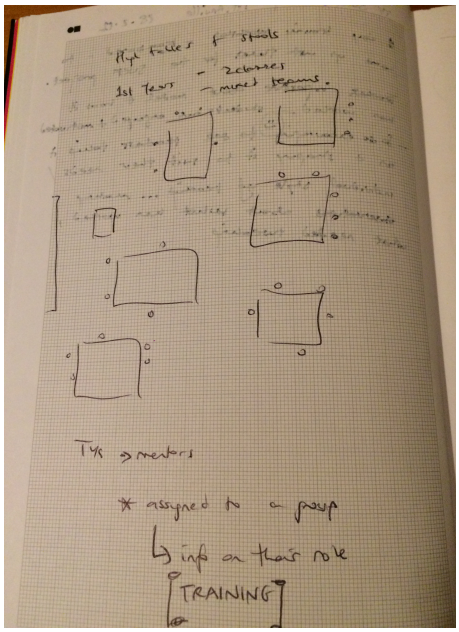
Final Questions

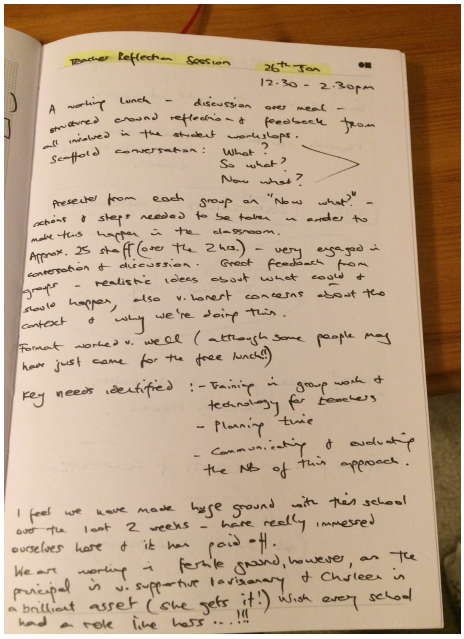
Did you value being part of the wider Bridge21 network of schools? Were there sufficient opportunities for integration/collaboration with other schools in the network? If so, why? If not, what value would additional opportunities for collaboration bring to your school?

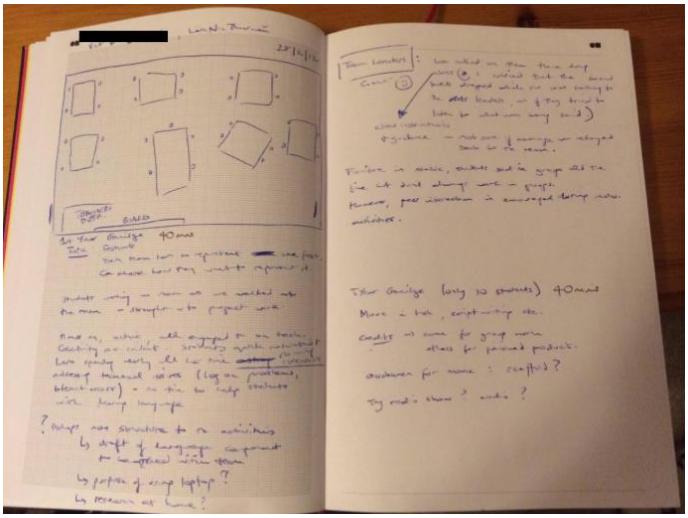
Do you consider Bridge21 to be in tune with the broad reforms proposed in JC2? In your opinion, what are the most evident links/areas of cross over?

Appendix 5.5 Researcher's Journal (Extracts)

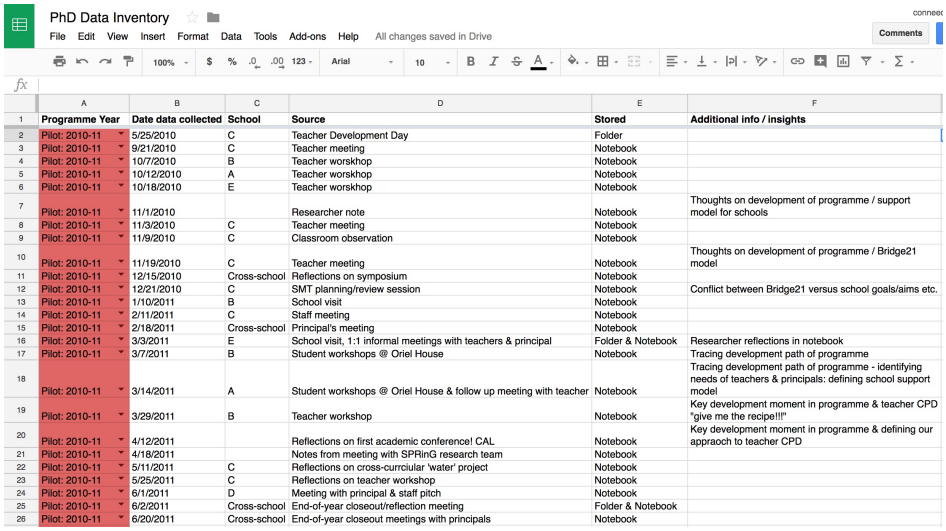








Log of Journal Entries (extract)



PhD Data Inventory

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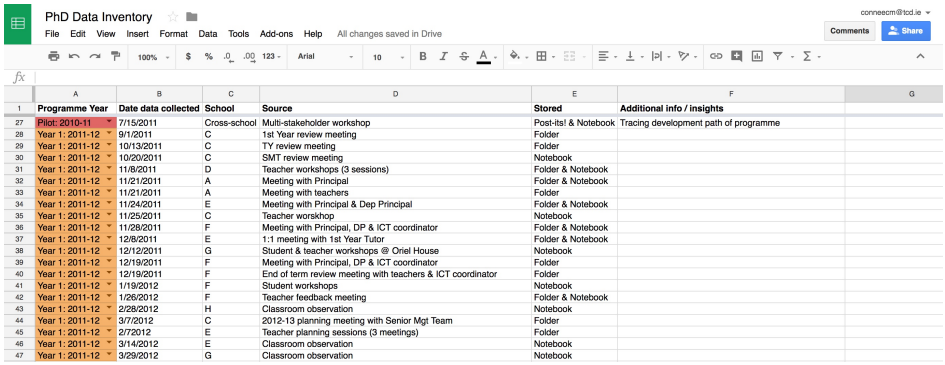
Comments

	A	B	C	D	E	F
1	**Programme Year**	**Date data collected**	**School**	**Source**	**Stored**	**Additional info / insights**
2	Pilot: 2010-11	5/25/2010	C	Teacher Development Day	Folder	
3	Pilot: 2010-11	9/21/2010	C	Teacher meeting	Notebook	
4	Pilot: 2010-11	10/7/2010	B	Teacher worskhop	Notebook	
5	Pilot: 2010-11	10/12/2010	A	Teacher worskhop	Notebook	
6	Pilot: 2010-11	10/18/2010	E	Teacher worskhop	Notebook	
7	Pilot: 2010-11	11/1/2010		Researcher note	Notebook	Thoughts on development of programme / support model for schools
8	Pilot: 2010-11	11/3/2010	C	Teacher meeting	Notebook	
9	Pilot: 2010-11	11/9/2010	C	Classroom observation	Notebook	
10	Pilot: 2010-11	11/19/2010	C	Teacher meeting	Notebook	Thoughts on development of programme / Bridge21 model
11	Pilot: 2010-11	12/15/2010	Cross-school	Reflections on symposium	Notebook	
12	Pilot: 2010-11	12/21/2010	C	SMT planning/review session	Notebook	Conflict between Bridge21 versus school goals/aims etc.
13	Pilot: 2010-11	1/10/2011	B	School visit	Notebook	
14	Pilot: 2010-11	2/11/2011	C	Staff meeting	Notebook	
15	Pilot: 2010-11	2/18/2011	Cross-school	Principal's meeting	Notebook	
16	Pilot: 2010-11	3/3/2011	E	School visit, 1:1 informal meetings with teachers & principal	Folder & Notebook	Researcher reflections in notebook
17	Pilot: 2010-11	3/7/2011	B	Student workshops @ Oriel House	Notebook	Tracing development path of programme
18	Pilot: 2010-11	3/14/2011	A	Student workshops @ Oriel House & follow up meeting with teacher	Notebook	Tracing development path of programme - identifying needs of teachers & principals: defining school support model
19	Pilot: 2010-11	3/29/2011	B	Teacher workshop	Notebook	Key development moment in programme & teacher CPD "give me the recipe!!!"
20	Pilot: 2010-11	4/12/2011		Reflections on first academic conference! CAL	Notebook	Key development moment in programme & defining our appraoch to teacher CPD
21	Pilot: 2010-11	4/18/2011		Notes from meeting with SPRinG research team	Notebook	
22	Pilot: 2010-11	5/11/2011	C	Reflections on cross-curricular 'water' project	Notebook	
23	Pilot: 2010-11	5/25/2011	C	Reflections on teacher workshop	Notebook	
24	Pilot: 2010-11	6/1/2011	D	Meeting with principal & staff pitch	Notebook	
25	Pilot: 2010-11	6/2/2011	Cross-school	End-of-year closeout/reflection meeting	Folder & Notebook	
26	Pilot: 2010-11	6/20/2011	Cross-school	End-of-year closeout meetings with principals	Notebook	



PhD Data Inventory

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Comments Share

	A	B	C	D	E	F	G
1	**Programme Year**	**Date data collected**	**School**	**Source**	**Stored**	**Additional info / insights**	
27	Pilot: 2010-11	7/15/2011	Cross-school	Multi-stakeholder workshop	Post-its! & Notebook	Tracing development path of programme	
28	Year 1: 2011-12	9/1/2011	C	1st Year review meeting	Folder		
29	Year 1: 2011-12	10/13/2011	C	TY review meeting	Folder		
30	Year 1: 2011-12	10/20/2011	C	SMT review meeting	Notebook		
31	Year 1: 2011-12	11/8/2011	D	Teacher workshops (3 sessions)	Folder & Notebook		
32	Year 1: 2011-12	11/21/2011	A	Meeting with Principal	Folder & Notebook		
33	Year 1: 2011-12	11/21/2011	A	Meeting with teachers	Folder		
34	Year 1: 2011-12	11/24/2011	E	Meeting with Principal & Dep Principal	Folder & Notebook		
35	Year 1: 2011-12	11/25/2011	C	Teacher worskhop	Notebook		
36	Year 1: 2011-12	11/28/2011	F	Meeting with Principal, DP & ICT coordinator	Folder & Notebook		
37	Year 1: 2011-12	12/8/2011	E	1:1 meeting with 1st Year Tutor	Folder & Notebook		
38	Year 1: 2011-12	12/12/2011	G	Student & teacher workshops @ Oriel House	Notebook		
39	Year 1: 2011-12	12/19/2011	F	Meeting with Principal, DP & ICT coordinator	Folder		
40	Year 1: 2011-12	12/19/2011	F	End of term review meeting with teachers & ICT coordinator	Folder		
41	Year 1: 2011-12	1/19/2012	F	Student workshops	Notebook		
42	Year 1: 2011-12	1/26/2012	F	Teacher feedback meeting	Folder & Notebook		
43	Year 1: 2011-12	2/28/2012	H	Classroom observation	Notebook		
44	Year 1: 2011-12	3/7/2012	C	2012-13 planning meeting with Senior Mgt Team	Folder		
45	Year 1: 2011-12	2/7/2012	E	Teacher planning sessions (3 meetings)	Folder		
46	Year 1: 2011-12	3/14/2012	E	Classroom observation	Notebook		
47	Year 1: 2011-12	3/29/2012	G	Classroom observation	Notebook		

Appendix 5.6 School Profiles

Code	Location	Language of Instruction	Gender	DEIS Status	Total Student Enrolment	Fees	University Outreach Programme	Year joined study
A	Dublin 2	English	Mixed	Yes	125	No	Yes	Pilot (2010-11)
B	Dublin 22	English	Girls	No	900	No	Yes	Pilot (2010-11)
C	Dublin 4	English	Mixed	No	120	Yes	No	Pilot (2010-11)
D	Sligo	English	Girls	No	400	No	No	Pilot (2010-11)
E	Dublin 8	English	Girls	Yes	170	No	Yes	Pilot (2010-11)
F	Dublin 14	English	Girls	No	630	Yes	No	1 (2011-12)
G	Co. Wicklow	English	Mixed	No	430	No	No	1 (2011-12)
H	Dublin 24	English	Mixed	No	800	No	Yes	1 (2011-12)
I	Co. Wexford	English	Mixed	Yes	550	No	No	2 (2012-13)
J	Co. Wexford	English	Mixed	No	770	No	No	2 (2012-13)
K	Co. Meath	English	Mixed	No	934	No	No	2 (2012-13)
L	Dublin 5	English	Girls	Yes	419	No	No	2 (2012-13)
M	Co. Wicklow	English	Mixed	Yes	280	No	No	3 (2013-14)
N	Co. Dublin	English	Mixed	No	800	No	No	3 (2013-14)
O	Dublin 12	English	Boys	No	640	No	Yes	3 (2013-14)
P	Dublin 3	English	Mixed	No	900	No	No	3 (2013-14)

Appendix 5.7 Research Ethics Documentation

Ethics Application Form

School of Computer Science and Statistics

Research Ethical Application Form

(version: August 2010)

Part A

Project Title: The Bridge21 Model applied in the context of Training Teachers to Teach Computer Science (CS) Concepts and Topics

Name of Lead Researcher (student in case of project work):

....Claire Conneely.....

TCD E-mail: ……conneecm@tcd.ie…….....…….

Contact Tel No.: ....8961397....……

Course Name and Code (if applicable): ……Ph.D. .

Estimated start date of survey/research: ……November 2010.....……

I confirm that I will (where relevant):

- Familiarize myself with the Data Protection Act and guidelines http://www.tcd.ie/info_compliance/dp/legislation.php;
- Tell participants that any recordings, e.g. audio/video/photographs, will not be identifiable unless prior written permission has been given. I will obtain permission for specific reuse (in papers, talks, etc.)
- Provide participants with an information sheet (or web-page for web-based experiments) that describes the main procedures (a copy of the information sheet must be included with this application)
- Obtain informed consent for participation (a copy of the informed consent form must be included with this application)
- Should the research be observational, ask participants for their consent to be observed
- Tell participants that their participation is voluntary
- Tell participants that they may withdraw at any time and for any reason without penalty
- Give participants the option of omitting questions they do not wish to answer if a questionnaire is used
- Tell participants that their data will be treated with full confidentiality and that, if published, it will not be identified as theirs
- On request, debrief participants at the end of their participation (i.e. give them a brief explanation of the study)
- Verify that participants are 18 years or older and competent to supply consent.
- If the study involves participants viewing video displays then I will verify that they understand that if they or anyone in their family has a history of epilepsy then the participant is proceeding at their own risk
- Declare any potential conflict of interest to participants.
- Inform participants that in the extremely unlikely event that illicit activity is reported to me during the study I will be obliged to report it to appropriate authorities.

Signed: ....

Date: .....18/November/2013.....

Part B

Please answer the following questions.		***Yes/No***
Has this research application or any application of a similar nature connected to this research project been refused ethical approval by another review committee of the College (or at the institutions of any collaborators)?		*NO*
Will your project involve photographing participants or electronic audio or video recordings?		*YES*
Will your project deliberately involve misleading participants in any way?		*NO*
Is there a risk of participants experiencing either physical or psychological distress or discomfort? If yes, give details on a separate sheet and state what you will tell them to do if they should experience any such problems (e.g. who they can contact for help).		NO
Does your study involve any of the following?	Children (under 18 years of age)	YES
	People with intellectual or communication difficulties	NO
	Patients	NO

Details of the Research Project Proposal must be submitted as a separate document to include the following information:

1. Title of project
2. Purpose of project including academic rationale
3. Brief description of methods and measurements to be used
4. Participants - recruitment methods, number, age, gender, exclusion/inclusion criteria, including statistical justification for numbers of participants
5. Debriefing arrangements
6. A clear concise statement of the ethical considerations raised by the project and how you intend to deal with them
7. Cite any relevant legislation relevant to the project with the method of compliance e.g. Data Protection Act etc.

Part C

I confirm that the materials I have submitted provided a complete and accurate account of the research I propose to conduct in this context, including my assessment of the ethical ramifications.

Signed: ..... Brendan Tangney .....

Date: 18/November/2013

Lead Researcher/student in case of project work

There is an obligation on the lead researcher to bring to the attention of the SCSS Research Ethics Committee any issues with ethical implications not clearly covered above.

External ethical approval has been received and no further ethical approval is required from the School's Research Ethical Committee. I have attached a copy of the external ethical approval for the School's Research Unit.

Signed: .....

Date: .....

Lead Researcher/student in case of project work

Part D

If external ethical approval has been received, please complete below.

Completed application forms together with supporting documentation should be submitted electronically to research-ethics@scss.tcd.ie **Please use TCD e-mail addresses only. When your application has been reviewed and approved by the Ethics committee hardcopies with original signatures should be submitted to the School of Computer Science & Statistics, Room F37, O'Reilly Institute, Trinity College, Dublin 2.**

Application Check List

- The following documents are required with each application:

1. SCSS Ethical Approval Form
2. Participants Information Sheet
3. Participants Consent Form
4. Research Project Proposal
5. Intended questionnaire/survey/interview protocol/screen shots/representative materials (as appropriate)

Ethics Research Project Proposal

Title of project: Bridge2College

Purpose of project (including academic rationale):

The Bridge2College is a joint research initiative between Trinity College's Centre for Research in IT in Education and the Trinity Access Programmes and Suas Educational Development. The principal investigator is Brendan Tangney and the project leader is John Lawlor.

The project seeks to address the problem of the lack of a pragmatic model for classroom practice that leverages the learning advantages of teamwork and technology. The research tracks the iterative development and implementation of a model for team-based technology-mediated learning using an action research methodology. In particular, the project aims to examine the efficacy of the model in a number of formal learning contexts. These include out-of-school outreach workshops – the **Bridge2College** programme – and in secondary school classrooms – the **Bridge21** programme.

Brief description of methods and measurements:

The participant set for this research project consists of students, teachers and school management teams. The data collection methods are as follows:

- Students will take part in learning activities based on teamwork and multimedia technology (PC computers, laptops, digital cameras, music recording equipment)
- Teachers will take part in training & subject-planning activities based on teamwork and multimedia technology (PC computers, laptops, digital cameras, music recording equipment)
- All participants will be asked to complete pre and post-questionnaires which will inform semi-structured interviews.
- A random sample of students & teachers will be observed during classroom activities using observation protocols, cameras and audiovisual equipment.
- A random sample of participants will take part in semi-structured interviews which will need to be audio recorded for later qualitative analysis.
- Data will be anonymised and treated using standard quantitative and qualitative techniques

Participants:

Participants will be recruited from schools who have given the research team permission to conduct the research project, obtained through the Board of Management and school principal.

For the **Bridge2College** (out-of-school outreach) programme students will be selected by their teachers and the research team. Both parental and student consent to take part in the research will be required to include each student in the data collection activities described above. The students will be drawn from primary school (ages 5-12) and secondary school (ages 12-18). To enable generalisations to be drawn the research will take place in at least 20 schools of varying demographics and gender mix.

For the **Bridge21** (classroom/in-school) programme, teachers will take part in the training activities on a voluntary basis and will give their consent to participate in the research. All students in participating teachers' classes will be involved in the learning activities as part of their normal school curriculum day. However, both parental and

child consent to take part in the research will be required to include an individual student in the data collection activities. The students will be drawn from primary school (ages 5-12) and secondary school (ages 12-18). To enable generalisations to be drawn the research will take place in at least 20 schools of varying demographics and gender mix.

As part of this research involves the use of computers by participants, individuals with epilepsy cannot take part.

Debriefing arrangements:

Debriefing will take place following the post-questionnaires at which stage the participants will be encouraged to ask any questions and raise concerns. Further debriefing will take place with the random sample of participants who participate in semi-structured interviews.

Following analysis of the data, students, parents, teachers, and members of the board of management of each school will be informed of the outcomes of the project.

Statement of ethical considerations:

The research project will take place as part of the normal school day. The **Bridge2College programme** will take place in a specifically designed TCD premises and the **Bridge21 programme** will take place in participants' schools.

All **Bridge2College programme** activities have been planned and designed to be of educational benefit to students and teachers, particularly in relation to the acquisition of 21st century learning skills and technical skill development. Before commencement of the project, it will be necessary to obtain permission from students, teachers, school principal and board of management. As they are under the age of 18, students will also require parental consent in order to take part in the project. Parents will be contacted through the school with details of the project and its possible consequences.

The **Bridge21** in-school programme activities will be directly relevant to curriculum requirements. Teachers will participate in the programme on a voluntary basis and the research team will assist the teacher in designing learning activities relevant to their subject area. All students in a participating class will take part in the learning activities. However, permission to record data from individual students will be sought from both parent and student. Thus, allowing a student to take part in the learning activities without requiring them to take part in the research.

Consent forms will be accompanied by information sheets (please see attached documents). Additional information sessions will be held with the board of management, school principal, class teacher, parents and students as required by the board of management or school principal.

Relevant legislation relevant to the project:

Data Protection Act

Information and Consent Forms

Principal/Board of Management - Information Sheet

Your school is invited to take part in **Bridge2College** –a joint research initiative between Trinity College's Centre for Research in IT in Education, the Trinity Access Programmes and Suas Educational Development. The principal investigator is Brendan Tangney and the project leader is John Lawlor. The B2C comprises two programmes:

1. A series of out-of-school outreach workshops (**Bridge2College**) which will take place during school time in a purpose-designed premises in Trinity College

2. An in-school programme (**Bridge21**) which involves a professional development programme for teachers & student training to adapt the B2C learning model for use in the formal classroom.

Bridge2College:

The overall aim of this programme is to provide an innovative learning experience for young people to become confident learners through the use of technology and teamwork. The programme seeks to positively engage students and encourage them to raise their personal learning aspirations. The programme will take place in Oriel House, in Trinity College from *9.30am – 3pm* each day. A member of staff will meet the group at the front gates of Trinity College at *9.15am* on the first morning and show them to the workshop centre at Oriel House. After that, students are expected to make their own way to and from the programme each day. It is important that students make every effort to be on time on the first morning; however, in the event of unexpected lateness, please phone 01-8964099 to inform the programme staff. Attendance and lateness throughout the programme will be recorded and reported according to the usual school guidelines.

During the programme, students will engage in challenging learning activities involving digital media, gaming, animation, mobile technology and web design, across a range of subject areas. As part of the programme, students will be using modern technology, which will include access to the internet and use of cameras. They will be under the supervision and guidance of adults and trained college student mentors at all times. All activities will comply with best practice in Child Protection and the policies of the school and Trinity College in this area to ensure that students benefit from the learning opportunities offered by technology in a safe and effective manner. Management of photographic images will be strictly in compliance with the above policies.

During the week, researchers from Trinity College will be present to collect information about the students' learning experiences. During the activities, interactions between the students working together will be recorded using observation tests. The students will also complete a pre- and post-questionnaire. When the programme is over, the research team *may* visit the school at a later date to conduct an interview with a selection of students.

Bridge21:

The overall aim of this programme is to adapt the B2C model for use in the formal classroom at second level. The B2C's alternative model (which is team-based, technology –mediated & cross-curricular) for second level education is based on the experience and success of the Bridge2College programme over the past 3 years. The adaption of the model to the formal classroom requires the development of a pedagogy that is based on collaboration, social learning and the creative use of technology.

The Bridge21 programme will take place throughout the academic year. During the programme, professional development workshops and seminars will be provided to participating staff, particularly in relation to teamwork skills, technology-mediated learning and developing the role of the teacher in the classroom. Training programmes will be also provided to students in relation to teamwork and technology skills. Members of the project team will spend significant portions of time in partner schools delivering workshops, engaging with students and supporting teachers and principals.

Throughout the programme, the project research team will collect information about students' and teachers' experiences. During class activity, interactions between students working together and between teachers and students will be recorded using observation tests. Students and teachers will complete pre- and post-questionnaires at various intervals during the programme. A random sample of students and teachers will also participate in interviews and focus groups at various intervals during the programme.

All information that is collected by the researchers from both programmes will be anonymised and stored in accordance with the Data Protection Act at Trinity College, Dublin. In the unlikely event that information about illegal activities should emerge during the study, the researchers will follow the school's Child Protection policy and inform the relevant authorities. There may be lectures, PhD theses, conference presentations and peer-reviewed journal articles written as a result of this project, however the students and school will not be identified.

We wish to seek your permission for students and teachers from your school to participate on the programme. Where appropriate, we would also like to publish work they may create during the programme that would be of educational benefit to other students. From time to time, we may also record video footage and images of students and teachers at work to use in communications and promotional/marketing material. Use of video footage and images will be strictly in accordance with best practice in Child Protection policies and guidelines.

We also wish to seek permission for the students and teachers to participate in the research part of the programme. Participation in this part of the programme is voluntary and students and teachers may withdraw from the process at any time, for any reason, without penalty and any information already recorded about them will not be used. Should any of the students and teachers wish to be omitted from the research part, they can still participate in the programme, but none of their information will be used in the research.

Please sign below to indicate your consent. If you have any questions please do not hesitate to contact us.

Kind regards,

Claire Conneely & John Lawlor

Bridge to College Programme Team

(01) 8964099 / conneecm@tcd.ie

Principal/Board of Management – Consent Form

The board has been provided with an information sheet which outlines the activities students and teachers will take part in, how data will be collected, stored and used and how it can contact the research team.

The board understands that it may withdraw the school from the project at any time should it wish to do so for any reason and without penalty.

Signature of Chair of Board of Management: _____

Date: _____

Signature of Principal: _____

Date: _____

Name of school: _____

Signature of Project Leader (TCD): _____

Date: _____

Teacher Information Sheet

You are invited to participate in the **Bridge21** pilot programme this year. The **Bridge21** programme is based on an alternative model for teaching and learning which is team-based, technology-mediated, project-based & cross-curricular. It has been developed over the past 3 years in an out-of-school context at the Bridge2College – a joint research initiative between Trinity College's Centre for Research in IT in Education, the Trinity Access Programmes and Suas Educational Development. The principal investigator is Brendan Tangney and the project leader is John Lawlor. The overall aim of **Bridge21** is to leverage the success of the B2C model and pilot its implementation in the formal classroom. The adaption of the model to the formal classroom requires the development of a pedagogy that is based on collaboration, social learning and the creative use of technology.

The Bridge21 programme will take place throughout the academic year. During the programme, professional development workshops and seminars will be provided to participating staff, particularly in relation to teamwork skills, technology-mediated learning and developing the role of the teacher in the classroom. Training programmes will be also provided to students in relation to teamwork and technology skills. Members of the project team will spend significant portions of time in partner schools delivering workshops, engaging with students and supporting teachers and principals.

Throughout the programme, the project research team will collect information about students' and teachers' experiences. During class activity, interactions between students working together and between teachers and students will be recorded using observation tests. Students and teachers will complete pre- and post-questionnaires at various intervals during the programme. A random sample of students and teachers will also participate in interviews and focus groups.

All information that is collected by the researchers will be anonymised and stored in accordance with the Data Protection Act at Trinity College, Dublin. In the unlikely event that information about illegal activities should emerge during the study, the researchers will follow the school's Child Protection policy and inform the relevant authorities. There may be lectures, PhD theses, conference presentations and peer-reviewed journal articles written as a result of this project, however the students and school will not be identified.

From time to time, we may also record video footage and images of you and students at work to use in communications and promotional/marketing material about the programme. Use of video footage and images will be strictly in accordance with best practice in Child Protection policies and guidelines. You have the right to remain anonymous and to choose where your information may be used. Should you wish to be omitted from any promotional materials, you can still participate in the programme, but no images/video footage of you will be used.

Participation in this programme is voluntary. Teachers may withdraw from the process at any time, for any reason, without penalty and any information already recorded about them will not be used. Should you wish to be omitted from the research part, you can still participate in the programme, but none of your information will be used in the research. Please sign below to indicate your consent. If you have any questions please do not hesitate to contact us.

Kind regards,

Claire Conneely & John Lawlor

Bridge to College Programme Team

(01) 8964099 / conneecm@tcd.ie

Teacher Consent Form

I have been provided with an information sheet which outlines the activities teachers will take part in, how data will be collected and stored and how I can contact the research team.

I understand that I may withdraw from the project at any time should I wish to do so for any reason and without penalty.

I also know that images/video footage of me may be used for promotional material about the Bridge21 programme and that I can withdraw from this at any time.

Data Protection: I agree to Trinity College, University of Dublin storing of any personal data relating to me which results from this project. I agree to the processing of such data for any purposes connected with the research project as outlined to me.

Signature of teacher: _____

Date: _____

Signature of Project Leader (TCD): _____

Date: _____

B21 Parent/Guardian Information Sheet

Dear Parent/Guardian,

This year, the school is participating in a pilot education project called **Bridge21**. This project is part of an overall education outreach programme at Trinity College Dublin, called the **Bridge2College –** a joint research initiative between Trinity College's Centre for Research in IT in Education, the Trinity Access Programmes and Suas Educational Development. The principal investigator is Brendan Tangney and the project leader is John Lawlor.

The overall aim of the programme is to develop a model of teaching and learning suited to the needs of students in the 21st century. The Bridge2College has been in operation for the past 3 years and has proven to be successful in improving students' attitudes towards learning and developing their skills in teamwork, technology, creativity and problem-solving. Bridge21 will aim to leverage the success of the B2C model and pilot its implementation in the formal classroom.

The project will take place during school time throughout the school year. During the programme, professional development workshops and seminars will be provided to staff. Members of the project team will spend significant portions of time in the school delivering workshops and supporting teachers and principals. All learning activities will take place during the normal school timetable and will be planned and designed in accordance with the guidelines and requirements of the Junior Cert curriculum.

Training programmes will also be provided for students, particularly in relation to the development of teamwork and technical/computer skills. These programmes will take place both in school and in the Bridge2College premises at Trinity College. As part of the programmes, your child will be using modern technology, which will include access to the internet and use of cameras. They will be under the supervision and guidance of adults at all times. All activities will comply with best practice in Child Protection and the policies of the school and Trinity College in this area to ensure that students benefit from the learning opportunities offered by technology in a safe and effective manner. Management of photographic images will be strictly in compliance with the above policies.

In order to demonstrate the effectiveness of the programme, researchers from Trinity College will collect information about the students' learning experiences at various stages during the school year. During class activities, interactions between students working together and between teachers and students will be recorded using observation tests. Students and teachers will complete pre- and post-questionnaires at various intervals during the programme. A random sample of students and teachers will also participate in interviews at the end of the programme.

All information that is collected by the researchers will be anonymised and stored in accordance with the Data Protection Act at Trinity College, Dublin. In the unlikely event that information about illegal activities should emerge during the study, the researchers will follow the school's Child Protection policy and inform the relevant authorities. There may be lectures, PhD theses, conference presentations and peer-reviewed journal articles written as a result of this project, however the students and school will not be identified.

We wish to seek your permission for your child to participate on the programme and to use the technology available in a safe and effective manner. Where appropriate, we would also like to publish work they may create during the programme that would be of educational benefit to other students.

We also wish to seek permission for your child to participate in the research part of the programme. Participation in this part of the programme is voluntary and you may remove your child from the process at any time, for any reason, without penalty and any information already recorded about them will not be used. Should you wish your child to be omitted from the research part, they can still participate in the programme, but none of their information will be used in the research.

From time to time, we may also record video footage and images of your child and their classmates and teachers at work – this will be used in communications and promotional/marketing material about the **B21** programme. Use of video footage and images will be strictly in accordance with best practice in Child Protection policies and guidelines. Your child's name will not appear alongside any images/video footage. Should you wish your child to be omitted from promotional material, they can still participate in the programme, but no images/video footage of them will be used.

Please sign below to indicate your consent and return the form to [insert teacher's name] as soon as possible. If you have any questions in relation to this, please do not hesitate to contact us.

Kind regards,

Claire Conneely & John Lawlor

Bridge to College Programme Team

(01) 8964099 / conneecm@tcd.ie

B21 Parent/Guardian Consent Form

I _____ (name of parent/guardian) consent to _____ _____ (name of child) taking part in the Bridge21 programme.

I have been provided with an information letter which outlines the activities my child will take part in, how research data will be collected and stored and how I can contact the research team. I understand that I may withdraw my child from the research project at any time should I wish to do so for any reason and without penalty.

I also know that images/video footage of my child may be used for promotional material about the Bridge21 programme but their name will not be identified.

Data Protection: I agree to Trinity College, University of Dublin storing of any personal data relating to my child which results from this project. I agree to the processing of such data for any purposes connected with the research project as outlined to me.

Signature of parent/ guardian: _____

Date: _____

Signature of Project Leader (TCD): _____

Date: _____

Please note: As this research involves the use of computers, children with epilepsy cannot take part in either the learning activity or research study, please inform the school if this is the case. If there is a family history of epilepsy the child may take part, but does so at your risk.

Student Information Sheet

The **Bridge2College** is a joint research initiative between Trinity College's Centre for Research in IT in Education and the Trinity Access Programmes and Suas Educational Development. The principal investigator is Brendan Tangney and the project leader is John Lawlor.

During the programme, researchers from Trinity College will collect information about your learning experience. Interactions between you and your classmates working together will be observed. Interactions between you and your teacher may also be recorded. You will also be asked to complete a questionnaire at different times during the programme. You may also be selected to take part in an interview with a small group of your classmates.

All information that is collected by the researchers will be anonymised (all names will be removed) and stored in Trinity College, Dublin. In the unlikely event that information about illegal activities should emerge during the study, the researchers will have to inform the relevant authorities. The results of the research are likely to be used in lectures, PhD theses, conference presentations and journal articles, but you or your school will not be identified.

Your participation in the research is voluntary and you can change your mind about it at any time – in that case we will not use any information already collected about you.

From time to time, we may also record video footage and images of you, your classmates and your teachers at work – this will be used in communications and promotional/marketing material about the **B2C** programme. You have the right to be anonymous; therefore your name will not appear alongside any images/video footage. Please keep in mind that you can change your mind at any time and in that case we will not use any images/video footage associated with you.

If you have any questions, please do not hesitate to ask your teacher, John or Claire.

Kind regards,

Claire Conneely & John Lawlor

Bridge to College Programme Team

(01) 8964099 / conneecm@tcd.ie

Participant Consent Form (Student)

I, _____

_____(your name) agree to take part in the research part of the **Bridge2College** programme.

I have read the information sheet provided about the project and know how information will be collected and stored. I understand that I can choose not to take part in the research at any time.

I also know that images/video footage of me may be used for promotional material about the **Bridge2College** programme and that I can change my mind about this at any time.

Data Protection: I agree to Trinity College, University of Dublin storing and using my information from this project.

Signature of participant: _____

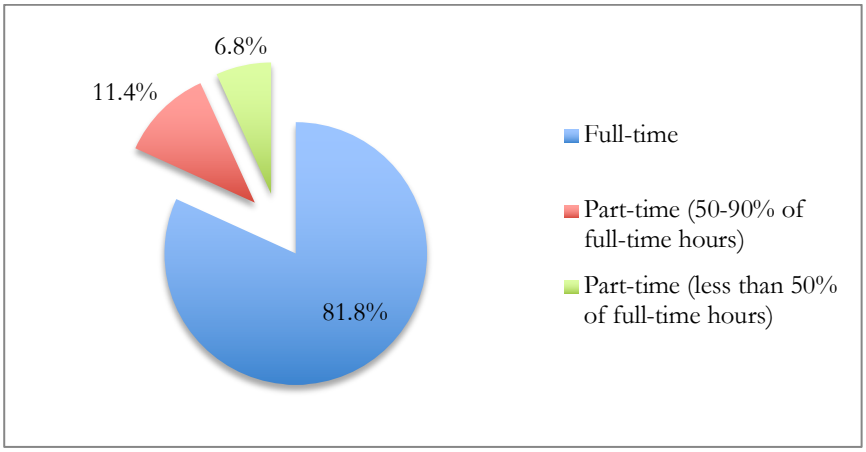
Date: _____

Signature of Project Leader (TCD): _____

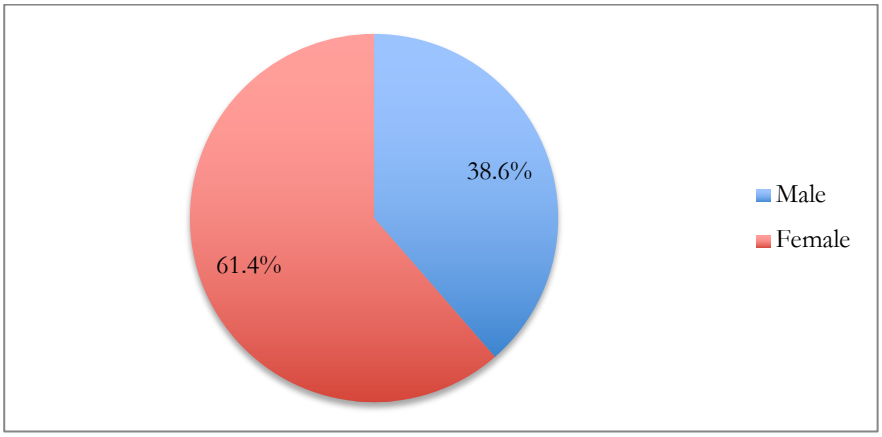
Date: _____

Appendix 6.1 Additional Data Analysis Tables

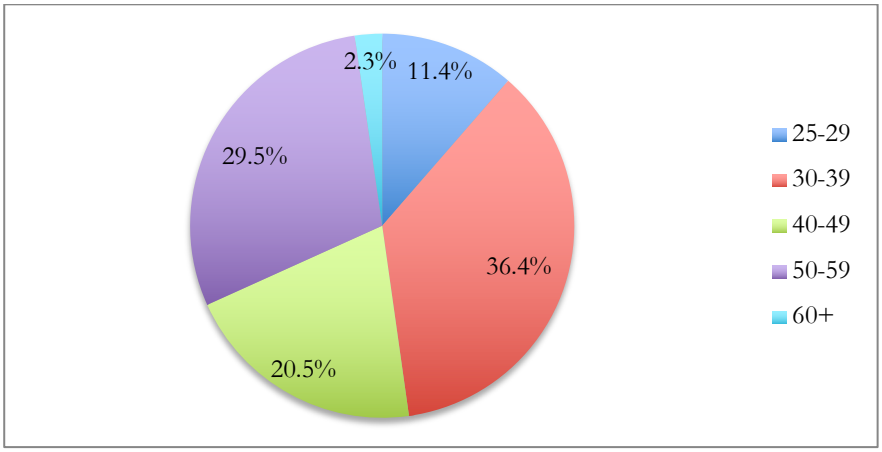
Teacher Questionnaire (Explanatory Phase)



Teacher questionnaire respondents: Employment status



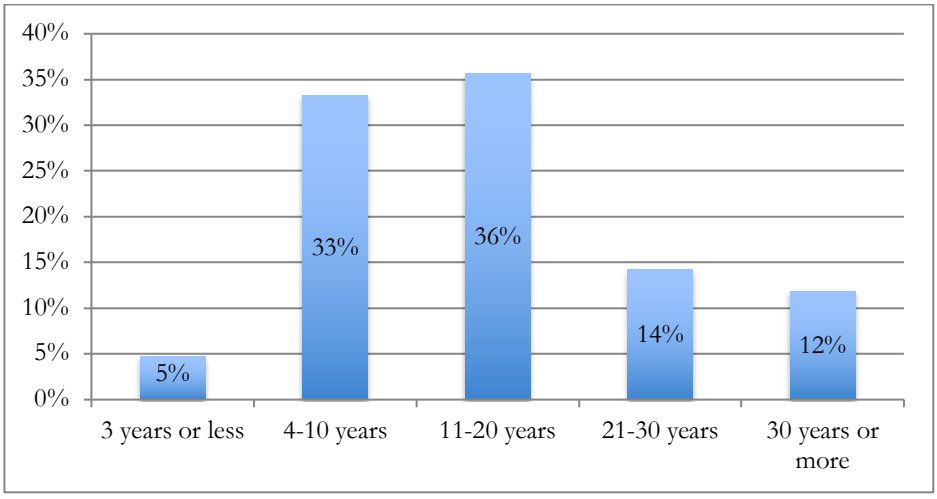
Teacher questionnaire respondents: Gender



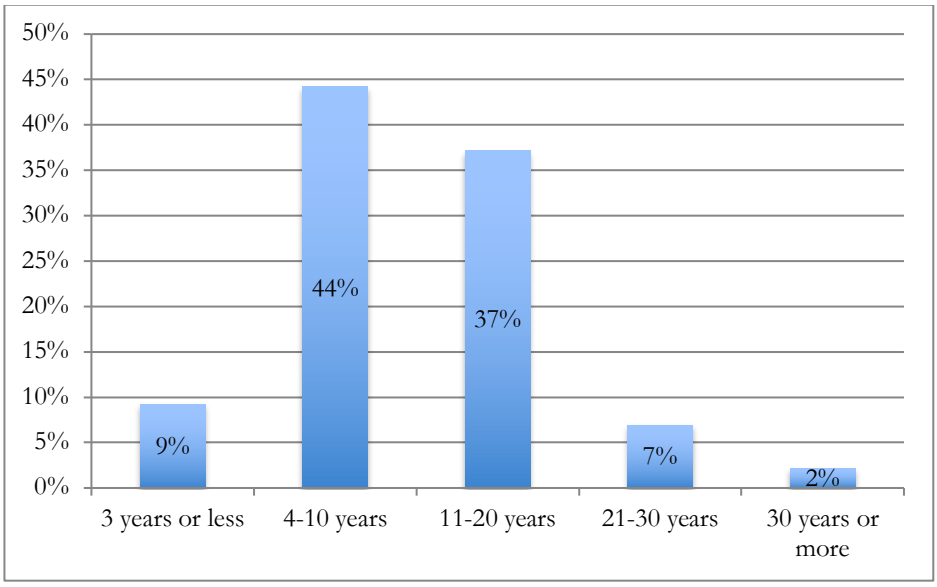
Teacher questionnaire respondents: Age profile (in years)

Age	Employment Status			Total
	Full-time	Part-time (50-90% of full-time hours)	Part-time (less than 50% of full-time hours)	
25-29	1	4	0	5
30-39	15	1	0	16
40-49	8	0	1	9
50-59	11	0	2	13
60+	1	0	0	1
	36	5	3	44

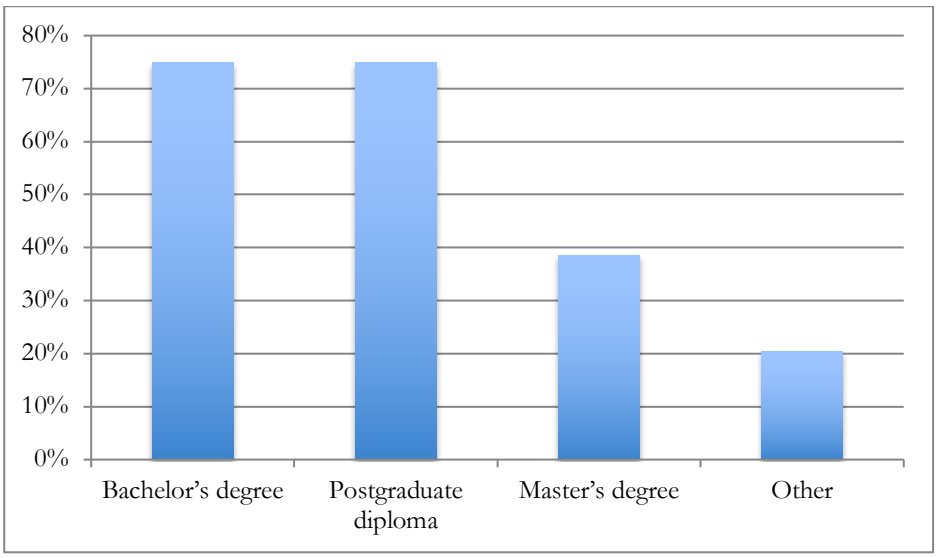
Crosstabs analysis: age by employment status



Teacher questionnaire respondents: Number of years teaching



Teacher questionnaire respondents: Number of years teaching at current school



Teacher questionnaire respondents: Education attainment levels

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
Equal variances assumed (A) or not assumed (N/A)		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Diff.	
									Lower	Upper
Extent use teamwork	A	0.14	0.71	0.00	29.00	1.00	0.00	0.38	-0.78	0.78
	N/A			0.00	25.23	1.00	0.00	0.39	-0.79	0.79
Extent use tech-mediated learning	A	0.16	0.69	0.96	29.00	0.34	0.35	0.36	-0.39	1.10
	N/A			0.95	24.61	0.35	0.35	0.37	-0.41	1.11
Extent use PBL	A	0.19	0.67	0.30	28.00	0.77	0.11	0.38	-0.66	0.88
	N/A			0.29	23.21	0.77	0.11	0.38	-0.67	0.90
Extent use learning space design	A	0.38	0.54	-0.27	29.00	0.79	-0.15	0.54	-1.25	0.96
	N/A			-0.26	23.69	0.80	-0.15	0.55	-1.29	1.00
Extent use teacher as facilitator	A	0.31	0.59	0.53	29.00	0.60	0.21	0.40	-0.60	1.02
	N/A			0.53	26.60	0.60	0.21	0.40	-0.60	1.02
Extent use reflection	A	1.10	0.30	1.83	29.00	0.08	0.74	0.40	-0.09	1.56
	N/A			1.88	28.31	0.07	0.74	0.39	-0.07	1.54
Extent use skills-focussed	A	0.13	0.72	1.14	29.00	0.27	0.43	0.38	-0.34	1.20
	N/A			1.13	25.59	0.27	0.43	0.38	-0.35	1.21
Extent use social learning	A	0.19	0.67	1.37	29.00	0.18	0.65	0.47	-0.32	1.62
	N/A			1.42	28.64	0.17	0.65	0.46	-0.28	1.58

Teacher questionnaire respondents: Independent Samples Test for gender difference in use of the model

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
Equal variances assumed (A) or not assumed (N/A)		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Diff.	
									Lower	Upper
How effective is Bridge21	A	0.48	0.49	-0.17	33	0.86	-0.04	0.20	-0.45	0.38
	N/A			-0.17	22.63	0.87	-0.04	0.21	-0.47	0.40
Effectiveness teamwork	A	2.71	0.11	0.94	29	0.36	0.19	0.21	-0.23	0.61
	N/A			0.97	28.80	0.34	0.19	0.20	-0.21	0.50
Effectiveness tech-mediated learning	A	0.20	0.66	0.10	29	0.33	0.27	0.27	-0.28	0.81
	N/A			1.01	27.39	0.32	0.27	0.26	-0.27	0.80
Effectiveness PBL	A	1.48	0.23	0.72	28	0.48	0.19	0.27	-0.36	0.74
	N/A			0.74	25.60	0.47	0.19	0.26	-0.35	0.73
Effectiveness learning space design	A	3.88	0.06	-0.24	26	0.81	-0.08	0.34	-0.79	0.62
	N/A			-0.22	15.83	0.83	-0.08	0.37	-0.87	0.71
Effectiveness teacher as facilitator	A	0.17	0.68	-0.69	29	0.50	-0.16	0.24	-0.65	0.32
	N/A			-0.69	25.93	0.50	-0.16	0.24	-0.65	0.32
Effectiveness reflection	A	0.08	0.79	1.06	28	0.30	0.31	0.30	-0.29	0.92
	N/A			1.04	23.95	0.31	0.31	0.30	-0.31	0.93
Effectiveness skills-focussed	A	0.33	0.57	0.09	29	0.93	0.02	0.25	-0.49	0.54
	N/A			0.09	27.73	0.93	0.02	0.25	-0.48	0.53
Effectiveness social learning	A	0.01	0.93	0.82	28	0.42	0.22	0.27	-0.33	0.76
	N/A			0.81	24.49	0.43	0.22	0.27	-0.34	0.77

Teacher questionnaire respondents: Independent Samples Test for gender difference in effectiveness of the model

Appendix 6.2 Additional sample Bridge21 learning activities

Sample cross-curricular project (implemented at School C)

Project Title	**Design the School Lunch Menu**
Description of task	The Principal has recently received complaints about the school menu. He is now asking you to re-design the school lunch for whole school. Each group is asked to propose a menu for one day of the school week. The best menu will be decided after presentations before the Principal, a member of the canteen staff and a food nutritionist expert. The best school lunch will be prepared on a Friday in November for the whole school. The lunch must meet the following requirements: • suit all students • nutritionally well balanced, appetizing & digestible • pleasing to the eye • value for money • easily prepared & served for a large number
Subjects	Home Economics, Science, Art, Business, English
Time Allocated	Project implementation: During 40 min classes of subjects involved over 7 weeks

Assessment criteria for 'Design the School Lunch Menu' project

Week	Deliverable	What to include	Weighting
1-6	Weekly Templates	Completed worksheets by group and individuals	10 %
1	Survey Design Completed	Survey	10 %
2	Survey Delivered and Analysis	Analysis of survey	10 %
3	Proposed Lunch Menu	Menu of food and reasons for your choice	10 %
4	Kitchen Observations	Summary of kitchen observations	10 %
5	Debate between groups	Written speeches for the debate	10 %
6	Final Presentation	Menu presentation + Sample Tasters of your proposed menu	30 %
7	Reflection on group work Tests on Subject Specific Areas	Reflection worksheets	10 %

Sample themes chosen for 'Thematic' scenario

Theme 1: Conflict

Exploring Coltan- a 'Conflict Mineral'

You are invited to participate in a live debate this Friday on the topic:

"*Apple is exploiting the 3rd world*"

You will work in teams to research & prepare the topic using the knowledge gained in your Science, History and Geography classes this week. You will also have the opportunity to develop and practice debating skills throughout the week in your English class.

Theme 2: Survival – The How To Guide

You are travelling in a plane (back in 1960's) when lightning strikes, damaging the plane's engines. The plane crash lands, and your group are the only survivors. Prepare and present a survival guide on how you survived for 1 year by yourselves.

You can present your survival guide through a mixture of

- Book
- Video
- Role Play
- Practical Demonstrations

Before starting on the survival guide, you will need to decide where you landed. (You can also decide when, if you believe in time travel). In your survival guide you will need to describe

- Shelter – what sort of shelter do you live in
- Food – On what food did you survive, where did it come from and how did you prepare it
- Fire – How do you make fire ?
- Water – How did you source clean drinking water
- Tools – What sort of tools did you use, make and how
- Health – How did you deal with health issues

Your survival guide will be assessed on the following criteria:

Shelter – type of shelter, details of construction, materials	10%
Food – Food choices and how it was it prepared	10%
Fire – How to make fire, materials used, details of other energy sources used	10%
Water –Sourcing & storage of clean drinking water	10%
Tools – What was used, how were they made, what materials were used	10%
Health – Health issues & how they were dealt with	10%
Map/ Description of Habitat	10%
Use of Irish Lang.	10%
Use of DVD/ Props/ Song/Demos	10%
Values/ Rules for living & surviving together	10%
TOTAL	100%

Theme 3: Save our Local Park

To reduce the national debt the government has decided to sell our local park to the Chinese Government. They plan to build an embassy on the grounds and close the part to the public. The only way to keep it open is to increase the number of people that use it every day.

*Your task is to create an **information campaign** which will gather public opinion and force the government to reverse their decision.*

Each campaign must be printed on an A4 sheet (can be double sided and colour). It must target two different groups of people who use the park, and for each group highlight at least two attractions for that group.

You will work on this project throughout this week in the following classes:

Science – Flora/Fauna/Study of Habitat

Maths – Length of Trails, Height of trees

Project Map - Timeline and Milestones (For Students)

Before Project Starts:
Suggestion for 2nd Years - use Philosophy class to reflect on last year's projects & teamwork. Use Bridge21 reflection sheets. Other possible questions:
What did I do well last year? What would I like to improve this year?

Mon: Introduction
Intro. to the project - content & topics; structure of the week & activities
ENFO speaker or marketing speaker/visit to park
Sample flyers - 'good' v 'bad' example - class discussion
Assess understanding of project
Divide into groups
Allocate roles – Leader, reporter, go-getter (resource manager), time manager, researcher(s), designer(s)?
Team name & group title
Brainstorm & identify at least two different groups of people as target audience. Place post-it on wall space
Mini presentation?

Tues: Planning Each group to identify two attractions per target group of people - brainstorm/post-its Develop a plan of tasks to do & identify resources needed for flyer content (specific content for subject areas) Mini presentation Team Reflection
Wed: 'Doing' Storyboard of flyer - design layout, headings, titles, content (text & images) Do up checklist of items Visit to park - collect photos, info & data Review checklist Team reflection
Thurs: Editing Edit day Optional return visit to park (if necessary) First draft before lunch Proof-reading & teacher feedback Second draft
Friday: Presenting and Reflecting 1st class - final draft & print brochures Prepare display stations Presentation @ Display Stations - 1st & 2nd years assessing each other - peer assessment: template (5 questions) Reflection - individual? Link to subjects & skills learned

Project Map – Timeline, Milestones & Assessment (Teacher Notes)

To be done before:	**Task(s)**
Mon	1. Detailed brief needs to be drawn up including -guest speaker -5 key areas for assessment -details of campaign -resources available to students -time limit etc. 2. Sample flyers need to be collected/photocopied 3. List of available resources need to be typed/photocopied 4. List of sources drawn up 5. Wall space cleared for each group's notes/post-its etc. 6. Ongoing assessment sheet drawn up per group and stuck on wall
Tues	1. Sheets with roles photocopied.

	2. Team reflection sheets photocopied (Bridge 21)
Wed	1. Organise whiteboard/A5 sheet per group with markers 2. Staffed well enough for trip to park 3. Team reflection sheet (Bridge 21)
Thur	1. Staffed well enough for park 2. English teacher timetabled for proof reading (use of language)
Fri	1. Get G21 and G22 booked for last three classes. 2. Print assessment sheets for each station. 3. Print groups flyers and photocopied if necessary 4. Help set up stations. (moving of furniture/desk and stand per station if possible)

Assessment:

The assessment will be based on the following five aspects:

1. Visual Impact - The overall appearance of the campaign
2. Language - The use of language
3. Communication - Communication of project at stands
4. Effectiveness - Would it encourage you to use the park?
5. Group Work - Did group meet the goals which they set for themselves?

What are the students being assessed for?

Rather than concentrating on the four subjects involved in the brief, we thought it would be useful to spend time on the five aspects which will be assessed (communication, language etc.) The nature of the project is to allow the students to take their own slant on the campaign and so we thought it would be restricting them by asking them to include all subjects. (We anticipate that at least two subjects will be naturally included). The students will be assessed and (i) individual feedback will be given to each group, (ii) each individual in the group will receive a merit, however all students in one group must receive the same merit, and (iii) there will be a small prize for the best group.

1-4 will be assessed at the end of project at the display. Each group will be given a station with copies of their information leaflets and any other resources they wish. (excluding PowerPoint) Each group will be visited by at least five people including students and teachers; each visitor will ask a few questions about the campaign and fill in the following assessment sheet based on their thoughts. (copy of assessment sheet on next page) These will be placed in a box at the stand to be gathered at end of display. We are aiming to have this completed before lunch so that a meeting can take place over lunch time on the Friday in order to have group feedback for the students prior to the reflection period at the end of the day.

The assessment of each groups' goals will be ongoing. Each group will receive an assessment sheet which will be stuck on their wall space. It should be accessible to students and teachers at all times. The idea of

this assessment type is to ensure work is ongoing and a potentially excellent project is not developed by one individual in a short space of time. Each group will post their list of tasks on Tuesday. Each time a facilitator is in the room, they should visit at least two groups individually and see where the group stands in comparison to their task timeline. In some cases, groups may be behind/ahead of planned tasks; once they can communicate where they are how they got there etc. and the teacher is happy that the group is working well to achieve goals, they initial the assessment sheet on wall and write any relevant comments. This sheet will be taken into consideration when overall feedback is being prepared etc.

The final period should be given to a class reflection period, starting with the individual. (Bridge 21 individual reflection sheets)

Appendix 6.3 Refined Teacher Resources

BRIDGE21
THE POWER OF LEARNING

Team selection: Guidelines for Teachers

Teamwork is a core principle of the Bridge21 approach to learning. A very structured approach to teamwork is applied, with team stability maintained over a set period of time. This allows students to grow and form together as a team, to support each other's development, commit themselves to a shared project and be able to interact with other groups. It also enables young people to develop their individual and collective capacities through sharing and building on their individual skills, talents and experience.

During Bridge21 classes, we would encourage you to design learning activities which will allow your students to work on challenging projects in teams of 4-5 students. Below are some guidelines on how to divide a group of students into teams. It is recommended that you do this in the class before learning activity so that they come to the Bridge21 class prepared and aware of the set-up.

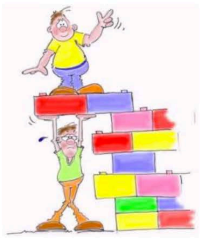
Some of the guidelines may not be relevant your particular group of students (for example, mixed gender), but we would encourage you to adhere to as many of the following suggestions as possible:

- ✓ Mixed gender
- ✓ Mixed ability
- ✓ Mix students from different classes
- ✓ Mix students from different year groups
- ✓ Pair students with Special Educational Needs with a trusted & responsible peer

The focus of Bridge21 is to enable students to develop the ability and skill to work with others of a different ability, personality type & skill set to themselves, therefore the following are not recommended:

- X No "best friends" together
- X Students cannot pick their own teams

Recommended team size: 4 students (min. 3 students, max.5 students @ team)



Team Roles

Electing a team leader

The purpose of the **Team Leader** is to keep the team on task and facilitates decision-making processes within the team. This student is a key link between the team and the teacher, as they report to the teacher on a regular basis for feedback, clarification and can request additional help if needed. They also try to ascertain the strengths of each team member and assign appropriate tasks to them (again, with the support of the teacher).

It is a good idea for teachers to lead a discussion/brainstorm on what makes an effective Team Leader, particularly if leadership is a skill that has not yet been developed or students have not yet been exposed to in the context of the formal classroom. It is important that they understand the core Bridge21 principles of leadership, so during the brainstorm/discussion, let them come up with ideas but make sure the following points are noted/highlighted. The leader:

- Is the link between the team and the facilitator(s)/teacher
- Not the "boss" or the "queen"
- Brings out the best in everyone, encourages talent-sharing
- Encourages everyone, keeps a positive attitude in the team
- Keeps the team on task and facilitates communication between members
- Supports the role of others
- Makes sure everyone is making a worthwhile contribution
- May not be the one "noticed" but is doing behind the scenes (but all the same - teachers can see when a leader is effective)

Other team roles:

Scribe: Documents the teams' work processes & progress throughout the task via photos, memos, notes etc. Records obstacles/challenges and achievements during the task for later reflection & discussion with the team & class

Time-keeper: Supports the team leader in keeping the team on task & ensures that timeframes are adhered to.

Researcher(s): Researches & finds specific material and/or resources to suit the learning activity

Reporter / Presenter (s): Summarises the team's work/discussion/results and presents them to another peer group, the teacher or the whole class

Further roles: (suitable for multimedia-based learning activities)

TV director and/or editor, Radio director and/or editor, Script-writer(s), Actor(s), Designer(s), Artist(s) etc.

Project Planning Template

Project title: _____

Subject(s): _____

Year/Class: _____

1. Explain the project (*summary of what students will be challenged to do*):

2. The learning intention (*what the project is intended to achieve*):

3. Previous learning needed to complete the project:

a. Subject content knowledge:	b. Key skills:

4. What the students will learn during the project:

a. Subject content knowledge:	b. Key skills:

5. Resources that students will need to access/use:

6. How the learning will be organised during the project (*weekly/ daily time allocation, total duration, physical space*)
7. Generating evidence of learning (*how will students' knowledge, understanding & skills be demonstrated*):

Project Design Checklist

(Adopted from the Buck Institute for Education: www.bie.org)

Does the Project . . .?			?
FOCUS ON SIGNIFICANT CONTENT AND AUTHENTIC ISSUES Students learn important subject matter content and address problems & issues from the world outside the classroom			
ESTABLISH A NEED TO KNOW AND DO Students are brought into the project by an entry event that captures interest and begins the inquiry process			
ENGAGE & MOTIVATE STUDENTS TO LEARN Students are engaged and motivated by the project & can see the connection between subject areas			
REQUIRES CONSTRUCTIVE USE OF TECHNOLOGY Technology is being used purposefully and to support students' learning			
DEVELOP SKILLS & KNOWLEDGE Students acquire key skills & competencies as well as subject knowledge			
INCORPORATE FEEDBACK AND REVISION Students use feedback and reflection to evaluate & improve their work			
CONCLUDE WITH A PUBLIC PRESENTATION Students exhibit products or present solutions and explain their work to others and respond to content- and process-focused questions			

BRIDGE 21
THE POWER OF LEARNING

Assessment Rubric - Template

	Beginning 1	Developing 2	Accomplished 3	Exemplary 4	Score
Stated Objective or Performance	Description of performance characteristics reflecting a **beginning** level of performance.	Description of performance characteristics reflecting **development and movement toward mastery** of performance.	Description of performance characteristics reflecting **mastery** of performance.	Description of performance characteristics reflecting the **highest level** of performance.	
Teamwork	No collaboration, with no input from some team members	Poor division of tasks, with minimum input from some team members	Fair division of tasks, but minimum input from some team members	Team worked collaboratively at all times, with all members participating equally and fair division of tasks.	
Writing Style, General Neatness and Presentation of work	Many grammar and spelling mistakes. Badly organised structure. Information is confusing and presented in an unimaginative manner	Some grammar and spelling mistakes. Badly organised structure and presentation of information. Effective in conveying main ideas, but a bit unimaginative.	Few grammar and spelling mistakes. Strong vocabulary. Good structure and presentation of information. Effective in conveying main ideas, but a bit unimaginative.	Clearly written with no grammar or spelling mistakes. Strong vocabulary. Excellent structure and presentation of information. Imaginative and very effective in conveying ideas.	
Design of products (website, video, blog etc.)	All products contain inappropriate images, film clips & audio files. Poor balance between original & copied content. Poor use of colour. Overall design & layout is unclear & difficult to follow	Some products contain appropriate and easily understood images, film clips & audio files. Poor balance between original & copied content. Good use of colour. Overall design & layout is unclear & difficult to follow	Some products contain appropriate and easily understood images, film clips & audio files. Good balance between original & copied content. Good use of colour. Overall design & layout is clear & easy to follow	All products contain appropriate and easily understood images, film clips & audio files. Good balance between original & copied content. Excellent use of colour. Overall design & layout is clear & easy to follow	
Content (Demonstration of knowledge & understanding)	Products contain little relevant or accurate information, with no evidence of original thinking. Little or no research is apparent.	Products contain information which is generally accurate, but not relevant. Little evidence of original thinking. Research is adequate.	Products contain information which is generally accurate and relevant. Some evidence of original thinking. Research is adequate.	Products demonstrate a depth of understanding & original thinking by using relevant and accurate detail. Research is thorough.	
Final Presentation of Work	Poor preparation and participation from 1 team member. The presenter cannot be heard and cannot be understood.	Neat and well prepared presentation, with participation from 1-2 team members. Presenters speak clearly and loudly enough to be heard, & engage the audience.	Neat and well prepared presentation, with participation from 2-3 team members. Presenters speak clearly and loudly enough to be heard, & engage the audience.	Neat and well prepared presentation, with participation from all team members. Presenters speak clearly and loudly enough to be heard, & engage the audience.	