Confidence amongst post-primary teachers in using computational thinking in the classroom.

An evaluation of whether scaffolding measures may improve confidence levels

Lisa Hegarty

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Declaration

I declare that the work described in this document is, except where otherwise stated, entirely my own work and has not been submitted as an exercise for a degree at this or any other university.

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Abstract

This study aims to evaluate whether the introduction of scaffolding measures such as peer-programming, motivational interviewing and reflective practices may improve confidence levels of post-primary school teachers in using computational thinking in the classroom. Entering the world of global competition, the emphasis is placed on students to be communicative, collaborative and to think critically and innovatively. Consent has not been agreed on the definition of computational thinking but Wing (2006) so describes as a way of "solving problems, designing systems, and understanding problems drawing on the concepts fundamental to computer science". Using the theoretical framework of social constructivism coupled with the Andragogical principles, the study seeks to monitor whether confidence levels amongst teachers remotely working in pairs to collaboratively produce an artefact. With it's original foundations in dyadic adult–child interaction, the concept of instructional scaffolding involves temporary and adaptive support to the learner (Smit J, Baker A., Eerde H, 2013). The intervention in this project will require participants to work in pairs, post online reflections of their experience and participate in a motivational interview. Quantitative and qualitative research methods are employed to measure whether an increase in confidence has occurred resulting in suggestions on further research.

Chapter 1: Introduction

1.1 Background and Rationale

The twenty-first century has witnessed rapid technological development in all aspects of the global citizens' everyday lives. Conducively. a burgeoning expectation in the Educational sector is emerging for teachers to be "conversant in so-called twenty-first-century skills, grounded primarily in the ability to use digital technologies for pedagogical purposes" (Bullock, 2013, p103). Government rhetoric indicates that technological skills are pivotal in the creation of a skilled workforce and for economic prosperity (*Digital strategy for schools 2015-2020*, Department of Education, 2015). The complexities of incorporating digital technologies in the teaching and learning domain are also tied in with much research in the area of capacity, confidence and self-efficacy and the need to evolve skills between personal to professional use into learning experiences (Bennett, Maton, & Kervin, 2008: Berger, 2007; Corrin, Bennett & Lockyer, 2010, Helsper & Enyon, 2009; Herrington & Herringon, 2006; Howe & Strauss, 2003; Keengwe, 2007; Lemon, 2013, Oliver & Goerke, 2007). Understanding the factors that affect teachers' integration of technology in the classroom has attracted many researchers. Teachers' self-efficacy beliefs toward technology integration have been considered a crucial factor that affects teachers' integration of technology (Wang et al. 2004; Albion 1999; Hall 2008; Ertmer et al. 2003). This dissertation attempts to further investigate.

1.2 Overview to the Ctwins project

The Ctwins project is a two-cycle study with the aim of improving computational thinking confidence in Educators through paired activities. The project was a collaboration between Trinity College Dublin and Queens University, Belfast and supported by Google. It was aimed towards post-primary school teachers residing within the Republic of Ireland and Northern Ireland, with little or no confidence in computational thinking. The format was such that the participants would attend two live meet-ups; the first to provide instruction in the Scratch programme, introduce the pairs to each other and to familiarise themselves with the online communication platform, Edmodo. The second live meet-up was to provide an opportunity for the Ctwins to showcase the

artefact that was created whilst working in pairs. Whilst the overall objective of this project is to create a Continual Professional Development offering in this area for teachers, this does not fall within the scope of this study. The researcher joined this project for it's second cycle to investigate whether the introduction of additional scaffolds would lead to enhanced confidence levels amongst the Ctwin participants. The second cycle of Ctwins ran over a period of nine weeks (n = 14). Communication between the spatially separated participants took place via Edmodo with technical support provided by an E-moderator, a member of the Ctwins project within Trinity College Dublin.

1.3 Research Objective

This study is an exploratory case study which investigates whether scaffolding measures would ameliorate confidence levels engaging in computational thinking amongst post-primary school teachers.

The researcher introduced of a trio of scaffolding measures:

(i) Pair programming (working in pairs)

(ii) Motivational Interviewing

(iii)Reflective practices by the participants online

The research was conducted within both qualitative and quantitative traditions. The data collection techniques comprised pre-and post-project surveys, observations and coding analysis of online reflections. The emerging findings indicate that scaffolding measures does indeed lead to enhanced confidence levels albeit with some adjustments to be made for future interventions.

1.4 Dissertation Roadmap

The literature review discusses the underlying pedagogical approaches of social constructivism, andragogy and experiential learning as the foundations of the Ctwins project. Providing guidance in what the term confidence may suggest, Bandura's (1986, 1997). The concept and categories of scaffolding are explored to assist the understanding of the introduction

of the proposed scaffolds. Subsequently, pair programming and it's application to Education are discussed. The theory and background to Reflective practices are described along with the principles of Motivational Interviewing.

The design chapter draws from the literature review and describes how the learning experience as designed and the introduction of the scaffolding interventions.

The methodology chapter provides details of the research question, the data methods employed and the choice of a case study methodology.

The data analysis chapter focuses on the data collected and analysed relating to the introduction of scaffolds with the subsequent findings explained. A discussion chapter reviews the findings.

The conclusion to the research question seeks to answer the research question and the effect on confidence by the introduction of pair-programming, motivational interviewing and reflective practices. Limitations to the study are noted and suggestions for further research are offered.

Chapter 2: Literature Review

2.1 Introduction

Technology is part of our zeitgeist and has permeated all areas of life from commerce to interpersonal communication. The educational sector is no exception. Educational technology has widened the routes of access and subject choice to all. Yet, teacher's engagement with technology seems fraught and underexplored. This paper questions whether the missing link between the education and the use of technology in the classroom lies in the lack of confidence amongst teachers and whether intervening with scaffolding measures of pairing, reflection and motivational interviewing may accordingly enhance.

2.2 Factors affecting confidence levels amongst teachers

With rapid technological development, a burgeoning expectation in Education is emerging for teachers to be "conversant in so-called twenty-first-century skills, grounded primarily in the ability to use digital technologies for pedagogical purposes" (Bullock, 2013, p103). Government rhetoric indicates that technological skills are pivotal in the creation of a skilled workforce and for economic prosperity (*Digital strategy for schools 2015-2020,* Department of Education, 2015). The complexities of incorporating digital technologies in the teaching and learning domain are also tied in with much research in the area of capacity, confidence and self-efficacy and the need to evolve skills between personal to professional use into learning experiences (Bennett, Maton, & Kervin, 2008: Berger, 2007; Corrin, Bennett & Lockyer, 2010, Helsper & Enyon, 2009; Herrington & Herringon, 2006; Howe & Strauss, 2003; Keengwe, 2007; Lemon, 2013, Oliver & Goerke, 2007). Understanding the factors that affect teachers' integration of technology in teaching has attracted many researchers. Teachers' self-efficacy beliefs toward technology integration have been considered a crucial factor that affects teachers' integration of technology (Wang et al. 2004; Albion 1999; Hall 2008; Ertmer et al. 2003). Bandura (1997) described perceived self-efficacy as person's judgment of their capabilities to perform a particular task. Furthermore, the characteristic of self-efficacy affects decisions regarding what behaviours to

undertake and determine how much effort a person will spend on an activity (Compeau et al. 1999). The notion that individuals' self-beliefs toward their capabilities affect their actions is embodied within Bandura's social cognitive theory, hence, ''what people think, believe, and feel affects how they behave'' (Bandura 1997, p 25). Bandura (1986, 1997) identified four basic sources of self-efficacy. The most potent is a "mastery experience" whereby a successful mastery experience will increase confidence whereas a weak experience will hamper same. Advocated also as a factor impacting on confidence is "vicarious experience" where one compares their abilities to peers (Ibid). Bandura (1986) explained that verbal persuasion, such as words of encouragement from a peer or teacher can ''…contribute to successful performance….'' (p 400). Wise and Trunnell (2001) argued that verbal persuasion is most powerful following a mastery experience. Self-efficacy is also affected by the individual's mood with lower self-efficacy arising from negative emotion (Bandura, 1997). Further aspects affecting teacher's confidence are lack of teacher competence, lack of time for training, lack of pedagogical training, lack of access to resources (Jamieson-Proctor, R. M., Burnett, P. C., Finger, G., & Watson, G. (2006). These barriers to confidence have been described as first-order or external barriers (Snoeyink and Ertmer, 2001) whilst internal factors such as teachers' resistance to change, no perception of benefits and fear have been highlighted as second-order barriers (Bingimlas,2009).

2.3 Pedagogical approach to CTwins

At the pedagogical heart of the CTwins project lies the theory of social constructivism. Based on work of classical sociologists such as George Herbert Mead and Emile Durkheim, psychologists such as Jerome Bruner, and educators such as Jean Piaget, John Dewey, and Lev Vygotsky, the theory espouses that social realms and interrelationships dictate the learning process in addition to the learner constructing knowledge through collaboration with others. Inherent features of this approach include the learner having an intentional sense of inquiry, a focus on the learner analysising, synthesising and explaining the learning content, the teacher playing the role

of a guiding facilitator along with the learner possessing an ability to demonstrate their learning. (Vermette, P., Foote, C., Bird, C., Mesibov, D., Harris-Ewing, S., & Battaglia, C., 2001).

2.4 Supporting Learning theory of Adult Learners

Reference may also be made to the concept of Andragogy which describes the art and science of teaching adult learners (Knowles, 1984) and which foundations lies in the Platonian instructional tradition of teaching young adults (Knapp, 1833, as cited in Taylor & Kroth, 2009). Merriam, 2001, disagrees that andragogy is not an "educational theory" but respects that adults learn differently to children which ought to attract a different teaching style. Further perspectives thereof see Conner (2004) shift the educational focus from teacher-led to the learner-centred in differentiating andragogy from pedagogy and the transfer of information from teacher to learners is considered pedagogical with andragogy promoting the reflection on the application of the knowledge garnered by the learner (Batson, 2008; Pew, 2007).

Constituting the Knowles andragogical approaches to adult education are five descriptive characteristics of the adult leaner:

1. Self-concept: Knowles contends that as a learner matures that there is a progression from being a dependent person to that of self-direction.

2. Experience: The maturing learner has built a bank of life experience which, as a person matures, furnishes a resource for learning. Additionally, this coincides with the social constructivism theory where previous experiences are brought to the fore in engaging in new learning ventures.

3. Readiness to learn: as a person matures their readiness to learn becomes oriented increasingly to the developmental tasks of their social roles

4. Orientation to learning: as a person matures their time perspective changes from one of postponed application of knowledge to immediacy of application.

5. Motivation to learn: as a person matures the motivation to learn is internal. Resonant of the aforementioned self-concept principle, the choice to join the CTwins project was not directed from an external force e.g. school, promotion but rather driven by an internal motivation to improve their teaching practice and their own personal development. Moreover, the general principles of andragogy highlight the desire of the learner for autonomy.

2.4 Additional influences on the CTwins Learning experience

Learning theories are aplenty and feature a menu to include Gardner's (1993) multiple intelligences, Vermunt's (1992) theory of learning styles, Kolb's (1984) theory of experiential learning, and Sternberg's (1997) theory of mental self-government, Gregorc's (1982) cognitive style differences, and various extensions of Jung's (1921/1970) psychological types (Lawrence, 1993) describe the observed differences among students' approaches towards learning and relate to the learning styles of students in higher education. For the purpose of this study, the Learning Style Inventory is employed with the objective of questioning whether the learning style affects confidence levels amongst the CTwins. Psychologist David Kolb proposes that the learning process involves "experience, reflecting, thinking, and acting" (Purdy, 2016) and subsequently created a Learning Style Inventory with the most recent revision being published in 2011. Influenced by Educationalists Paiget, John Dewey, and Kurt Lewin, Kolb contended that learning occurs via experience rather than a lecture style delivery. Reference may be made to learning theories as espoused by Piaget (Stage theory), and Kolb (Experiential Learning Theory). Piaget (1997) maintains that learners must be pro-active in seeking to construct knowledge and not merely reproducing instruction

2.5 The Concept of Scaffolding

With it's original foundations in dyadic adult–child interaction, the concept of instructional scaffolding involves temporary and adaptive support to the learner (Smit J, Baker A., Eerde H, 2013). Historically, the metaphor of scaffolding described parental support to

toddlers as they learned to construct pyramids with wooden blocks (Wood, Bruner & Ross, 1976). The intention of the endeavour is to bridge the gap between the current abilities of the learner in order that they subsequently may solve the problem or complete the required task. By the same token, the purpose is also to encourage the learner's interest in the lesson and to retain their engagement (Bellard, Kim & Hannafin, 2013). It is a temporary measure with the view of withdrawing the support as the learner becomes skilfully empowered to deal independently with the task (Collins, Brown, & Newman, 1989). The concept comprises two elements – dynamic assessment of the learner's current status and the provision of the correct amount of support (Wood, 2003). Dynamic assessment would result in the support being faded out if the learner had become equipped to deal with the learning task and conversely, increased if the learner was exhibiting signs of weakness (Pea, 2004). The adjustment of the scaffolding support is inherent in the approach. Scaffolder and scaffoldee must both be familiar with what represents a successful output (Wertsch & Kazak, 2005). In order to achieve the status of independent performance, it is necessary for the learner to recognise when a task is complete (Ibid).

2.6 Categories of Scaffolding Measures

Three distinctions of scaffolding are commonly proposed – One-to-one scaffolding, Computer-based scaffolding and Peer scaffolding.

2.6.1 One-to-One scaffolding. Bellard, 2014, describes one-to-one scaffolding as one teacher facilitating one learner and who tailors the support directly to the learner's needs. Meta-analysis conducted by Vanlyn, 2011, found an average effect size of 0.79 on cognitive learning outcomes. Whilst it is considered the ideal form of scaffolding, it is often impractical resource-wise (Belland, Burdo, & Gu, 2015). Given the number of Ctwin participants, this option is neither relevant nor applicable.

2.6.2 Peer scaffolding. This refers to support being provided by fellow learners or between a more experienced learner supporting a weaker learner. with the underpinning principle of strength in numbers of peer learners (Davin & Donato,2013). Such an approach

requires a framework for learners on how and when to scaffold (Bellard, 2014). Whilst the number of Scaffolders would appear attractive in theory, the deficiency of expertise amongst the learners would prove unbeneficial (Ibid). However, contradictory research exists on the influence of expert tutors on learning outcomes in problem based learning (Albanese, 2004; Dolman et al., 2002). Analyses by Leary, Walker, Shelton & Fitt, 2013, suggests that "learning decreases as tutor expertise increases". Bearing the aforementioned in mind, it is preferable to employ peer scaffolding as a partial scaffold for Ctwins with the option of posting via Edmodo comments, suggestions or requests for help. The bulk of this type of scaffolding would be provided by the E-Moderator via the Edmodo platform. What would constitute a scaffold is the pairing up of the participants to engage together in the creation of the artefact. A lightweight framework of passing the project from one twin to the other every other week together with a requirement to construct a blog of their experience was provided. The intention thereof is to facilitate support between the Ctwins when difficulties arise with the task. The reflection serves to self-monitor their task progress and confidence levels whilst also appeasing any performance fears that fellow participants may have.

2.6.3 Computer-based scaffolding. Whilst the original definition of scaffolding centres on a one-to-one basis to toddlers who engaged in unstructured problem-solving, the idea lost appeal within formal education due to the limited time resources of the teacher (Wood, Bruner, & Ross, 1976). To fill this gap, computer-based scaffolding measures have been introduced. This idea involves the use of technology as learner supports. Considerations when deploying computer-based scaffolding include the variations brought about by learner's prior achievement and their socioeconomic status (Belland, Glazewski, & Richardson, 2011). Crippen & Archambault, 2012, note that scaffolding has grown in use alongside problem-centred instruction in STEM education and this supports the application to Ctwins.

Scaffolding measures during the Ctwins project will be threefold; Pairing, the production of an online reflective blog and individual participation in an interview mid-cycle of the study.

2.7 The concept of Pairing Programming

Pair programming (PP) is described as a programming technique where two programmers share one keyboard and one monitor whilst cognitively collaborating to finish a programming task (Williams and Kessler 2002; Balijepally et al. 2009). It is a practice supported by eXtreme Programming and is an Agile programming methodology. To cut down on the time that it takes to produce code is the objective of the endeavour. Typically, two roles are played, one of the driver who uses the keyboard to produce code whilst being monitored for errors by their peer. The benefits of Pair Programming approaches centre on the transfer of knowledge, higher quality of software being produced and enhanced communication within the development team (Plonka, L. & Van der Linden, J, 2002). Nevertheless, the adoption of this approach is quite low. In a longitudinal study conducted by Vanhannen et al. (2007) examining the adoption of PP in a Finnish company over two years, it was observed that the take-up rates for PP amounted to approximately ten percent. It has been proven that new recruits to industry use statistically more than senior members of the organisation during their first month of work (Coman et al, 2008). Interestingly, the rates of usage converged after two months (Ibid). Analyses conducted by Hulkko and Abrahamsson (2005) evaluated the amount of PP over different iterations of a project and the first two iterations manifested the most PP.

2.7.1 Extension of the Pairing Programming approach to education.

In contrast to industry where all non-trivial software projects are collaborative efforts, the academic approach to student programmers is that code should be composed by the learner in isolation (Maguire, P, Maguire., R, Hyland, P, Marshall, 2014). This leads to the learner "equating communication and sharing with cheating" (Williams and Kessler, 2000). With a proposed move from instructivist towards social constructivism, educational thought now veers towards co-operational learning amongst up-and-coming computer programmers (McDowell, Hanks & Werner, 2003). Co-operational learning consists of students working together, for one class period to several weeks, to achieve shared learning goals and complete jointly specific tasks and assignments (Johnson,

Johnson, & Holubec, 2008). Working in pairs has aroused responses of learners "enjoying the camaraderie.... learned more from each other…. felt more confident" (Williams and Upchurch, 2001).

Conversely, in the academic paper *Pair Dynamics in team collaboration* (2009), a study was made into how the personality traits and communication skills would affect pair programmers levels of satisfaction, compatibility, communication and confidence levels. The findings showed no increase in confidence. For this reason, additional scaffolding measures have been proposed in this study.

In applying the above to the CTwins project, during the first live meet-up, the participants were divided into twins to work collaboratively but unlike traditional pair programming, to work virtually (Maurer, F., & Wells, D., 2011.). The underpinning intention is to foster a sense of confidence through collaboration with their twin in creating the artefact. The mutual input into the production of an artefact is intended to provide support and mutual learning with the goal of increasing confidence. Inbuilt in this intention is the need to reflect on the stages of learning which increase confidence between the pairs.

2.8 Reflective practices as a scaffolding measure

Knowles theory of Andragogy (1990) in practical terms, is concerned with the learning adult focusing more on the process and less on the concepts. Strategies such as reflection and self-evaluation are appropriate to monitor this self-development (Morales, M. 2016). Definitions are manifold. In reflective practice, practitioners engage in a continuous cycle of self-observation and self-evaluation in order to understand their own actions and the reactions they prompt in themselves and in learners (Brookfield, 1995; Thiel, 1999). Silverman & Casazza, 2000 advocate the deconstruction of long-held habits of behaviour by looking beyond the behaviour itself to their own self-image and examining why they do what they do. The purpose is to reflect on one's actions in order to engage and maintain continuous learning (Shoen, 1984).

2.8.1 Background to Reflective Practices.

*"*Reflective practice…involves thinking about and critically analyzing one's actions with the goal of improving one's professional practice*"* (Imel, 1994). Moon (1999) opines that reflective practices have been emerging in professional practices "often without a good deal on thought on reflective practices". Philosophical backgrounds to reflection take account of Dewey who describes it as a mind process of conscious and deliberate consideration of a concept whilst taking account of already elements that support the concept and possible future expansion and consequence arising from the concept. Additionally, Jürgen Habermas, 1978, considers reflection more as a tool in expanding knowledge as opposed to a process. Literature has developed from these grounding philosophies with Shoen allocating two perspectives to reflective practice in professions – that of the reflection-in and reflection-on-action (Shoen, 1983). However, Argysis and Schon feature the contradictions in professional areas that exist in real life practice, how that practice is governed by the habits gained in the day-to-day work and not by the reflection on concepts. Reflection in action would be concerned by a known, almost standard response to a given situation. Conversely, reflection-on-action would consider new responses to a situation not already prescribed for by work habits or previously received professional training.

2.9 ZPD, Online Communities and the role of the E-Moderator

The research literature has shown that since scaffolding is a concept that needs to be modified to suit the circumstances of implementation (i.e. the scope of the task and the learner's own zone of development), the nature is inherently dynamic (Bellard, 2014). Reaction to the live learning of the participants is central to encourage participation and to retain motivation. Vygotsky (1980) recognises that the closer in proximity the learner is to the expert, the more fruitful the learning experience. A discussion forum is an online community which terms are used interchangeably by the literature. It falls under the term asynchronous communication which is communication involving a time lag. The most commonly used forms would be email and discussion forums.

While the literature concerning what exactly constitutes an online community is inexact and neither is academically nor universally established, a notion emerges more from the descriptions provided rather than a strict bona fide classification. Thereof, Rheingold (1993, p5) opines *"Social aggregations that emerge from the Net when enough people carry on public discussion long enough, with sufficient human feeling"* (Rheingold, 1993, p5). Further attempts at definitions were offered by Preece (2000) and focus on the trio considerations of:

(i)The social interaction of users sharing a common purpose;

(ii) The underpinning frameworks and policies to inform such an interaction;

(iii) An appropriately designed computer software to encourage a sense of community. Cohen (1985) advocates the perspective of the "symbolic community" where shared meanings and norms define the parameters. Furthering this view, the essence of belonging online and sharing an emotional bond has theoretically evolved (Blanchard and Markus (2002, 2004).

2.10 Summary

In this literature review, the factors affecting confidence levels amongst teachers in using computational thinking in the classroom has been highlighted. The pedagogical approaches and learning theories to inform the design have been discussed. To spearhead an intervention to improve confidence levels, background conceptual identifying of scaffolding has been outlined and categorized. The proposed scaffolds of pair programming, reflection and motivational interviewing are described. The aforementioned is to provide guidance for the design and implementation of the scaffolds in this study.

Chapter 3: Design and Implementation

3.1 Introduction

This chapter discusses the design and introduction of scaffolding measures to increase confidence amongst post-primary teachers in using computational thinking in the classroom. Informed by the literature, it seeks to investigate whether the scaffolding measures of pair programming, motivational interviewing and reflective practices may affect confidence levels.

3.2 Aim

The aim of the project is to examine whether the intervention of scaffolding measures – Pairing, reflective blogging and motivational interviewing - may lead to increased confidence amongst the cohort of post- primary level teachers in engaging computational thinking in the classroom.

3.3 The Learning Experience

Following a recruitment drive conducted by Trinity College Dublin and Queens University in Belfast, sixteen post-primary school teachers volunteered to participate in the CTwins project. The age profile ranged from 23 years of age to 48 and all but two were female. Their motivation was to explore computational thinking in an educational environment and to increase confidence in so doing. Drawing on the literature on pair programming, the cohort was divided into pairs – Ctwins – to collaborate and create an artefact that would reflect their teaching practice. The choice of artefact was left to their own discretion. To commence the CTwins project, participants attended a live meet-up wherein instruction was provided in Scratch. To enhance co-operative leaning, support and communication, an introduction to the features of Edmodo were provided and participants were requested to set up log-in details. Under the supervision of the Scratch instructor, participants were allocated time to "play" about with Scratch and the opportunity to ask further questions and to seek clarifications. The format of the project was such that each twin takes turns in developing the project on a weekly basis and

then passes on the project to their twin to further progress the following week. In the interim, interactions via Edmodo are encouraged with one twin drafting an online reflection on their experience whilst the other twin continues with the design aspect of the course. This scaffold is to foster the approach of reflection within the participants and for other participants to potentially learn therefrom. A sample reflection was posted by the researcher to provide guidance on what reflections would entail to include tone, length and sample content. Informed by Shoen (1984), the reflection requirement was to post on "reflection-in-action" whereby the participants ponder their experiences as they progress through the Scratch task. This was followed by up a request to "reflect-on-action" which would be a look back at what had happened and to consider whether change in confidence had occurred. Guiding the interactions on Edmodo is an E-Moderator who is skilled in Scratch programming and available to answer queries and concerns (Salmon, 2004). Moreover, the E-moderator keeps reign of activity in the event of a dip in activity. Piaget (1997) maintains that learners must be pro-active in seeking to construct knowledge and not merely reproducing instruction. Input from the E-moderator enhances their construction of knowledge by providing clarification and encouragement. Moreover, triggers from interpersonal interactions on the discussion forum may lead to construction of knowledge under the guise of experiential learning (Kolb, 1984) and vicarious experience (Bandura, 1997).

3.4 Technology to support the learning experience

Following an introductory face-to-face tutorial in the programme, Scratch, the CTwin participants are paired together to collaborate and create an artefact using Scratch, relevant to their teaching practice.

Developed by Massachusetts Institute of Technology in coordination with Lifelong Kindergarten Group, Scratch is a graphical drag and drop event driven programming framework. Hawk (2009) describes it as a visual, block-based computer programming language editor.

Puzzle type pieces are used to create and construct the artefact. As it is not driven by complicated code, it is an appropriate platform for those new to programming. Upon request, support is provided by a Scratch expert throughout the programme. Collaboration, assistance and reflections are noted on the educational communication platform, Edmodo. Co-operational learning occurs when participants witness other reflections and artefacts being constructed.

Founded in Chicago, Illinois in 2008 when two school district employees set out to bridge the gap between how students live their lives and how they learn in school, Edmodo was created to bring education into a 21st century environment. With a current membership of 77,044,174 worldwide, it is deemed the number one learning network resource for teachers and learners to collaborate. Moreover, it is widely used in Irish school settings and accordingly considered appropriate for this project. An attempt to conduct individual interviews with the participants

3.5 Pedagogy

Guiding the design of the Ctwins project is the educational theory of social constructivism.

To facilitate the social aspect of social constructivism, the CTwins project arranges for the participants to work together on mutually agreed project in pairs, a structure which echoes a computer science practice amongst programmers operating likewise. Moreover, interactive communication and collaboration amongst the group of CTwins is encouraged and facilitated using online community discussion via Edmodo. Where necessary, a guide in the form of an e-moderator provides scaffolding guidance, direction and encouragement. Intrinsic in social constructivist pedagogies are the principles of co-operative learning, problem solving and collaboration. By being assigned a peer, the learners collaborate and problem solve whilst creating the artefact. Similarly, co-operational learning occurs from interactions between the E-moderator and the Scratch tutor. As these exchanges are posted on Edmodo, each participant may view other's exchanges which improves the overall learning experience.

Furthermore, Experiential Learning principles (Knowles, 1984) are respected.

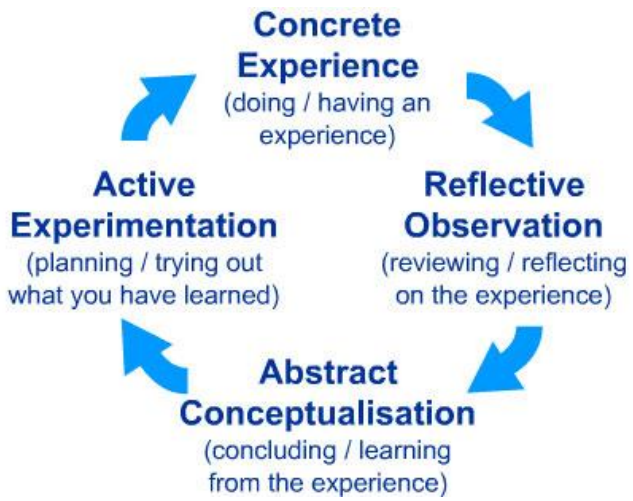

Figure 1. Kolb and Fry's Learning Process

This cyclical four stage process influenced the design of the programme.

- Concrete Experience: Ctwins receive a live tutorial from the Scratch instructor following which they have the opportunity to accustom themselves with features of Scratch.
- Reflective Observation: Once one twin passes the project to their twin, it was requested of them to post a reflective blog of their experience via Edmodo. For those who felt reticent about posting publicly online, an option to correspond directly with the researcher was offered.
- Abstract Conceptualisation: As the programme progresses and confidence increases amongst the Ctwins, they apply their burgeoning knowledge into the creation of an artefact. Reflection also falls under this stage.
- Active Experimentation: The Ctwins produce an artefact relevant to their teaching practice. This is showcased in the final live meet-up with a presentation given by the pairs to each of their peers. Once again, incorporated into this exercise is of reflecting on other's achievements and witnessing levels of increased confidence amongst all.

Constituting the Knowles andragogical approaches to adult education are five descriptive characteristics of the adult leaner:

1. Self-concept: Knowles contends that as a learner matures that there is a progression from being a dependent person to that of self-direction. This is relevant to the CTwins participants who voluntarily joined the project. Moreover, the choice in the output/artefact is allocated to the participants' own decision.

2. Experience: The maturing learner has built a bank of life experience which, as a person matures, furnishes a resource for learning. Additionally, this coincides with the social constructivism theory where previous experiences are brought to the fore in engaging in new learning ventures.

3. Readiness to learn: as a person matures their readiness to learn becomes oriented increasingly to the developmental tasks of their social roles; For this cohort, the CTwin participant are teachers seeking to enhance their social and professional roles as teachers.

4. Orientation to learning: as a person matures their time perspective changes from one of postponed application of knowledge to immediacy of application. The CTwins are required to start construction and creating the artefact following the initial meet up. Employing computational thinking, the participants move from subject-centredness to problem centredness;

5. Motivation to learn: as a person matures the motivation to learn is internal. Resonant of the aforementioned self-concept principle, the choice to join the CTwins project was not directed from an external force e.g. school, promotion but rather driven by an internal motivation to improve their teaching practice and their own personal development.

The literature supports the validity of learning styles. In applying this to CTwins, following an introductory instruction on the use of Scratch, a computer programming software, the learners are paired to create collaboratively either a work of art or an artefact relevant to their teaching practice. Input from the E-moderator enhances their construction of knowledge by providing clarification and encouragement. Moreover, triggers from interpersonal interactions

on the discussion forum may lead to construction of knowledge. The Ctwins are required to post a reflection to the communication platform, Edmodo, with the dual intention of taking notice of their confidence levels along with inspiring learning amongst the peers.

3.5 Instructional Design: The ARCS Motivational model

Instructional design is the practice of creating "instructional experiences which make the acquisition of knowledge and skill more efficient, effective, and appealing *(*Merrill, M. D.; Drake, L.; Lacy, M. J.; Pratt, J. (1996). After analysing the learner's needs and state, the end goal of instruction is set up whilst supportive facilitation is provided to bridge the gap. For this study, ARCS was chosen after considering the links existing between motivation and confidence.

Developed by Keller (1987), the ARCS model of instructional design incorporated is an acronym of motivational conditions within a learning experience – Attention, Relevance, Confidence and Satisfaction. Motivation is an important component of any instructional design (Barbuto, 2006). Herein, we focus on John Keller's ARCS Model of Motivational Design Theories, which examines motivational factors throughout a learning process and guides and orientates teaching, according to these factors: Attention, Relevance, Confidence, and Satisfaction. The ARCS model is described as one of the most valid tools used in the design, application, and evaluation of instructional software programs (European Journal of Contemporary Education, 2016, Vol. (15), Is. 1 107). Furthermore, it ensures motivation in learning, which is critically important for the instruction to be successful and influential. In addition, this model stimulates and motivates learners to continue learning (Huett, 2006).

The following table demonstrates how it applies to the Ctwins Project:

Attention	• The personal live meet-up of the Ctwins in Queens University Belfast was

	intended as an introductory ice-breaker exercise between the participants prior to their embarking on subsequent online inter-correspondence and engagement.
Perceptual inquiry	• Participants had the opportunity to meet with the E-Moderator, the Scratch tutor and the Researcher. • Both of these initiatives were to build familiarity between all in order that participants would be confident to engage.
Various media used	• The researcher conversed with each participant to explain the use of reflections and that an interview would be conducted mid-course via skype.
Inquiry arousal	• Introductory tutorial provided in the use of Scratch • Introductory tutorial provided in the use of Edmodo

	• The participants were given an opportunity to “play” around with Edmodo and Scratch, under the supervision of the tutors, to arouse inquiry and motivation. • Participants requested to set up Edmodo accounts for online community conversation
Relevance Goal Orientation	• Participants discussed their motivation for joining the project • Examples of artefacts previously produced in the first pilot were showcased to provide an example of required output from the project and to orientate towards the f • Paired participants had the autonomy to choose the type of output they would aim to produce which was relevant to their teaching practice. • Participants were notified of where support from the E-moderator and Scratch tutor may be found.

Familiarity	To enthuse familiarity amongst the teacher-participants, unlike the pilot project, the participants would refer their artefact to their teaching practice. This was an evolution from the pilot project in which a work of art was the mandated output. Technologically, the participants are already acquainted with using computers and engaging with software programmes.
Confidence Learning Requirements Personal Control	• The E-Moderator provides positive reinforcement in the discussion forums • Prompting by the E-Moderator • Rapport between and amongst other learners is encouraged • A sample reflection is provided by the research to guide on what is involved in considering the evolution of their own confidence levels

	• The learners may choose the time and interaction with their pairs; a feature which is supported by Andragogical principles. • As stated above, the choice of output is their own volition.
Satisfaction Natural Consequences	• Meaningful opportunities for learners to apply their knowledge can be found in the construction of the artefact which reflects real-life teaching practice • Further resources are posted by the researcher to provide global views of confidence and aspects for consideration. These may also be used by the teacher participant with their own school learners. • Reinforcement is provided by E-Moderator in praise of tasks being developed.

Positive Consequences	• Getting correct answers public noted up provides reinforcement • Growing knowledge from one aspect of Scratch to another reinforces confidence in their learning
Equity	• Learners are treated equally and bias towards the more frequent posters is avoided • When the participants' online activity is becoming deficient, the E-moderator sends motivation emails to sustain attention • Scaffolding, as advised by the literature, is faded out leaving participants to self-direct to progress without assistance.

Table adapted from JM Keller (2010)

3.6 Motivational Interviewing as a scaffolding measure

To expand on the theme of motivation within the ARCS model, further scaffolding was provided by motivational interviewing of the individual CTwin. Motivational Interviewing (MI) is a method that centres on facilitating and engaging intrinsic motivation within the learner in order to change behaviour (Rollick. & Miller, 1995) MI is a goal-oriented, client-centered counselling style for eliciting behaviour change by assisting the client/learner. With its foundation in the therapeutic modalities and originally within the treatment of addiction, the style of interviewing has been expanded to various other arena, most recently to education (Rollnick, S., Kaplan, S. G., & Rutschman, R., 2016).

The spirit of MI is based on three elements:

(i) Collaboration between the interviewer and learner as opposed to confrontational, top-down hierarchal instruction;

(ii) Evoking the learners' ideas about change and confidence;

(iii) Emphasis on the autonomy of the learner which is in line with andragogy.

The principles of motivational interviewing centre on:

(i) Empathy – following upon the interventions of the E-moderator, the interviewer aims to see "through the eyes of the learner" in order that the interviewee feels comfortable in discussing their genuine issues on confidence

(ii) Support of self-efficacy – the interviewer draws on previous successes and strengths of the learner to enhance confidence levels;

(iii) Tackle resistance – this is where the learner becomes ambivalent towards the project

(iv) Develop discrepancy – the interviewer attempts to engage with the learner on why motivation and confidence has slackened

The intention is to challenge limiting beliefs amongst participants regarding confidence levels by raising awareness of progress in action and motivating continued application to the task at hand.

3.7 Design of Pair-programming and reflection as scaffolds

The literature review supports the validity of having the participants work in pairs. During the first live meet-up, the participants were divided into twins to work collaboratively but unlike traditional pair programming, to work virtually (Wells, 2011). The underpinning intention is to foster a sense of confidence through collaboration with their twin in creating the artefact. The mutual input into the production of an artefact is intended to provide support and learning with the goal of increasing confidence. Inbuilt in this intention is the need to reflect on the stages of learning which increase confidence between the pairs (Shoen, 1984). There is also a learning opportunity for fellow learners to learn from their paired twin and to benefit from the reflections of other twins. To scaffold the learners in posting their online reflections, a sample reflection was posted by the Researcher (www.Edmodo.com. Log – in hegartli@tcd.ie – password Hotmail1976).

The Researcher elected reflective practices as a potential scaffold to increase confidence for the following reasons:

(i) Teachers qualified in the Northern Irish and the Republic of Ireland are required to undertake reflective practice as part of their teacher professional training qualification courses. Accordingly, the participants were all familiar with what such a measure would entail;

(ii) Supported by Shoen's concept of "thinking in and on action" [reflection], the scaffold sought to encourage elevated confidence levels amongst the participants by posting their journey of developing the artefact during the course and towards the conclusion, to reflect retrospectively on what was learned and whether confidence levels increased;

(iii) The task of posting reflective practice was also intended to encourage confidence both between the individual pairs and also amongst fellow CTwin colleagues.

Supported by Bandura's theory of self-efficacy, the learners may also profit from "vicarious experience" in observing their peers' online interactions via Edmodo. Supporting the participants and guide by Vkosky's theory of the Zone of Proximal Development (ZPD), the role of E-moderator is held by a member of the CTwins project team, a teacher who holds expertise in Scratch programming. The marriage of being a teacher with experience in the use of Scratch fits well with the participants' professional profile. Underlying the E-moderator intervention is the five-step model of teaching and learning proposed by Gilly Salmon, 1980. Features such as Access & Motivation, Online socialisation, information exchange, knowledge construction and further development are incorporated in the CTwins project and the detail of which shall be discussed in the following chapter.

3.8 Summary

Dewey's theory on social constructivism maintains that learners do not learn in isolation but rather by being part of a larger community and the world in general. Merged with the andragogic viewpoints on adult learners (Knowles, 1984) where intrinsic motivation and autonomy are potent features, the design of this study is further supported by the ARCs, given it's emphasis on motivation. Communication and interaction amongst the participants is further endorsed by the facilitation of the E-moderator in line with the Gilly Salmon model and Vygosky's concept of the zone of the proximal development.

Chapter 4: Methodology and Implementation

4.1 Introduction

This chapter outlines the exploratory case study approach employed to investigate whether confidence levels in the use of computational thinking may be increased amongst post primary teachers with scaffolding measures such a pair programming, motivational interviewing and reflection. A case study is 'a study of a singularity conducted in depth in natural settings' (Bassey, 1999, p. 47) and is distinguished by a focus on one particular 'bounded' phenomenon or experience that can be defined as a finite 'case' (Merriam, 1998). A case study will focus on a phenomenon and attempts to answer "how" or "why" questions when the boundaries between phenomenon and context remain blurred (Yin, 2003). The advantage of such an approach using detailed descriptions to recreate the phenomenon being experienced by the participant using mixed methods to unearth results from the data collected (McKernan, 1996). Both quantitative and qualitative analysis were employed with Creswell (2002) noting the differences in that quantitative research is the process of collecting, analysing, interpreting, and writing the results of a study, while qualitative research is the approach to data collection, analysis, and report writing differing from the traditional, quantitative approaches.

4.2 Research Question

The central research question used to inform this study is:

Confidence amongst post-primary teachers using computational thinking in the classroom.

The sub-question relates to whether the introduction of scaffolding measures of:

Pair-programming

Interviewing

Reflective exercises

will lead to an increase of confidence amongst the post-primary teacher participants in using computational thinking.

4.3 Overview of Data Instruments

A variety of data instruments were used to include pre-and post-surveys, coding of the participants' online interactions via Edmodo and coding of the audio recoding arising from the focus group.

4.3.1 Pre-and Post surveys (Quantitative method). Questions for the surveys were adapted by a validated instrument, Fisher et al. (2016), which in turn were based on Tagney et al. (2010) to explore teachers' attitudes towards engaging in computer programming. In particular, the survey was designed to elicit data on teachers' reactions to knowledge and skills, qualifications and attitudes to computer programming. For the latter, a seven-point Likert scale was used to gauge responses with 1 indicating strongly agreed and 7 strongly disagree (n = 13). The surveys examined the following items:

(i) Biographical information of the participants – gender, age, qualifications and number of years of teaching experience;

(ii) Previous experience of computing programmes and computer languages;

(iii) Attitudes to programming and to teaching (items were drawn chiefly from versions of the Technology Acceptance Model (TAM) which relates constructs such as perceived usefulness and perceived ease of use of technology to behavioural intention to use it (Davis, 1989, Venatest et al., 2003; Teo, 2012).

These items were adapted to address programming using a 7-point Likert scale.

The choice of using Likert scales are valid given that Likert's primary concern was with "uni-dimensionality ie ensuring that all items would measure the same thing" (Oppenheim, A.M, 2000). Furthermore, the surveys were expanded by the Researcher to probe whether confidence levels had increased following scaffolding measures being introduced during the nine-week project.

Both surveys were completed in hand writing by the participants during the live meet-ups at the start and end of the Ctwins project.

The results were extracted from the survey and entered into an Excel spreadsheet as a quantitative analysis method. Such a method was selected to facilitate prompt arrangement, organisation and calculation of the responses. The researcher was interested in assessing whether the following background and incidental features may affect confidence levels:

4.3.2 Coding of Edmodo transcript (Qualitative method). During the nine-week project, participants communicated online via the Education communication platform, Edmodo. This mainly took the format of inter-pair collaboration and also the posting of reflective blogs. To data analyse the scaffolding measures of reflective practice and pairing programming during online community interactions, the researcher printed the transcript and employed Affective coding methods. Affective coding methods investigate subjective qualities of human experience by directly acknowledging and naming those experiences (Santana, 2016). Closely linked to sentiment coding and values coding, this coding method seeks to label and enumerate the values, attitude and belief systems at play (Goleman, 1995; Kahneman, 2011). This particular coding measure was chosen by the researcher as she considered the issue of confidence to be of the emotive and attitudinal nature and accordingly, considered it appropriate. To carry out this coding analysis, the research printed out the transcript from the online interaction and absorbed the data as a whole. Thereafter, the researcher set about establishing codes over a one day period labelling coded units according to values, attitudes and beliefs. Allowing some physical space from this data corpus, the researcher, some days later, revised the codes "with fresh eyes" to categorise them and to reflecting on their collective meaning, interaction and interplay. This approach is based on the premise that the three constructs are part of an interconnected system (Saldana, 2016). Subsequent themes would then be used to inform findings. A copy of the transcription and sample coding may be located in Appendices F & G.

4.3.3 Motivational Interviewing (Qualitative method). In order to encourage ongoing confident participation and engagement during the course of the programme, the

Research proposed interviewing each participant individually using Skype. Coding of the recordings is advocated to provide analysis.

4.3.4 Analysis of focus group (Qualitative method). A focus group was conducted at the end of the nine week project when participants attended an exhibition to showcase the artefacts that were collaboratively created by the sets of twins.

The researcher was guided by Hess (1968) who states the advantages of the process of focus group interviews as follows:

Synergism – where a wider bank of data emerges through the group interaction

Snowballing – where one response is conducive to a chain reaction of further comment

Stimulation – where the group discussion causes interest in a topic

Security – where the group structure provides a safe space for candid responses

Spontaneity – when participants are not required to respond to every question, their answers may be more spontaneous and genuine.

The focus was recorded using audio recording to facilitate transcription of the content for the purpose of the analysis by the Researcher.

4.4 Research Strategy

Quantitative research is based on collecting facts and studying the relationship between different sets of facts. Babbie (2005, p. 387) defines qualitative research as 'the non-numerical examination and interpretation of observations, for the purpose of discovering underlying meanings and patterns of relationships'. In accordance with the endorsement of Babbie (2005), the use of the qualitative research methodology in this study ensured that the researcher could maximise the opportunity to utilise the expertise of the sample by investigating underlying meanings and perceptions underpinning their responses Notwithstanding the value of this ideal, the appropriateness of quantitative research in terms of its aims ultimately did overly correspond with the exploratory nature of the study. The fact that the research sample in this study is

comprised of post-primary school teachers engaging in a computational thinking project, does not resonate with the objectives of quantitative research in terms of its aims to seek to study a sample in order to predict the actions of the general population (Hitchcock and Hughes, 1995); to attempt to produce quantifiable results (Bell, 2005) or to establish facts that are representative (Bogdan and Bilken, 1998). Nevertheless, for the purposes of comparing pre-and post-programme confidence levels, quantitative methods were employed to numerate the question of whether or not an increase of confidence occurred.

Qualitative research endorses the sentiment of the aims of this study in terms of its holistic, purposeful, inductive and intuitive nature. Qualitative research seeks to understand an individual's perception through insight rather than statistics and is concerned with details, attitudes and perspective (Bogdan and Bilken, 1998), which corresponds with the examination of the theme of confidence in this study. Cohen (2003) states that the nature of a phenonomen together with the cause and effect relationship may be explored in a broader sense by examining one case study in detail. Moreover, a situation may be explored and explained leading to the suggestions of solutions (Soy, 1997). Similarly, case studies have been described as "a detailed, in-depth data collection involving multiple sources of information rich in context" by Creswell (1998). Similarly, Cresswell, 2008 opines that qualitative data provides a clearer understanding of the participants' views of the experience compared with quantitative data alone rendering it an appropriate for this educational research. Taking these viewpoints on board, the researcher will exclusively rely predominantly on qualitative research methods and sources with the exploratory case study design providing the foundations.

4.5 Ethics

The relevant Ethics approval was granted to the School of Computer Science and Statistics in support of the overall CTtwins project team. Given that all participants are over the age of eighteen years, neither parental nor school board consent was required. The participants

engaged voluntarily with this project and completed a participant consent form prior to engagement (Appendix D).

4.6 Researcher bias

The researcher was not acquainted with any of the participants before the introduction of this course. The participants were informed that they were involved in a research project. Hence, no researcher bias was apparent.

4.7 Profile of Participants

Cresswell (2006) states that samples are selected to represent a population in order that the results may be generalised to the population. The sample for this project, n = 14 comprised adults ranging from twenty-three years of age to forty-eight years of age and all are employed post-primary school teachers. In line with the cross-cultural initiative between the North and South of Ireland, teachers were geographically located across both jurisdictions. The recruitment drive was advertised via the Computer in Education Society of Ireland (CESI), The Teachers Council of Ireland and via nominations from peer teacher students in the MSc. Technology & Learning degree in Trinity College. A broad selection of subjects is taught by the participant teachers ranging from Spanish to Physical Education. Each teacher was familiar with the use of computing in both their professional and personal lives.

4.8 Rigour and validity

Triangulation is the process of merging input from the participants with types of data (observation and interviews) or methods of collection such as interviews and questionnaires. Additionally, descriptions and themes as part of the qualitative research approach are considered (Cresswell, 2008). Herein, triangulation was composed from various datasets including pre-and

post-questionnaire, online reflections via the Edmodo platform and coding of the focus group content. Observational protocol by Creswell (2008) was employed to validate the objective observation during the learning experience via Edmodo correspondence and during the focus group.

4.9 Summary

This chapter identified the case study approach undertaken to investigate the research question and sub-question. The accompanying data collection methods are described in relation thereto. The next chapter will analyse and discuss the data collected during this phase.

Chapter Five Data Analysis & Findings

5.1 Introduction

This chapter highlights the results of the data analysis and discusses findings that arise. Firstly, an overview of the data sets collated along with the methods of data analysis methods which were applied thereto is presented. Secondly, their findings are discussed. The final segment of this chapter notes potential limitations of the study and the areas that may deserve further investigation.

5.2 Overview of Data Sources

Table 1

Overview of data instruments and applicable research methods

Data Instrument	Research Method
Pre-course survey	Quantitative analysis using Excel
Post course survey	Quantitative analysis using Excel
Transcript of Online Community Interaction Focus Group	Affective Coding Method (Deductive Approach) Coding Method (Inductive approach)

5.3 Data Analysis

Stake (1995) describes data analysis as a process that commences with the Researcher's and continues until the conclusions emerge from the study. This involves taking a broad view of all data sets taking notes, gathering observations and the appropriate organization of the data

(Cresswell, 2008). The Researcher has been continuously data analysising from examining the initial surveys, to observing the online interactions culminating with the focus group and the post programme survey. Attention was also given to the data sets from Cycle I of the Ctwins as a means of background information but this data avenue does not fall into the scope of this project.

5.3.1 Pre-and Post-Surveys. The confidence survey was administered before the launch meeting and at the end of the exhibition meeting to 14 participants. Ultimately, complete data was only available for 10 of these. The raw data was then entered into an Excel spreadsheet with participants' anonymity being preserved by using codes.

The items in the survey were:

1 I enjoy working with computers

2 I am very unsure of my ability to use computers for programming

3 I consider myself a more skilled computer user than most of my colleagues

4 Computers are far too complicated for me

5 I am interested in learning about using programming in my teaching practice but lack confidence

6 I often have difficulties when trying to learn how to use a new computer tool

7 I am typically open to learning about new computer tools and applications

8 Computer Programming is too difficult a topic for me

9 As far as computers go, I feel less competent than my students

10 I think overall I could evolve into being a good computer programmer with the correct training and support

Participants were invited to rate each item from 1, indicating agreement to 7, indicating disagreement.

Table 2

Raw data before launch

Teacher	A2	B2	C2	D2	E2	F2	G2	H2	I2	J2	K2	L2	M2	N2
Q1	1	3	2	1	1	2	1	1	1	1	1	2	1	1
Q2	7	1	4	2	4	5	2	7	5	6	7	5	2	3
Q3	4	4	4	3	1	4	1	1	4	5	6	2	4	2
Q4	7	4	5	7	7	6	7	7	7	7	7	6	7	7
Q5	3	1	5	2	2	2	1	5	3	1	5	3	1	1
Q6	4	3	2	2	5	7	6	6	5	7	7	4	7	6
Q7	4	1	1	1	1	1	1	1	1	1	1	2	1	1
Q8	4	1	3	4	6	7	6	7	7	7	7	6	7	5
Q9	4	1	4	5	5	4	7	7	7	5	6	4	1	5
Q10	4	1	2	2	2	2	2	1	1	1	7	2	1	1

Table 3

Raw data after exhibition.

Teacher	A2	B2	C2	D2	E2	F2	G2	H2	I2	J2	K2	L2	M2	N2
Q1		1	1	1			1	1	2	1	1	2	1	
Q2		5	3	2			3	7	7	7	6	3	6	
Q3		4	3	2			1	1	2	2	2	2	2	
Q4		6	7	7			7	7	7	7	7	6	6	
Q5		2	4	1			5	7	5	7	6	2	7	
Q6		1	5	2			2	7	6	7	6	5	7	
Q7		1	1	1			3	1	1	1	7	2	1	
Q8		5	6	7			7	7	7	7	7	5	3	
Q9		2	3	7			7	3	7	7	6	5	1	
Q10		2	2	1			2	1	1	1	6	2	1	

The raw data sometimes indicated agreement with a negative statement relating to confidence, and at other times a positive.

Thus the data in the following tables (overleaf) is normalised, to map positive and negative items to indicate confidence on a scale from 0 to 100 percent. 0% would arise from a raw score of 1, indicating agreement with a negative statement. 100% would arise from a raw score of 1 indicating agreement with a positive statement, and so on.

Data for participants A2, E2, F2 and N2 was omitted due to incomplete responses to the survey. The overall figures are the average of each participant's confidence.

Table 4

Normalised data before launch

Teacher	A2	B2	C2	D2	E2	F2	G2	H2	I2	J2	K2	L2	M2	N2
Q1		67%	83%	100%			100%	100%	100%	100%	100%	83%	100%	
Q2		0%	50%	17%			17%	100%	67%	83%	100%	67%	17%	
Q3		50%	50%	67%			100%	100%	50%	33%	17%	83%	50%	
Q4		50%	67%	100%			100%	100%	100%	100%	100%	83%	100%	
Q5		0%	67%	17%			0%	67%	33%	0%	67%	33%	0%	
Q6		33%	17%	17%			83%	83%	67%	100%	100%	50%	100%	
Q7		100%	100%	100%			100%	100%	100%	100%	100%	83%	100%	
Q8		0%	33%	50%			83%	100%	100%	100%	100%	83%	100%	
Q9		0%	50%	67%			100%	100%	100%	67%	83%	50%	0%	
Q10		100%	83%	83%			83%	100%	100%	100%	0%	83%	100%	
OVERALL		**40%**	**60%**	**62%**			**77%**	**95%**	**82%**	**78%**	**77%**	**70%**	**67%**	

Table 5

Normalised data after exhibition

Teacher	A2	B2	C2	D2	E2	F2	G2	H2	I2	J2	K2	L2	M2	N2
Q1		100%	100%	100%			100%	100%	83%	100%	100%	83%	100%	
Q2		67%	33%	17%			33%	100%	100%	100%	83%	33%	83%	
Q3		50%	67%	83%			100%	100%	83%	83%	83%	83%	83%	
Q4		83%	100%	100%			100%	100%	100%	100%	100%	83%	83%	
Q5		17%	50%	0%			67%	100%	67%	100%	83%	17%	100%	
Q6		0%	67%	17%			17%	100%	83%	100%	83%	67%	100%	
Q7		100%	100%	100%			67%	100%	100%	100%	0%	83%	100%	
Q8		67%	83%	100%			100%	100%	100%	100%	100%	67%	33%	
Q9		17%	33%	100%			100%	33%	100%	100%	83%	67%	0%	
Q10		83%	83%	100%			83%	100%	100%	100%	17%	83%	100%	
OVERALL		**58%**	**72%**	**72%**			**77%**	**93%**	**92%**	**98%**	**73%**	**67%**	**78%**	

The average of overall confidence for all valid participants before the launch is 71% and after the exhibition, 78%. Applying a T-test to this data yields a p-value of 0.03, indicating an acceptable probability (less than 0.05) that the overall increase in confidence observed might be due simply to chance. Thus, the increase observed can be judged to be meaningful. To analyse the raw data more deeply , the Researcher sought to enquire as to whether the following aspects had an impact on confidence levels:

- Subjects taught by the participants and whether those may, at the outset, affect confidence levels
- Age of participant and being conscious of theories espoused by Mark Prensky (2001) on the difference between use by youths, so-called “digital natives” and technology and older adults who “immigrate” towards technological usage.

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Subjects taught by the participants and whether those may, at the outset, affect confidence levels

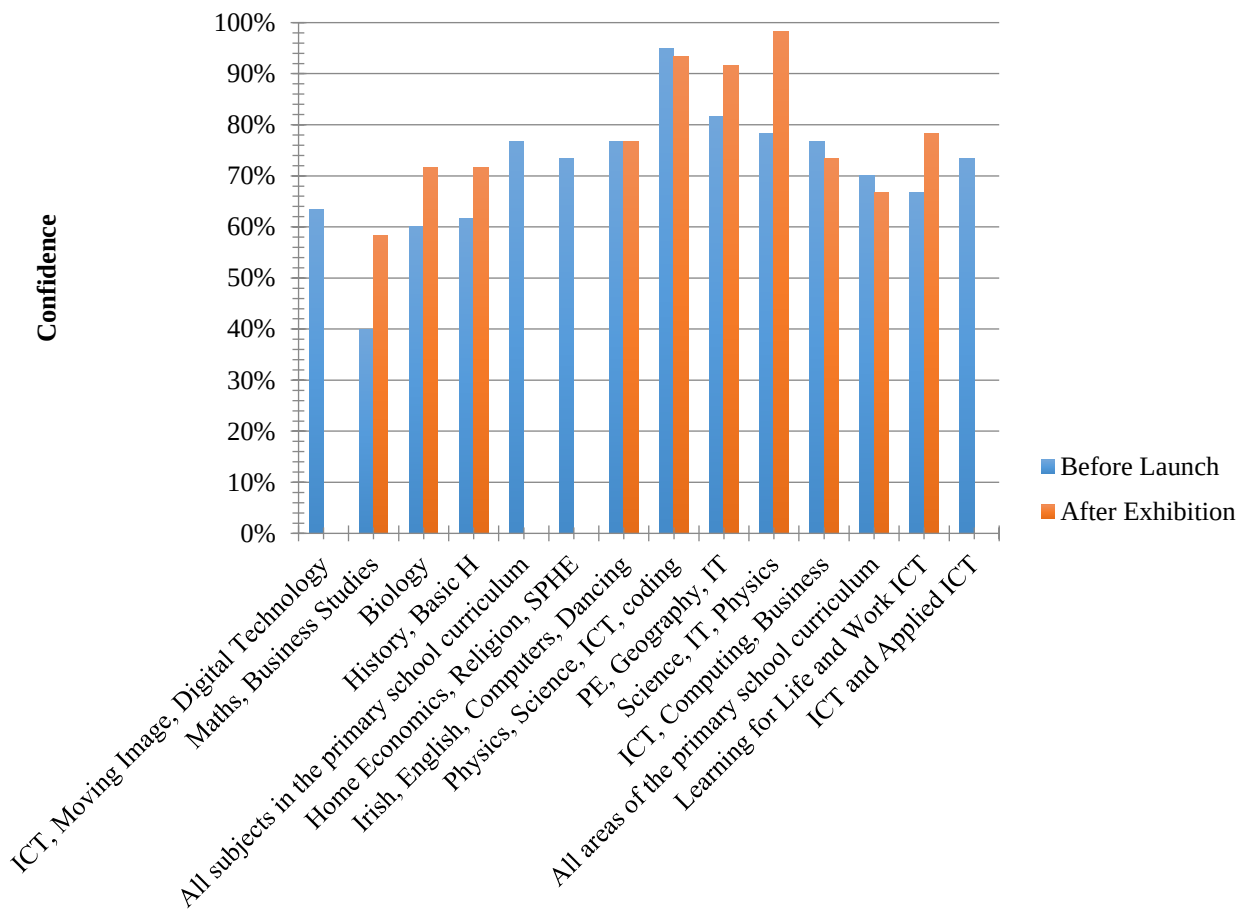

Figure 2. Confidence before Launch and After Exhibition

The finding emerges that all those who had previous experience of teaching ICT skills in the classroom showed improvements in confidence levels. However, it is also apparent that teachers who did not teach ICT skills showed a marked increase in confidence levels, for example, both the Biology teacher and History teacher increasing their confidence levels by 10%.

Age of participant and being conscious of theories espoused by Mark Prensky (2001) on the difference between use by youths, so-called "digital natives" and technology and older adults who "immigrate" towards technological usage.

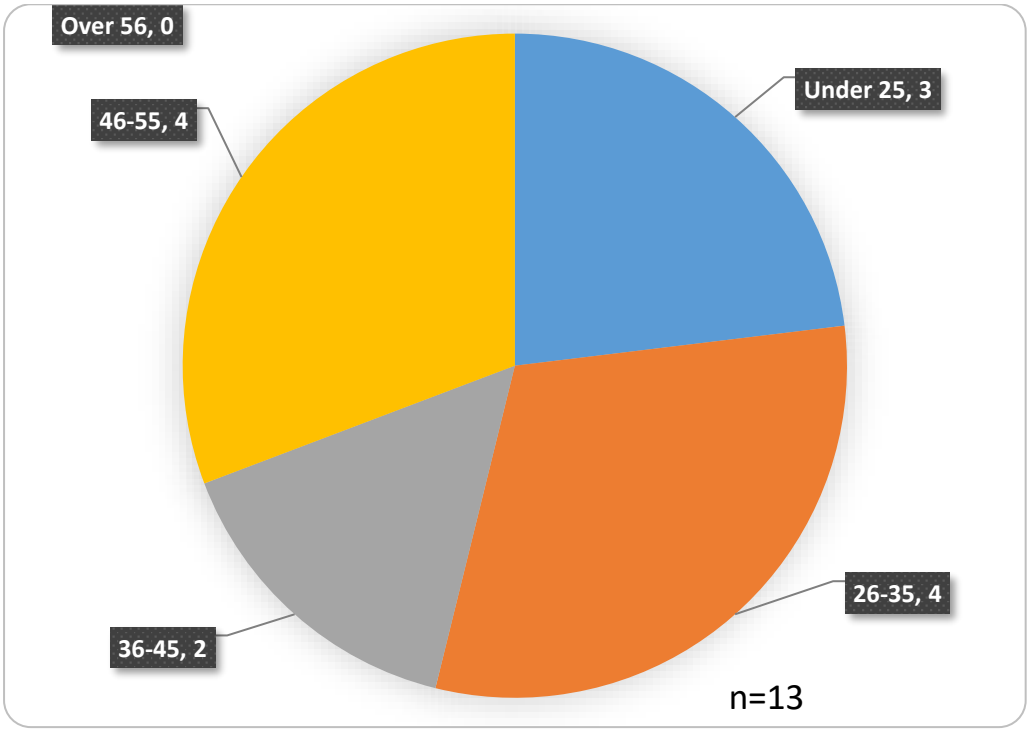

Figure 3. Age of Participants

Examining the cohort from an age perspective attempts to investigate whether being older or younger would have an influence on confidence levels. After contrasting the participants' ages against the raw data, nothing of note emerged and accordingly, for this project , it did not feature as an influencing factor on confidence levels. However, this finding needs to be borne in mind with their pre-existing experience in ICT teaching.

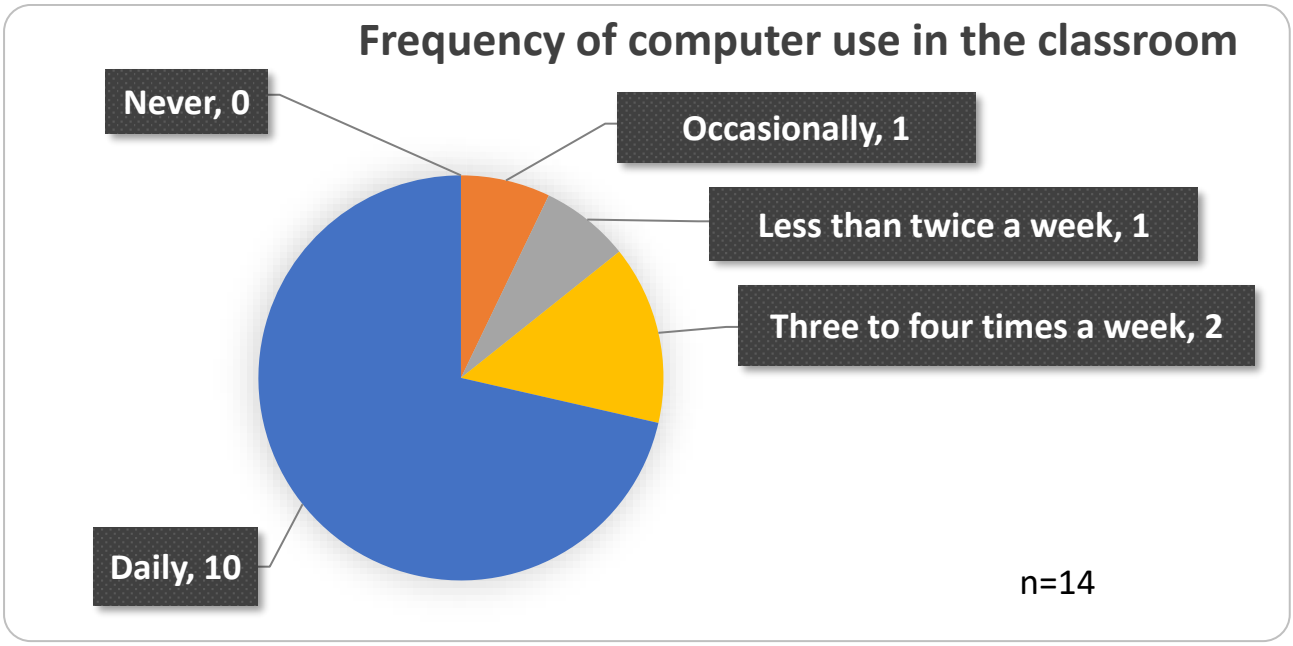

Figure 4. Prior experience of using computing in the classroom

The research sought to investigate if regular use of computers was already occurring in the classroom. This analysis showed that over half of the participants use computers in their classrooms on a daily basis. It is possible that the existing familiarity with computers may feature in the increase of their confidence levels. That is to say that a certain level of confidence existed before joining the Ctwins project.

Not all pre-surveys were optimally completed as participants erred in not completing the reverse page. This error was noticed by the researcher after the pre-survey and extra attention was placed on this issue for the post-survey rendering a higher response of fully completed surveys. Moreover, incomplete data emerged from the post-survey as some of the participants were unable to attend the exhibition.

5.3.2 The scaffolding measure of Reflective Practices & Pair Programming via Edmodo.

Shoen (1983) defined reflective practice as "thoughtfully considering one's own experience in applying knowledge to practice". Kolb's theory of experiential learning (1984), from which the design of this project is informed, advocates reflective

practice as a means of transforming experience into knowledge. A requirement of the project was for each twin to post a reflection online via Edmodo during the week when the other twin continued to develop the artefact.

5.3.3 Overview of the analysis of the Online Community interactions. To data analyse the scaffolding measures of reflective practice and pairing programming during online community interactions, the researcher printed the transcript and employed Affective coding methods. Affective coding methods investigate subjective qualities of human experience by directly acknowledging and naming those experiences (Santana, 2016). Closely linked to sentiment coding and values coding, this coding method seeks to label and enumerate the values, attitude and belief systems at play (Goleman, 1995; Kahneman, 2011). This particular coding measure was chosen by the researcher as she considered the issue of confidence to be of the emotive and attitudinal nature and accordingly, considered it appropriate. To carry out this coding analysis, the research printed out the transcript from the online interaction and absorbed the data as a whole. Thereafter, the researcher set about establishing codes over a one-day period labelling coded units according to values, attitudes and beliefs. Allowing some physical space from this data corpus, the researcher, some days later, revised the codes "with fresh eyes" to categorise them and to reflecting on their collective meaning, interaction and interplay. This approach is based on the premise that the three constructs are part of an interconnected system (Saldana, 2016). Subsequent themes would then be used to inform findings. A copy of the transcription may be located in Appendix F with identities overcovered to ensure participant anonymity and to comply with Data Protection legislation

5.3.4 Findings from the data analysis of the Online Community interactions

Table 6

Data codes collected from the online community interaction

Icebreaker (11)	E-Moderator (17)	Computational Thinking (15)
ICT in the classroom (8)	Reflection in action (10)	Reflection on action (6)
Pairing/twins (17)	Problem solving (6)	Social Constructivism (15)
Artefact (9)	Facilitation/Guidance/support (22)	Co-Operative Learning (20)
Experiential Learning (11)	Edmodo (5)	Critical Thinking (6)
Logistical difficulties (8)	Motivational Interviewing (7)	Confidence (8)
Self-Efficacy (8)	Prompts (21)	Busy at school (7)
Collaboration (17)	Motivation (8)	Project Outcome (8)
Positivity (6)	Success/Satisfaction (7)	Mastery (6)

Following the iterative process of coding and recoding, the researcher categorised the codes into the following themes:

Table 7

Table of Themes

Confidence	Positivity, self-efficacy, motivation, success, satisfaction, expression of confidence
Pair Programming	Pairing/Twins, collaboration, problem solving
Reflection	Reflection-in-action, Reflection-on-action

In themes emerging from the Edmodo interactions, the participants began in immediately reflect when prompted by the Researcher to consider what the term "Computational Thinking" meant to them.

"Computational thinking is problem solving using algorithms"

"……..thinking in a logical and sequential way…"

"…..a problem solving method using algorithms…"

"….take a problem that needs to be resolved, understand it by breaking it into small more manageable parts, and develop a solution using this information…."

"The thought process (human or computer) necessary to formulate, break down, understand and solve a problem"

Some of the descriptions are dictionary defined which shows social constructivism at play with the participants' construction of meaning for themselves. It also highlights that reflective practices are encouraging the learning experience which aims to increase confidence.

As the course continued, the Researcher posts a sample reflection to provide guidance on how to construct an online reflection which adheres to Shoen's "thinking-in-action" whereby the participant considers their actions and confidence levels. This is also further endorsed by the Researcher asking what the term confidence means to the participants. The aim was to increase awareness of the attitude. The E-Moderator also reminds participants to undertake the reflection and offers of guidance were periodically offered by the Researcher to the participants.

"….Not being afraid to take risks.."

"…the belief in yourself or others to complete a task….."

The above comments are a further example of the participants reflecting on what confidence means and also showing self-awareness of the concept.

Throughout the course, an interesting finding emerged in that the participants who self-reported the lowest levels of confidence in the pre-course survey, posted the most reflections. Additionally, those who posted reflections did so on numerous occasions. This may indicate that the scaffolding

measure of reflection did indeed lead to increased confidence as the participants discussed their issues about Scratch and thoughts on confidence.

During the focus group, which findings shall be subsequently discussed, the participants expressed a lack of confidence in posting online citing fear of exposing their weaknesses and an insecurity of who would be reading the posts. This hindered a more prolific use of reflective posts in spite of the forum being set to private settings and not openly available to non-participants. More productive results from reflective blogging may have occurred if the participants were assured of their privacy prior to the commencement of the project. Furthermore, again from focus group findings, members of the cohort who were over the age of forty expressed a reluctance and dislike of online posting. Whilst it was thought by the Researcher that perhaps digital natives (Prensky, 2001) would be more prone to online interaction as social networking would be extremely prevalent in such generations, the fact that youngest participant aged 23 years of age sent the researcher a private reflection as he felt uncomfortable to post online, seemed to weaken this thinking. When reflections were not plentifully forthcoming, the Researcher offered the option of private reflections to be sent directly to her. This yielded only one response. It is proposed that the participants were not confident in discussing their confidence levels. This was highlighted by the fact the participants were quite comfortable in discussing technical issues.

However, for those who did reflect, increasing confidence levels could be witnessed as the Ctwins progressed in creating the artefact. This ties in with Bandura's theory of confidence increasing with mastery of a task.

Indicative postings such as:

"Github [artefact] forces reflection at gunpoint"

"I think that we are almost there and I'm really pleased with the progress"

"Overall I enjoyed the experience and would be confidence to try it in class…."

"Delighted with the finished game…."

"All in all, the project provided good motivation to learn new things and new approaches"

"I got a lot to show for my effort"

Bandura's criteria of mastering a task to improve confidence is supported by the above comments. However, for a valid analysis, one must bear in mind that half of the participants did have ICT skills before commencing the project and further research would be needed to investigate a sample where no previous ICT skills were held.

5.4 The Scaffold of Pair-Programming

Guided by the practice amongst computer programmers to work in pairs with one coding and the other monitoring and reviewing, the Ctwins participants were paired to work on a mutually decided artefact during the course. A further intention was that the pairs would mutually support each other in their endeavour thus aiming to increase confidence levels. The themes manifest strong features of collaboration which is an inherent component of Pair-Programming. All expressed satisfaction with being twined for the project. A fall out of participants did happen at the beginning of the course and this may be ascribed to the data code noted "busy at work" and also, the principles of andragogy where adults have many, conflicting life demands which may hamper continued commitment.

The twins were allowed to create their own twin names to provide autonomy, once again in andragogy and an ice breaker requirement to introduce themselves online at the beginning of the course.

Wide scale satisfaction with the concept of pair programming may be gleaned from the following statements:

"Having a twin ensures that you learn from this person and also puts a bit of necessary pressure on you to ensure that you complete the work…."…..

"Working with others has been a rewarding experience between working with my twin and others…"

"Lovely to be partners with a fellow Donegal lady…." –

"I was lucky to be partnered with X…."……appreciated the support

"….thanks to my twin at the testing…." Ability to problem solve with a partner

"I have enjoyed creating a collaborative piece of code…" Showing satisfaction with working with the partner to create the artefact

"Collaboration was evident to me….having X's knowledge of nutrition really aids the project"

"The twinning side is what is really standing out to me at the minute as suggestions and help that you can get from others really shows how important and useful collaboration is in education"

The data reveals that pair programming was a successful scaffold in increasing confidence with the twins appreciating the support, being with like-minded people, being accountable to the other twin and being grateful for knowledge construction. This is summarized with the comment "You were more motivated working with another person"

5.5 The Scaffold of Motivational Interviewing

The objective of the Researcher was to host a mid-course interview via Skype with each individual CTwin to bolster motivation and confidence. Despite many efforts to arrange suitable times, communication failed. It transpired from the focus group that there is a delay in notifications within the Edmodo platform that frustrated arrangements. Moreover, it also became apparent that not all participants have sufficient internet access within their homes and rely on school supplies. A second attempt was made by the researcher via email enclosing a survey instrument – The Situational Motivation Scale (SIMS) – which objective was to incite awareness of motivation and confidence. No response was received to this request. Improvements might be made in arranging in advance, at the live introduction, a set time for such an interview and also a variety of communication platforms which may suit the preference or age of the participant e.g. Facetime, email, telephone. It must also be considered that "being busy" featured quite prominently in the focus group feedback and the matter may simply have been a lack of time and too many tasks to complete for the project.

5.6 Focus Group Analysis

A focus group was conducted following the exhibition of the artefacts by the participants at the end of the course. To ensure continued rapport, this focus group was conducted by the project manager of the Ctwins project, Dr. Richard Millwood, with the researcher observing. A set of semi-structured questions were drafted which allowed for impromptu and spontaneous utterances to occur outside those boundaries. The forty-minute conversation was audio recorded and transcribed by the Researcher. To analyse the transcript, an inductive coding approach was applied taking into account the key features of Bandura's concept of self-efficacy as discussed in the literature review. The construct of a focus group, by its very nature, lends itself towards the scaffold of "Thinking-on-action" reflective measure (Shoen, 1984).

Table 8 - Data codes from the Focus Group transcript

Explanation (6)	Collaboration (with NI schools) (2)	Participation (8)
Fear (6)	Experience (7)	Autonomy (4)
Communication (7)	Privacy (5)	Feeling stupid (8)
Guilt (4)	Busyness (8)	Edmodo deficiencies (4)
Sharing reflections (9)	Life demands (8)	Not knowing (4)
Twins (10)	Satisfaction (10)	Improvement (12)

Table 9 Data Themes table

Emotions	Fear, feeling stupid, lack of experience, not knowing, guilt, satisfaction, Mastery
Communication	Twins, Edmodo, sharing reflections, privacy
Pairing	Twins, Edmodo, satisfaction, life demands, busyness

The themes elicit a fear of "not knowing" and appearing stupid in front of their peers and the project team. Working in pairs, whilst appreciated by the twins, was often hampered by being busy at work.

5.5.1 Analysis of focus group. The effectiveness of the scaffolds of pairing were revealed from this coding exercise including co-operational learning between the twins in times of difficulty with the artefact. Participants expressed a desire to have more face-to-face live time with their twin to form more of an agenda before the project and in the midst thereof. The reliance upon one twin upon another to produce or return work proved motivational. The motivation to complete the project lead to the overall increase in confidence, post course, in computing. Whilst most had experience of ICT, the fact that one participant found that no previous knowledge was required, that it "was ok to know nothing". The busy lives of teachers and their respective work demands impacted up on the pair arrangements when peak school requirement e.g. mock oral exams, sports lead to a decrease in communication amongst the pairs but the fact that they are all teachers lent a mutual understanding of the situation – "Remember it is a small part of our busy lives".

Samples of the positive effect of pairing can be elicited from the following statements:

"You were more motivated working with another person" (Increased confidence)

"When they shared, you felt the onus was on you, you had that push" (Motivation to participate)

Emotions underlying confidence are apparent from the data codes from the online community and from the focus group. These range from fear of signing up for the course in the first instance, fear of disappointing the other twin and guilt of not completing the work in due course. Exposing their lack of experience caused the participants "to feel stupid" lead to reluctance to reflect online thus rendering the scaffold less effective.

"I felt very stupid and if I was asking a particularly stupid question, I didn't want you to hear it"

"I didn't know the level of stupidity to express…."

However, as the project progressed between the twins and the exhibition took place, the twins showed increased confidence with the pairing output – "when you work it out that sense of achievement and sense of success when you see it on the screen". Others cited a sense of accomplishment. Privacy, an uncertainty about what to post via reflection and that "everybody has different sensitivities…." Seemed to restrict but not the effect of the scaffold of reflective practice.

Summary

The findings resulting from the data analysis via a mixed method data collection indicate that the scaffolds of pair programming and reflective practices do, in differing measures, affect the levels of confidence amongst post-primary teachers in using computational thinking. The facility to exchange ideas and construct knowledge lead to an effective scaffolding of pair programming. The coding approaches revealed that the levels of confidence increased as the pairs worked jointly creating the artefact and the quantitative analysis showed an average increase in confidence levels from the pre-course of 71% to 78%. The focus group further endorsed this increase with each attending participant declaring that they would now feel confident using computing in the classroom.

Chapter 6 Conclusion

The aim of this study was to investigate whether confidence levels amongst post-primary school teachers in using computational thinking in the classroom may be increased by the introduction of the scaffolding measures of pair-programming, motivational interviewing and reflective practices.

Concretely defined terms such as confidence and computational thinking underlie the research question. For the purpose of this project, Bandura (1994) indicates four key features that affect confidence levels: Mastery of a task, vicarious experience [amongst peers or an instructor], verbal persuasion and the existing emotional state of the learner. The first three features are inherent in the Ctwins cycle learning design with the emotional state being an unexamined feature in this instance. Whilst a complicated issue to address and define, further research to assess the emotional state of the participant before engaging in such project might produce some fruitful results. The Researcher also suggests that the term, Computational thinking, might prove a deterrent for participants signing up for such endeavours such as Ctwins. A simplification of the term may attract less confident participants and accordingly, yield more robust findings.

Given that the majority of the Ctwin participants had previous experience of using computers in the classroom, problems with accurate recruitment meant that the sample did not reach it's target of teachers with little or no experience of computing and who lacked confidence. The Researcher suggests that a more prolific and specified recruitment drive would attract the less confident and once again, produce more reliable findings. Further research into factors that hindered others from not registering for the Ctwins course, in the first instance, might prove fruitful.

The Scaffolding measures of Motivational Interviewing did not render any results due to failure in establishing communication channels. The focus group data reveals that pair-programming enhanced confidence with twins citing mutual support, troubleshooting and mastery of the task at the core thereof – "The twinning side is what is really standing out to me at the minute as suggestions and help that you can get from others really shows how important and useful collaboration is in education". Moreover, all participants at the exhibition stated that following the interaction in the course, that they now would feel confident using computational thinking in the classroom. The quantitative data manifested an average increase in confidence from 71% to 78%. The Researcher proposes that the scaffolding measure of reflective practice furnished "vicarious experience" (Bandura, 1994) which indirectly led to improved confidence levels. However, lack of confidence in posting online reflections might also limit this scaffold and further research into the most appropriate format of reflection would be useful. The Researcher proposes that systematic online prompting occur within the Ctwins programme to directly enhance confidence levels, by taking account of the four features espoused by Bandura (1994).

Finally, the literature has shown ample theories, approaches and principles relating to concept of scaffolding but the focus is primarily on the child-learner. Similarly, the literature is scarce on scaffolding measures geared towards the adult learner. Further research and possible adaption of current principles might enhance the introduction of scaffolding measures which may potentially lead to increased confidence.

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APPENDIX A – ETHICS APPLICATION FORM

School of Computer Science & Statistics
Research Ethics Application

CHECKLIST

The following documents are required with each application:

1.	• SCSS Ethical **Application Form**	
2.	• **Participant's Information Sheet** must include the following: a) Declarations from Part A of the application form; b) Details provided to participants about how they were selected to participate; c) Declaration of all conflicts of interest.	
3.	• **Participant's Consent Form** must include the following: a) Declarations from Part A of the application form; **b)** Researchers contact details provided for counter-signature (your participant will keep one copy of the signed consent form and return a copy to you).	
4.	• **Research Project Proposal** must include the following: a) You must inform the Ethics Committee **who** your intended participants are i.e. are they your work colleagues, class mates etc. b) How will you recruit the participants i.e. **how** do you intend asking people to take part in your research? For example, will you stand on Pearse Street asking passers-by? c) If your participants are under the age of 18, you must seek both parental/guardian AND child consent.	
5.	• Intended **questionnaire**/survey/interview protocol/screen shots/representative materials (as appropriate)	
6.	• **URL** to intended on-line survey (as appropriate)	

Notes on Conflict of Interest

1. If your intended participants are work colleagues, you must declare a potential conflict of interest: you are taking advantage of your existing relationships in order to make progress in your research. It is best to acknowledge this in your invitation to participants.
2. If your research is also intended to direct commercial or other exploitation, this must be declared. For example, *"Please be advised that this research is being conducted by an employee of the company that supplies the product or service which form an object of study within the research."*

Notes for questionnaires and interviews

1. If your questionnaire is **paper based**, you must have the following **opt-out** clause on the top of each page of the questionnaire: *"Each question is optional. Feel free to omit a response to any question; however the researcher would be grateful if all questions are responded to."*
2. If you questionnaire is **on-line**, the first page of your questionnaire must repeat the content of the information sheet. This must be followed by the consent form. If the participant does not agree to the consent, they must automatically be exited from the questionnaire.
3. Each question must be **optional**.
4. The participant must have the option to '**not submit, exit without submitting'** at the

final submission point on your questionnaire.

5. If you have open-ended questions on your questionnaire you must warn the participant against naming **third parties**: "*Please do not name third parties in any open text field of the questionnaire. Any such replies will be anonymised."*
6. You must inform your participants regarding **illicit activity**: "*In the extremely unlikely event that illicit activity is reported I will be obliged to report it to appropriate authorities."*

APPENDIX B

UNIVERSITY OF DUBLIN, TRINITY COLLEGE

Faculty of Engineering, Mathematics and Science

School of Computer Science and Statistics

RESEARCH ETHICS PROTOCOL

When is Ethical Approval Needed?

Ethical approval is required before any studies involving human participants can commence. This requirement applies to studies to be undertaken by staff, postgraduate and undergraduate students. In the case of collaborative projects involving researchers from outside the School, ethical approval obtained from an external research ethics body may suffice – evidence of same must be submitted to the SCSS Research Ethics Committee prior to the commencement of the study (see procedures below). In the absence of such external approval, approval must be obtained as per this document. Additional ethical approval may be required if the project involves or is funded by an external body, for example, studies under FP7 automatically require such approval.

For the purpose of this document a "study" may be understood to involve a potentially staged series of different experiments to be conducted over a period of time. If substantive changes are made to a study following receipt of ethical approval, this will constitute a new study for which further ethical approval must be obtained.

Procedure

Completed application forms together with supporting documentation should be submitted electronically to research-ethics@scss.tcd.ie To submit, if the proposal is from an undergraduate or postgraduate students, the **completed** application package must be presented to the academic supervisor who will sign after verifying completeness. These signed originals may be scanned and emailed. Please use TCD e-mail addresses only. When your application has been reviewed and approved by the Ethics committee hardcopies of the application form with original signatures should be submitted to the School of Computer Science & Statistics, Room F37, O'Reilly Institute, Trinity College, Dublin 2.

The Committee will consider each application and normally provide a response within two weeks but not more than one month later. Applications that are considered not to have significant ethical implications may be evaluated by the Committee Chair without reference to the full Committee. Applications will otherwise be considered at a meeting of the SCSS Research Ethics Committee. When approval has been obtained from an external research ethics committee, and School approval is not required, a copy of the external ethical approval must be submitted to the School's Research Unit, prior to commencement of study, for noting by the SCSS Research Ethics Committee.

Please note that in signing the approval form one is making a commitment to review the provisions of the Data Protection Act, like legislation and College Policy on Good Research Practice. Please ensure that your study conforms to the standards of anonymity preservation and data retention set in those documents. Those provisions suggest a default proscription against making digital or photographic recordings of participants. A study which requires such records must include in the research ethics approval application a justification and documentation of the methods by which the statutory provisions and research practise guidelines will be met.

Note: These procedures may be amended from time-to-time following recommendation by the SCSS Research Ethics Committee and with the approval of the SCSS Research Committee.

Before seeking ethical approval researchers should:

- identify actual and potential ethical issues that might arise;
- reflect on how these will be addressed; and
- formulate procedures to deal with all such issues.

During the research project researchers should:

- implement the ethical procedures;
- obtain continuous feedback from participants about ethical issues;
- periodically review the ethical strategy in the light of feedback received; and
- if required, update their ethical procedures;
- retain copies of consent forms signed by the participants.

Composition of the SCSS Research Ethics Committee

The Committee will consist of a Chairperson/Convenor appointed by the Director of Research and two other experts – a member of the School's academic staff and external advisors. The internal and external members will be selected from a panel approved by the Director of Research from time to time. Members will be selected on a case by case basis by the Chairperson subject to their availability. Researchers will be precluded from the Committee

considering ethical approval for their study.

School of Computer Science and Statistics
Research Ethical Application Form

Part A

Project Title: .CTWINS.....
.....

Name of Lead Researcher (student in case of project work): ....Nina Bresnihan..... .....

Name of Supervisor: .... Nina Breshnihan..... .....

TCD E-mail: Nina.Bresnihan@scss.tcd.ie……. Contact Tel No.: 00 353 1 896 2704.....……

Course Name and Code (if applicable): …MSc Learning & Technology
…….....……..……

Estimated start date of survey/research: …4/02/2017..... .....……

I confirm that I will (where relevant):

- Familiarize myself with the Data Protection Act and the College Good Research Practice 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.
- Act in accordance with the information provided (i.e. if I tell participants I will not do something, then I will not do it).

Signed: ..... Date: .....12/01/2017.....
Lead Researcher

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
Does this study contain commercially sensitive material?		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)	No
	People with intellectual or communication difficulties	No

School of Computer Science and Statistics
Research Ethical Application Form

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: ..... Date: .....1/12/2017.....
Lead Researcher

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.

Part D

If external or other TCD Ethics Committee approval has been received, please complete below.

External/TCD 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 E

If the research is proposed by an undergraduate or postgraduate student, please have the below section completed.

I confirm, as an academic supervisor of this proposed research that the documents at hand are complete (i.e. each item on the submission checklist is accounted for) and are in a form that is suitable for review by the SCSS Research Ethics Committee

Signed: ..... Date: ....
Supervisor

ompleted 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.

TRINITY COLLEGE DUBLIN
INFORMED CONSENT FORM

LEAD RESEARCHERS: Nina Bresnihan

BACKGROUND OF RESEARCH: *(explain the background, context and relevance of the research)*

PROCEDURES OF THIS STUDY: (*explain what will happen in this particular study, including duration and risks to the participant)*

PUBLICATION: (*explain the intended publication and presentation venues for the research)*

Individual results may be aggregated anonymously and research reported on aggregate results.

DECLARATION:

- I am 18 years or older and am competent to provide consent.
- I have read, or had read to me, a document providing information about this research and this consent form. I have had the opportunity to ask questions and all my questions have been answered to my satisfaction and understand the description of the research that is being provided to me.
- I agree that my data is used for scientific purposes and I have no objection that my data is published in scientific publications in a way that does not reveal my identity.
- I understand that if I make illicit activities known, these will be reported to appropriate authorities.
- I understand that I may stop electronic recordings at any time, and that I may at any time, even subsequent to my participation have such recordings destroyed (except in situations such as above).
- I understand that, subject to the constraints above, no recordings will be replayed in any public forum or made available to any audience other than the current researchers/research team.
- I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights.
- I understand that I may refuse to answer any question and that I may withdraw at any time without penalty.
- I understand that my participation is fully anonymous and that no personal details about me will be recorded.
- I understand that if I or anyone in my family has a history of epilepsy then I am proceeding at my own risk.
- I have received a copy of this agreement.

PARTICIPANT'S NAME:

PARTICIPANT'S SIGNATURE:

Date:

Statement of investigator's responsibility: I have explained the nature and purpose of this research study, the procedures to be undertaken and any risks that may be involved. I have offered to answer any questions and fully answered such questions. I believe that the participant understands my explanation and has freely given informed consent.

INVESTIGATOR'S SIGNATURE:

Date: 01/12/2017

TRINITY COLLEGE DUBLIN

INFORMATION SHEET FOR PROSPECTIVE PARTICIPANTS

This sheet should inform participants of the following, as appropriate to the study:

- The background context of the research explaining its relevance
- The procedures relevant to the participant within this particular study
- Declarations of conflicts of interest
- The voluntary nature of participation: the right to withdraw and to omit individual responses without penalty
- The expected duration of the participant's involvement
- Anticipated risks/benefits to the participant
- The provisions for debriefing after participation
- Preservation of participant and third-party anonymity in analysis, publication and presentation of resulting data and findings
- Cautions about inadvertent discovery of illicit activities
- Provision for verifying direct quotations and their contextual appropriateness
- No audio or video recordings will be made available to anyone other than the research/research team, nor will any such recordings be replayed in any public forum or presentation of the research.

Of course, the information sheet for participants will vary with the study at hand. It should provide all information necessary for informed consent.

Appendix B – Ctwins Proposal

1. Purpose of project including academic rationale

The CTWINS ('Computational Thinking Wins' or 'Coding Twins') project aims to develop confidence in post-primary educators in their use of computational thinking to solve problems, with a focus on competence in computer programming and designing spreadsheets. The project will begin with a face-to-face **launch** workshop to join a new cross-border online Community of Practice (CoP). Then, over nine weeks, participants develop solutions to practical exercises in **remote pairs,** seeking expertise from the online community. Results will be shared at a face-to-face **exhibition** event for the whole community. The project will be evaluated for its effect on building the confidence in participating educators, indicated by their willingness to consider more challenging courses in computational thinking and self-directed learning.

The **objectives** of the project are:

1. to develop new practical exercises in computational thinking for the professional development of educators;
2. to improve confidence in educators using these exercises with support;
3. to create and disseminate this model of peer- and mentor- support for educators packaged in a toolkit ready for other CPD providers to use;
4. to build lasting professional relationships between educators from the north and south of Ireland.

2. Brief description of methods and measurements to be used

The project will be evaluated using a mixed-methods multiple case study. The success of the project in meeting its objectives will be assessed using Kirkpatrick's model of learning evaluation:

2.1 The Kirkpatrick Model:

Level 1 Reaction: The degree to which participants find the training favourable, engaging and relevant to their jobs

Level 2 Learning: The degree to which participants acquire the intended knowledge, skills, attitude, confidence and commitment based on their participation

Level 3 Behaviour: The degree to which participants apply what they learned when they are back on the job

Level 4 Results: The degree to which targeted outcomes occur as a result of the training and the support and accountability package (**THIS DOES NOT APPLY TO THE CURRENT RESEARCH QUESTION)**

2.2 Data Collection Instruments:

Kirkpatrick Level	**Instrument**	**Timing**	**Purpose**
Learning	Online Pre- and Post- Survey	• Launch Event (Pre-) Exhibition Event (Post-) • Mid programme liaison with participants	Evaluate confidence levels pre- and post- intervention To gauge any change evolving in confidence levels
Learning	Completed Practical Exercises	End of intervention	Learning/competence gained

Reaction	Focus Group	Final exhibition event	Reaction to the learning experience Feedback on practical exercises and CoP Exploration of issues around confidence
All	CoP participation	Will run from the first meeting throughout the 9-week programme and beyond.	Qualitative analysis of contributions along with quantitative measures of participation, retention and completion
Behaviour Results	Follow-on Email Questions	1 month after	Self-assessment Changes in attitudes and behaviour

3. Participants:

3.1 Profile:

Five practicing second-level teachers from the Republic of Ireland and five from Northern Ireland will be selected for each of the two phases of the project (total of 20). They will be teachers of non-computing subjects who lack confidence in their computer use. All participants will be over

18. All efforts will be made during our recruitment process to ensure a reasonable gender balance in the participant groups.

3.2 Recruitment methods:

We will use purposive sampling, targeting specific teachers who fit the profile. In Ireland we will make a call for participation to the Computers in Education Society of Ireland (CESI) membership and through the Education Centre network. Those contacted will be invited to encourage appropriate colleagues in their schools. In Northern Ireland we will connect with schools through our partner in Queens University Belfast, Dr. Pamela Cowan and her colleagues in her role as teacher educator with links to many schools for both CPD and initial teacher education.

For both cases we will also use social media to promote the project and invite interest. There will be an online specification of the 'willing but unconfident' teacher which will explain the commitment, inviting completion of an online form to apply. We will also explain the benefits for the individual and the anticipated impact on their future practice.

4. Debriefing arrangements

After the final focus groups the participants will be debriefed about the research and they will be given the opportunity to ask questions or raise any concerns that they might have. It will be made clear to them that, upon request, the participants will be informed about the findings of the research after it is completed.

5. Concise statement of the ethical considerations

All participants are over the age of 18. It will be made clear to the participants we do not intend to evaluate their technological competency, but rather to assess the effectiveness of the intervention on increasing their confidence levels. It will also be made clear that the results will be used only for our own research purposes. Participants will be informed that they may withdraw from the research at any time. Participant identities will be kept anonymous.

6. Legislation relevant to the project

All information that is collected by the research will be encrypted and stored in accordance with the Data Protection Act at Trinity College, Dublin.

APPENDIX C – PARTICIPANTS INFORMATION SHEET

You are invited to participate in the **CTWINS** research project. The project is based in the School of Computer Science and Statistics, Trinity College Dublin and The School of Education, Queens University Belfast and led by Dr Richard Millwood (Richard.Millwood@scss.tcd.ie) and Dr Pamela Cowan (p.cowan@qub.ac.uk). Lisa Hegarty, a second year student in the MSc Learning & Technology Masters programme in Trinity College shall conduct a research dissertation into the evaluation of the factors affecting confidence amongst second level teachers engaging computational thinking in their teaching practice. This dissertation shall be submitted in part fulfilment of the MSc Learning & Technology.

Research Project Overview:
The overall aim of the project is two-fold. It is to develop a model of teaching and learning suited to the development of Computational Thinking skills, and to address the issue of teachers' lack of confidence when it comes to acquiring such skills.

The CTWINS CPD programme, which you are participating in, will take place over a nine-week period.

We have selected 5 teachers from Northern Ireland and 5 teachers from the Republic of Ireland to partake. All are second-level teachers of non-computing related subjects. In Ireland you have been invited to partake through a call for participation to the Computers in Education Society of Ireland (CESI) membership, invitations to various second level schools and through the Education Centre network. In Northern Ireland connected with schools through our partner in Queens University Belfast, Dr. Pamela Cowan and her colleagues in her role as teacher educator with links to many schools for both CPD and initial teacher education. Those contacted were also invited to encourage appropriate colleagues in their schools.

We will begin with a face-to-face **launch** and professional development workshop where you will join a new cross-border online Community of Practice (CoP). Then over the nine weeks, you will work on practical exercises in **remote pairs,** with support from the online community. Results will be shared at a face-to-face **exhibition** event for the whole community. The workshops and the exercises will address issues such as Computational Thinking and problem solving, computer programming, spreadsheets, creativity and collaboration.

Research Participation
In order to demonstrate the effectiveness of the programme, researchers from Trinity College will collect information about teachers' experiences at various stages during the project. You will be invited to

(1) complete two paper-based surveys (one at the launch event and one at the exhibition event date) (2) provide the research team with permission to examine your contributions to the online community and the practical exercises you complete

(3)agree to be interviewed mid-programme to discuss any barriers to progress and participation

(4)provide consent for the research team to record your voice contributions to a focus group conducted at the end of the exhibition event and

(5) finally, answer a few follow-up questions by email at a future date.

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 extremely unlikely event that illicit activity is reported during the study, the research team will be obliged to report it to appropriate authorities. There may be lectures, Ph.D. theses, conference presentations and peer-reviewed journal articles written as a result of this project, however the participants will not be identified. The voice recordings of the focus group will not be replayed in any public venue, and are constructed solely for transcription purposes for review by the research team.

Voluntary nature
Participating in this project is voluntary. You may change your mind and stop at any time. You may also choose to not answer a question for any reason.

Benefits
We hope that this project will result in the improvement in the way Computational Thinking skills are taught and learned and help increase the confidence teachers have in their ability to learn such skills.

Risks and discomforts
Answering questions about one's experiences may be uncomfortable. You can choose not to answer a question at any time. You may withdraw from the study at any time without penalty.

Confidentiality
We plan to publish the results of this study. Our report will not include any information that would identify you, or your school. To keep your information safe, we will move the audio file from the recorder to a password-protected server. We will remove or change names in the focus-group transcripts. We cannot absolutely guarantee confidentiality because the participants may share information in front of

each other during the interview. We will address this by asking participants not to repeat what others said.

If you have any questions in relation to this, please do not hesitate to contact us.

Kind regards,

Nina Bresnihan (CTWINS Research Coordinator)
School of Computer Science & Statistics
Trinity College Dublin
Dublin 2
+353 00 1 896 2704
Nina.Bresnihan@scss.tcd.ie

Lisa Hegarty (CTWINS Research Assistant)
MSc Learning & Technology
+353 00 87 2143 790
hegartli@tcd.ie

APPENDIX D – PARTICIPANTS CONCENT FORM

Please read, and then sign the following if you wish to participate in the research process. You are under no obligation to participate and can opt in / out of at any stage of the process.

Data Protection: I agree to Trinity College, University of Dublin anonymizing and storing all information that is collected by the researchers in accordance with the Data Protection Act. I agree to the processing of such data for purposes connected with the research project as outlined in the Information Sheet.

- My participation is voluntary, and that I may withdraw at any time and for any reason without penalty from the research process and related data gathering.
- All my data will be treated with full confidentiality and stored securely so that, in the event that any data is published, my data will not be identified as mine, nor identify my school or students.
- When completing surveys, I can omit questions I do not wish to answer. *The follow-up questionnaire will be administered by email (use video displays). If you or anyone in your family has a history of epilepsy then you are proceeding at your own risk.*
- In the extremely unlikely event that illicit activity is reported during the study, the research team will be obliged to report it to appropriate authorities.

Consent: I have been provided with an information and consent sheet detailing how my data will be processed and how I can contact the research team. The research team will also provide a debrief, at the end of the exhibition event. By signing this consent form I confirm that I am over 18, have read and understood the contents of the information and consent forms, ***and give permission to be contacted by the team.***

Signature of Teacher: _____Date: _____

Signature of Researcher (TCD): _____Date: _____

APPENDIX E – PRE AND POST SURVEYS

Participation in this survey is entirely voluntary. Each item is optional and you can choose not to answer a question at any time. You may withdraw from the survey at any time without penalty.

SECTION A: ABOUT ME

1. Name

2. Age
   Please select one of the following options:

   Under 25 ▢

   26-35 ▢

   36-45 ▢

   46-55 ▢

   Over 56 ▢

3. Gender:

4. How long have you been teaching?
   Please select one of the following options:

   Less than 1 year ▢

   1 to 6 years ▢

   7 to 11 years ▢

   12 to 16 years ▢

   17 to 25 years ▢

   26 to 34 years ▢

   Over 35 years ▢

5. Where are you currently teaching?
   Please select one of the following options:

   Northern Ireland ▢

   Republic of Ireland ▢

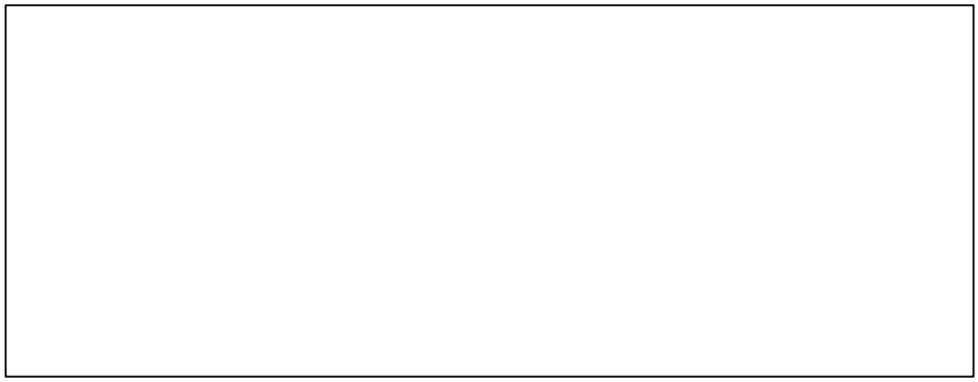
6. What subjects do you currently teach?

7. Do you currently use computers in your teaching?
   Please select one of the following options:

   Yes ▢

   No ▢

8. If so what computing tools do you use?
   E.g. PowerPoint, Whiteboard….



9. If you use computing tools in the classroom, please select how frequently do you use them?
    - Less than twice per week
    - Three to four times per week
    - Daily
    - Occasionally
    - Never
    - If other, please describe:

_____

_____

_____

SECTION B: HOW I FEEL ABOUT COMPUTERS

Describe what the term Computational Thinking means to you. Is there any other word(s) that might mean the same to you, please note below?

Describe what the term Programming means to you?

Please circle the options that apply to you (from 1 (Strongly agree) to 7 (Strongly disagree)

	AGREE						DISAGRE
1. I enjoy working with computers	1	2	3	4	5	6	7
2. I am very unsure of my ability to use computers for programming in my teaching practice	1	2	3	4	5	6	7
3. I consider myself a more skilled computer user than most of my colleagues	1	2	3	4	5	6	7
4. Computers are far too complicated for me	1	2	3	4	5	6	7

5. I am interested in learning about using programming in my teaching practice but lack confidence	1	2	3	4	5	6	7
6. I often have difficulties when trying to learn how to use a new computer tool	1	2	3	4	5	6	7
7. I am typically open to learning about new computer tools and applications	1	2	3	4	5	6	7
8. Computer programming is too difficult a topic for me	1	2	3	4	5	6	7
9. As far as computers go, I feel less competent than my students	1	2	3	4	5	6	7
10. I think overall I could evolve into being good computer programmer with the correct training and support	1	2	3	4	5	6	7

If any, which of the following barriers hinder my use of computers in the classroom?

Please select as many as you so wish.

- I feel that I have limited skills in using computers
- I consider that I have a lack of training in using computers
- Lack of access to computer resources within the school affects my confidence

- Fear of failure in using computers hinders me from using computers
- I am afraid of my students knowing more than I do
- There is a lack or insufficient technical support within the school
- I do not consider computers as a useful tool in the classroom
- I would prefer to retain the status quo in the classroom and do not see any reason to change.

Mid-programme interview with individual participants conducted via

Skype/Zoom/Camtesia or via email according to participants' preferences.

This is an open-ended interview and questions hereinafter are indicative.

- How do you feel that you are progressing at this stage of the CTWINS programme?
- Do you consider that your confidence is increasing or decreasing regarding your use of computers?
- What is the most difficult aspect of the programme so far?
- How can we assist with this difficulty?
- Any other comments to make ?

APPENDIX F – FOCUS GROUP QUESTIONS

Focus Group– Cycle 2 C Twins

How did you hear about C Twins/where come across/how could we recruit better?

An email from Tanya. An email had been sent to the school, Northern Ireland based email sent out through C2K, then the VP sent it out to all of us.

Same – email came from the principal

Yes same, principal announced at staff meeting

Dr Megan sent it to me as I am on trinity post grad course

There was a bit of doubt when I first heard about it, we knew it was a computer thing that was about it. It was computer course and then someone else said I think there's more to it then that - I think there is some coding and then everyone freaked out because with my staff here if computers are involved everyone freaks out and everyone goes blank. A bit like when I looked at question coding myself

Did you get the leaflet explaining what the project was about?

I think that was in the email

It was in the email. Did you read it/did you find anything it in attractive.

Yes it sounded interesting… did you get yours off Megan?

Yes it was Megan

Yes that's how I found out the post it was with it so I printed it out and stuck it on my staff board.

And you took interest. Did anyone else in the school take an interest?

No it was too late actually by that time. There was some interested takers but too late

I think a little feature video –showing exactly what it involves like someone literally at the computer clicking to make the cap notes because everyone in my school said it was really hard but when I got there the first day I thought it was really doable. Would that be a good idea?

Of course it would – great idea

An information session on it as well I suppose. Reading about it is one thing but an information session where everyone can sit down and ask questions and see if it was something they could actually do. We

were ok as we had already done scratchboards, So the Principal and VP had sent it to us as they knew we were interested. They knew we had done the course and said for use to look into it

I think because of the calibration as well, the fact that there was NI schools and other schools I thought it was something that could be really interesting.

Why would that be interesting?

To form new partnerships - we are looking to push our IT in the school in recent years and to broaden the scope and see what could be done with it.

Brilliant Great ok if anything is still burning in your mind after this - you can always email myself or Lisa. This is true of all these questions You can come back to us later if you think of something later

What motivated you to register/to participate

I think you didn't need any previous knowledge. It was ok to know nothing. That was motivation for me. There wouldn't be a strong learning curve. They were looking for people with no experience/

I would agree with that

Was it true?

Yes you could learn at your own pace. I was partnered with a stronger partner. I think most people found that so you were really learning from the partner as well

Well I though Edmodo. Made it more difficult to learn from the partner - I would have preferred to pester Rachel more frequently with instant, maybe text messages

Yes communications - If you had an idea and just wanted to ok send a whatsapp in a group might have been better. With elmodo you mightn't get the notification for an hour alter. I think that might have been a problem with the skype as well. We put up our address and it come up yes available - Like last night my partner she was sick and was writing to me at 9 o'clock and I didn't get it until 11. She was offline by the time I replied to her.

So I'm not trying to put words in your mouth but what I think your saying is notification is important – like with whatsapp it would come to your phone straight away and el modo wouldn't.

Yes we used whatsapp a lot didn't we?

Yes we thought elmodo was a formal communication in front of 20 people and sometimes we wanted to communicate between the 2 of us not in front of 20 people

So did you notice the group you were in was just you and your partner – and mags my self and Lisa were all involved in the other as we were researching, and this maybe wasn't private enough for you?

Yes I felt this in particular I felt very stupid and if I was asking a particularly stupid question I didn't really want you to hear about it 3 academics. And maybe that's just my barrier my age and my personality

But isn't that one of the great barriers to learning because you mentioned earlier, as you were showing that presentation earlier, if you want to learn French you go to France, its not actually all these dual lingo experts have discovered that those who learn most are those who are not afraid to look like an eejit who just say actually I don't get how the cat moves, juts tell me how the cat moves. So I guess when you feel afraid , like I felt the same, the first week when people asked stuff on elmodo and everyone got an email about that one person and you were there I don't want to be the next one when everyone's phone was beeping

I didn't come across elmodo before so I was uncertain to who was reading what, So I didn't want to go in there and talk about things when you didn't know the level of stupidity to express - so there was reluctance

So yes that story has come from 2 or 3 of you now if not more did anyone else feel the same?

Yes definitely, I think communication was our biggest problem. Just a giant vacuum of emails building up in one directions and is it email number 4 you stop.

And also I was saying to John earlier because you don't know the person, like if it was someone who I knew I could ask 'what the hell' and I know I forgot to click on share a few times so gemma could have thought I did nothing for 3 weeks and I'm actually embarrassed about that now. Whereas if gemma had known me better she could have asked me what was going on. But there is a social nicety that you cant ask someone to get your sh*t together.

Yes like that we met up once at the end, what if we if we met up in the middle so you could say "right nothings getting done what can we do to fix this" at least you still have time if its in the middle. Doing that over elmodo doest work so a meet up in the middle could work.

Or even at the initial meet up if you could offer a phone number. Have a list of references between you – our references might be different to yours. Like give each others number but don't ring me after 8 o'clock etc

I think the big thing I will take from this is the kids - when I'm trying to get them to work in teams I'm going to try and get them to use google hangouts in their groups, none of this emailing each other, I realise if I cant get through to someone to someone, how can the kids, right now video calling is banned in the school but I'm going to see if there a safe way of doing it

Isn't there instant messaging on google classroom

Yes, they all have google accounts so if we could do google hangouts.

Even if they don't have hangouts you can set up a forum and can ask a question and there is instant chat on that - that's more instant - you can instantly talk to someone

That's even why companies have open plan/rid of walls - when your face to face you can get through to someone and get stuff done so much quicker.

A positive about elmodo is if you do hour of code and hand it over to next person - forget about it – nice to get an email from mags saying how are you getting on. The prompts were nice/reminders where nice/what did you think about it was nice. Remember it was a small part of our busy lives so you would hand it over and forget about it. Reminds you need to go back again

Did you get any enjoyment/any pleasure from it and what was it?

Yes when you got into it

Yes when my code worked out

When it's a difficult code and you see all the problem solving behind it and when you work it out that sense of achievement and sense of success when you see it on the screen. And I think the kids get that as well they get the sense of achievement when they make a game or make the car move

It's a sense of accomplishment

What don't you enjoy/anything that was miserable?

I found the time of year was difficult; I have this up under my reflection already. But I think for teachers an easier time of the year is before Christmas. That as we start to move into January we hit mock exams have exams, in NI we have control assessment and correcting mock exams. For a project October and November is better.

I think Sept/Oct might be a better time. Yes we all come back fresh from summer and not worn down.

All the sports finals and mocks and school tours are at the minute and even on Tuesday inspector coming in.

Yes I was living in a hotel last week to do the orals and internet wasn't working and I had to listen to kids try and speak Irish tomorrow and couldn't deal with this right now.

I had sports finals and just have no time - so time is important.

Another thing is location, I'm from Donegal so having to travel down to Belfast and today to Dublin. So if it was suggested to have a session in the middle I would be up for that. Belfast was ok but travelling to Dublin today was a big trip for me.

Yes we had to come down the night before

So therefore there are several motivation for doing things online which need testing/we are not sure of the right/such as geographical dispersion and such as not being able to work at the same time - so meeting isn't helpful and cost of travel – all these things

Yes car parking blew me away today/my jaw dropped.

And the reflective post you had to write, did they help

I think it would have been easier to reflect if they were more private as reflecting is so personal anyway. Sometimes you mightn't want to share with partner for what ever reason

Yes I felt very uncertain about all this – were we supposed to reflect in the group to you or where were we supposed to post them

The idea was that you would learn from reflections or find answers. Also what Paul said was true not everyone wants to share, the idea was that you wouldn't mind sharing with other people, that it would help. That these are the problems with reflections, everyone has different sensitivities.

And not everyone is good at reflections, it's a skill in itself and not something we are thought how to do, some people are uncomfortable at expressing just how they felt, and knowing what level do you pitch it at.

I could possibly turn this into a lecture on the good things on reflections but its not the time nor the place for it, however if you have any more thoughts or want to discuss further afterwards –it is your choice if you want to send it to lisa directly or elmodo public space or your friend directly.

This is probably the wrong attitude but I noticed when I sent it to you I didn't notice anyone else writing this so I thought/I wasn't sure how much to share or if I was writing the correct thing. In college for me reflecting was a massive thing but you only sent it to your lecturer no one else read it. So I could say what I wanted once I had something to back it up ad my lecturer was the only person who was doing to see it

I was in work situation, I hadn't talked to my twin in 3-4 weeks, I didn't want to post that in case these saw me log in and thought I was just giving out

That's literally the reality, I was busy with camogie, Breda was busy with Home Ec. I cant say I'm busy, I'm not giving out just we were both busy at different times, that was just the reality.

We didn't know whether to reflect on project, or focus on how to modify or improve it.

From my point of view I probably didn't read documentation and when a request came up for reflection I was like "what reflection, I'm here to code". I actually didn't reflect until yesterday, reflection project was finished yesterday and then I did reflection, probably more of a evaluation than reflection .I've got positives, negatives and recommendations at end and just about how 8 weeks went. Maybe it was said at the start or in Belfast and I wasn't listening.

I was the same I had a whatsapp from Claire as my internet kicked in saying that she had posted the elmodo and the reflection and I was like "reflection, what reflection. What are you talking about". Even directions for the reflections – even if there was a topic per week so we knew what we were writing about. I think also – how is it going to be used, we needed it to know this to know how to reflect as reflecting is such a general statement – so yes that idea of particular focus ie "week 1 reflect on planning'. Yes but even more direct then that – its too vague

If you were asking me to reflect every week – that would put me off.

I'm impressed with the level of reflecting on reflection – I'm going to move on so we can get through. We offered you the opportunity to interview. Did you find that helped your confidence?

We put up our interview skype, it didn't post we were on at the a time. But it didn't work that was a fault with elmodo

Did you get a lot of people wanting to interview?

I felt the timing was particularly busy the last few weeks so midterm to yesterday I literally had no free time, not with this but different things, this was just another time consuming thing that had to be done

Would it be difficult to go about, if we do something with PDST, someone can cover your classes, would that be possible, like CPD thing, would that work across the north?

These would be things to consider for google, who are funding us to find out how to do this effectively. The Government could possibly pay for days. Did you find the online interactions improved your learning experience at all?

I felt it was very stilted, the time delay blocked fluidity, also distracted by other stuff. I wouldn't hear back, she had practicals, I was going to Rachel saying I cant figure this out, as we are in the same school, instead of asking my partner because I couldn't get in contact with her, it was frustrating as we were both interested . I also knew a little more than my partner so was explaining things over elmodo but without the personal contact didn't know if she was getting it.

I'm in the same school as Breda actually and she was saying to me have you heard from your partner, I asked her did you not exchange number like we did. I know she was nervous and not sure if she could do the right thing

Even the basics of knowing that you have to click the share button – not knowing I hadn't shared and it hadn't automatically gone through. Just basic things like that

Yes we tried to help by writing the booklet- whether it helps is another matter

Isn't that part of the learning process - we know now and we wont make that mistake again

And I'm interested to know if there is any other areas of successful online learning - in relation to other areas altogether/even unsuccessful ones and how you would compare?

In general our school is a google school and we have emails and can set up chats etc and I find that very helpful. In science department- we have a google folder, I put up resources and put up PowerPoint's and in general when it's used by people on same level and know how to do which and what - it can be very helpful. But then again if your working with people in the science department who don't check their emails etc and I say I put it in the folder and they just ask can you email it to me.

Yes so problem of shared practice

The problem with having to learn to hit the share button is alot of time passes, and this puts you off as you spend time doing things. This was something Rachel showed me, I learned that day in Belfast. Instant messaging would be good for that or even google hangout, instead of an el modo account if each twin was giving a google hangout where we can message and show code on camera and explain how to do it.

Yes we cant take the personal side out of it

In our proposal to google we were going to use google but we used elmodo as we thought teachers would know elmodo already - but oh no we got that wrong. Very helpful but we will move on again. Key question do you feel more confident about computer skills?

Yes,

Yes I'm more interested and I'm more curious now, I wouldn't have before now. Even watching projects today and seeing how you use it, its not just a case of going to apples store and getting a mac but starting at the beginning.

Do you all agree with that? Would you have got better at it anyway without taking part?

No, I would have never tried it, and when we did try it wasn't too stressful and any progress I made I felt quite proud of myself, and it gave me more confidence even to play around with it - I wasn't destroying or wrecking the project

You were also more motivated when working with another person. When they shared you felt the onus was on you, you had that push. But how do you measure computing skills, for example to click on the share, who to say that's a good level? So before I used twins I didn't know that and now I do - it has to be measurable.

I think the instructions part – like when I used to wok on my own projects ad share with kids and give them opportunity ie option to decrease. I hope I made the instructions clear to Ursula, like if you click this, this will happen, and on next screen press space bar etc, it was a case that in real life coding. I think that as a coding computer skill I would never thought I needed to have in my skill set.

The idea you need to click on sprite? To see code – I know that should be obvious but its not really.

Agreed. I've been programming for 30 years and I didn't get that either

And even when you're teaching that as a teacher, if you say there's the sprite and that's the background - half of them will still do it wrong.

Yes I could be half way though and realise it's in the wrong thing

Any aspect of project that help you develop things /did it inspire you do to trial and error

Yes and it was nice that you could try anything and keep adding to it and wasn't graded, and didn't matter what you made at the end that was most important, some people could do something massive –but there was no levels, higher or lower, we were all learning at our own rate, which is really good

This is going to sound really stupid but you know as a teacher you are used to telling people what to do and giving instruction, I found it really hard being the underdog, I felt so out of control the whole time, I don't know if anyone felt the same.

Was that unpleasant? Yes. Was it unpleasant to point you felt like leaving project or giving up, what kept you going is what I'm saying?

I think as teachers that's built in, we have that type of personality that doesn't give in, things change all the time and we cant sit there and say we are not teaching you, to be teacher you have to have that resilience anyways

And if your partner is getting onto you and had put in work, you cant just leave it and not put in work, as someone else has put time in.

And the guilt aswel – if they were spending an extra hour on this

So having said that were you overall satisfied with what you have been doing?

Yes definitely

Well Paul I have to say you said no

Yeah, the controversy of everything that was just said if partner has started the project and its totally done, its de-motivating and I think I sent mag something and realised today I didn't share it properly, she came back saying I did it through Irish and I hadn't, she was clearly looking at something else.

So you recommend we need to make much more trouble to make sure twins are working. We cant see evidence of working.

Yes at the same time there was a high level of support as mags could step in, but that was a problem with elmodo, as clearly I hadn't done something correctly. But at the same time I still feel like my skills have improved a little as I tried to do something from scratch for the first time, it was de-motivating for me the fact that in school we don't have desktops so its not practical for me to use it in school so that was something I really didn't factor in at the start.

I think clarity as well, Jacinta is in my school and she thought you were doing scratch project and when you sent her the python - so clarity around what the project is, from the start.

And definitely face to face video calls

And even my partner at the start I didn't end up being with that person, I got put with breda and I suggested it - as she's home etc her partner wasn't getting on , and we were already 2 weeks behind, but I never got to sit down with her and have that conversation from the start – so like to sit down and discuss the first day what will work for you – we never got to have that conversation. Conversation wasn't fluid enough we needed that conversation to start.

Id agree with Jennifer - the first day my partner wasn't there so I had to advise the ideas and I felt guilty

Yes its this whole social thing you don't want to be the bully "do it this way do it that way"

Yes exactly, so when she took it on and changed it a bit I was delighted I didn't want it to be all mine.

Yes taking some time to sit down, the 2 people face to face, I don't think it works unless people are face to face. Yes we compromise then. Yes and sit down and have a plan that you both agree on and not one person to feel overwhelmed.

So again I'm going to move on and want for all of you answer this. Do you intend to develop in this area scratch or coding?

Yes.

Will you look for courses?

I will try and engage students in school to learn with them.

Yes I do like the idea of e-twinning I think it has amazing possibilities and that's what made me want to come here in the first place. Even though there wasn't communication, there was the peer pressure there and I did way more than what I would have done if it was just me and a lecturer saying" you need to have this done by Monday"

And do you feel you will carry on learning in programming?

Yes definitely

Yes I would like to continue learning and again its probably this whole leader thing – but to know that it is ok to keep emailing and keep posting in the group. When you don't know if you were doing things right

You'd almost like a second go of it

Yes I really would

Id do more, yes it's endless

Yes I would do more, but I wouldn't be too ambitious about how far I would get in it and keep it at a level I am comfortable at learning and not put myself under too much pressure

If you were coming into this a second time you would be much more confident.

Myself and Rachel are going to work it out like a postgrad for next year as coding is coming into our school and were looking into developing and learning python and stuff like that. We were in the Ctwins and the principal said this was there if we wanted/if we were interested

Would you recommend a project like this a teaching project

If I was doing it again I would bring someone with me from my school as its an extra motivation.

Yes so we had the kids convinced it's a competition between us, so we were enjoying that banter in the staffroom so I'd definitely recommend bringing another teacher from your school. Even the connections you can make, there's people I would never have met.

So our original design was for quotes, two from one school twinning from two from another school. So you fit that model perfectly as your both in same school but with two different twins. Not to be competitive but more a case of being able to turn to someone who was local for moral support

Yes we did that a lot.

So we should return to that and recommend it.

If I was recommending it, I would say to teacher to make sure their partner will be there the first day as I felt when my partner wasn't there and weren't getting back to me, I didn't know if it was going ahead and then my new partner we just didn't have the same time together as everyone else - so you really need a solid person and who's not going to give in too easily.

If there was a buy in or something, Although it might put people off. Or might get the right people in there/people who are interested to learn. Maybe good idea to say teachers or pair of teachers when sending the emailing next time .

Richard I have a question just from your own observations - from cycle 1 of C twins – how did we fair off?

My memory is that this is a more sophisticated group and we were more sophisticated too in lots of ways - as we learned from first cycle. We only had 6 in the first cycle and only 5 turned up to this exhibition event. As a designer you ask whether you should change the design to accommodate the recommendations or stick with it and see if I can make it work –in a stubborn kind of way - and we have to have that debate internally

And do you think its still at a developmental stage?

The first cycle? Yes. Yes this is the structure of action and research for me, you go more than once on the same thing and you gather data and you alter it and find right things to for the next time.

I definitely think you should do it again if you can get that connection between 2 schools and make it quite strong, you could make something really good and connect schools with north from schools from south

and then they can connect in othe ways, not just within scratch but something for them Our school wanted us to connect with others schools, then if there's anything we are interested in or they are interested in, we can get back to each other. It's a nice way to get people involved - when else are we going to get to know a school from the north. It was one of the motivations from our school to get us involved –to see if there's any bridging. You have an autistic unit can we do anything to our autistic unit - I think that's a really good way to get them to buy in. So I think it's a really good idea but I think there's work to be done

I felt abit disconnected from school. I think if you were going through the principals of our school they would be saying "oh you're going to trinity, it's a google project" -you've got key words there that make it sound better. In the north everything is PR driven/its facebook driven, I was tweeting here earlier – its part of my job I have to tweet, I'm not bragging.

If you were saying to the principal "its great to have staff contributing to this Google/trinity/queens project" My principal would ask how are you getting Claire/ how the project doing etc. So I felt very disconnected, I'm doing this but there is no connection back at office in relation to what I am doing here.

Yes my principal didn't even know.

Ours was constantly checking in with us asking how it was going and said it was great that it was Google and want to come up for a day.

Email me after this event with your principals email address and I will send them the report.

Sharon is not here but what school is she from? Ill send her one too.

Calls out names

End

APPENDIX G SAMPLE CODING OF FOCUS GROUP

APPENDIX H SITUATIONAL MOTIVATIONAL INTERVIEW MODEL

The Situational Motivation Scale (SIMS)

Directions:

Read each item carefully. Using the scale below, please circle/highlight the number that best describes the reason why you engaged in the CTwins project

1 – Not at all

2 Very little

3. Little

4. Moderately

5. Enough

6. A lot

7. Exactly

Why did you engage with CTwins activity?

1. Because I thinking that the activity is interesting – 1,2,3,4,5,6,7
2. Because I am doing it for my own good – 1,2,3,4,5,6,7
3. Because I am supposed to do it – 1,2,3,4,5,6,7
4. There may be good reasons to do this activity but personally, I don't see any– 1,2,3,4,5,6,7
5. Because I think that the activity is interesting – 1,2,3,4,5,6,7
6. Because I think that this activity is good for me – 1,2,3,4,5,6,7
7. Because it is something that I have to do – 1,2,3,4,5,6,7
8. I do this activity but I am not sure if it is worth it– 1,2,3,4,5,6,7
9. Because this activity is fun– 1,2,3,4,5,6,7
10. By personal decision – 1,2,3,4,5,6,7
11. Because I don't have any choice – 1,2,3,4,5,6,7
12. I don't know; I don't see what this activity brings me– 1,2,3,4,5,6,7
13. Because I feel good when doing this activity – 1,2,3,4,5,6,7
14. Because I feel that this activity is important to me – 1,2,3,4,5,6,7
15. Because I feel that I have to do it– 1,2,3,4,5,6,7
16. I do this activity but am not sure it is a good thing to pursue it – 1,2,3,4,5,6,7